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HIGHBURY BUSINESS

Companies can be strange things, especially nowadays. They keep on changing. Take Europe's two leading consumer electronics companies, Philips and Thomson. Europe is, of course, not the ideal place in which to base a CE organisation, since the emergence of huge, low-cost manufacturing in the Far East. So changes to European CE companies are to be expected.

Philips has an enviable reputation, especially for research and innovation. It pioneered the CD, along with Sony, and went on to develop the LaserDisc, a product that was ahead of its time and failed to take off. It also developed the first consumer videotape system to be marketed (N1500), and also one of the last (V2000), with Grundig. These were just a few of its achievements over many decades. In recent years Philips has gone through a difficult, loss-making period, while still maintaining its position as a leading brand. It returned to profitability in 2003, following three years of substantial job cuts and increased outsourcing. The company continued to do well during the first half of 2004, then issued a warning that its CE unit would be unlikely to be profitable for the year as a whole. There is to be yet greater reliance on external manufacturing capacity, to meet the challenge from Asian brands.

The latest moves at Philips have been the adoption of a new advertising slogan and a change from being a manufacturing-based company to a "market-driven healthcare, lifestyle and technology group". The company has set up a business unit to manufacture products "for consumer health and wellness", but remains Europe's largest CE producer. The "let's make things better" slogan, in use since 1995, has been dropped. Pity that: it had a nice, reassuring note, emphasising product quality as the aim. Personally I don't find the new slogan, "sense and simplicity", nearly as appealing. According to Philips' chief executive Gerard Kleisterlee it has been adopted because "somewhere along the way the promise of the technological revolution to make our lives easier is not being delivered". Apparently research has revealed that the customers who generate by far the largest proportion of Philips' revenues "share a dislike for the unnecessary hassle often created by technology". Can't argue with that, I suppose.

Thomson, Europe's other major CE company, has been undergoing more radical changes. This French company made its first major impact in the UK when, in June 1987, it bought Ferguson from EMI. Thomson had been expanding rapidly in Europe, having taken over various other well-known companies including Telefunken, NordMende and Saba. The aim, it seems, was to prosper through sheer size. At that time Thomson was a strange combination of CE and a major defence electronics operation. The two subsequently parted company, Thomson CE changing its name to Thomson Multimedia and continuing its major expansion, this time in N. America where it took over the RCA and GE CE operations. It seemed foolhardy at the time, when Asian manufacturing was expanding rapidly, and from 2000 Thomson decided to move away from consumer electronics. Last year it merged its TV and video manufacturing businesses with the Chinese company TCL, creating the world's largest TV manufacturer – but controlled by the Chinese. Thomson now intends to become primarily a provider of services and equipment for the media industry. That's certainly a major change of direction.

Four years ago CE products accounted for 95 per cent of Thomson's sales. They now represent a quarter of revenues. The company's current aim is to concentrate on supplying a full range of services for media content providers, from post-production equipment to OB trucks, including set-top boxes and film replication technology. It has had some success with Hollywood studios and TV networks. In 2000 it bought Technicolor and in 2001 Grass Valley in its move away from CE to media support. But investors do not seem to have been too happy, and the shares have been languishing. Changes in the constitution of the company have been announced, including a new Chief Executive, a share buy-back and the entry of a new large shareholder, presumably a private equity concern. It remains to be seen how Thomson will fare in its new form.

A somewhat different story comes from Sony which has been successful, as part of a consortium with two other companies, in gaining control of MGM. This gives Sony access to the studio's film library of over 4,000 titles, plus 10,000 TV episodes. It will be added to Sony's existing library of 3,000 films and 35,000 TV episodes, acquired mainly after Sony bought Columbia Pictures fifteen years ago. It has been estimated that Sony now has access to about half of all movies ever made in colour. Sony is already active in cable TV broadcasting, and has just signed an agreement with the US cable giant Comcast to launch at least three channels there. Earlier this year Sony merged its recorded music business with Bertelsmann's BMG division, producing huge savings for both groups.

Sony has become a vastly greater force in the entertainment business. Yet there is no suggestion that it might leave its CE origins, which have been going through a bad phase – things would have been a lot worse without the PlayStation games business. The logic is that Sony controls software to back its hardware. It learnt the hard way from Betamax. This time round it could give Blu-ray a significant advantage. There are other considerations, such as the growing use of broadband connections for video purposes including video-on-demand. For the present, Sony seems to be well placed to meet whatever the future holds.

News

Pacesetters

Pace Micro Technology announced several new, innovative products at IBC 2004. The company demonstrated Europe's first high-definition personal video recorder (HD PVR), Model TDX840, which has been designed for use with satellite and cable services. It incorporates MPEG-2 decoding, a minimum 160GB hard-disk drive, and can be configured for all major conditional access (CA) and middleware systems.

The Pace PVR2GO, claimed to be the world's first mobile video recorder for pay-TV.

The TDX840 is to be launched in the second half of 2005 and will provide live recording, pause live TV, fast forward, rewind and time-shift and content for recording and playback at high-resolution rather than standard-definition quality.

Pace also displayed a Euro 1080 HD set-top box, Model DS840. Its features include a high-definition multimedia interface (HDMI) for connection to high-specification displays and projectors, and SPDIF for connection to surround-sound audio systems or hi-fi amplifiers. It has an MPEG-2 decoder, a 300MHz, 420MIPS RISC processor and works with HD video at HP@HL. Other features include a multilingual EPG, a teletext timer for programming VCR and DVD recordings, TV/VCR scart connectors (both with composite or RGB video output), component video outputs, a terrestrial RF loop-through and a USB 1.1 port for software upgrades and data transfer to external devices such as a memory card reader. The DS840 HD digital satellite box is due to go on sale in Europe this December.

Pace launched what is claimed to be the world's first mobile PVR for pay-TV, the hand-held Model PVR2GO. It has a 5in. (12·7cm) widescreen display and a 40GB hard-disk drive. The PVR2GO can also be used for viewing JPEG images and playing games, and as an audio player – it's compatible with MP3 and Windows Media audio files. Other features include integrated speakers, 3D-surround sound, a headphone socket, wireless headset provision, an analogue TV output socket plus USB 2.0 and IEEE 1394 ports.

Pace has also unveiled an MPEG-4 high-definition set-top box, Model TSX800, with a hard-disk drive for personal video recording.

Model DB440 is Pace's second-generation STB based on Windows Media 9. It uses the Windows CE operating system and can handle a full range of Windows Media 9 video and audio material. It also works with Microsoft's Digital Rights Management (DRM) and incorporates a programmable digital signal processor. Initial targets for the DB440 are broadband and internet service providers, for advanced on-demand and interactive TV services.

Pace showed digital STBs with integrated GSM, SMS and GPRS wireless return-channel technology. A wireless return channel will enable digital satellite and terrestrial broadcasters to deliver interactive, internet-based services via mobile-phone networks instead of PSTN lines.

A multi-room PVR system that enables cable, satellite and IP broadcasters to distribute video content and PVR services to multiple TV sets in a household was demonstrated. It uses wireless, Ethernet or coaxial cable to stream recorded content from a subscriber's hard drive to non-PVR STBs.

Model DSR210F is designed for satellite radio services. It connects with a domestic stereo system to enable free-to-air satellite radio services to be distributed throughout the home.

Mobile phone TV trials

Starting next spring O_2 and NTL's broadcast division are to carry out the first UK trial of multi-channel TV to mobile phones. Nine transmitters will be used, covering an area of 120 square km around Oxford. O_2 customers will be provided with multimedia mobile phones that incorporate a TV receiver. Those participating will be able to receive sixteen channels devoted to music, sport, news, comedy, soaps, documentary material, drama, cartoons, plus specialist channels including interactive gaming and shopping.

The trial will test consumer demand for mobile TV services, the demand for specific types of content and likely viewing habits. It will use the DVB-H transmission standard for handheld devices, which has been designed for low-power consumption and robust reception.

Rohde and Schwarz has introduced a range of DVB-H compatible equipment to encourage the development of such services. It includes transmitters, a data inserter and test and measuring equipment. Since mobile phones have little energy to spare for multimedia reception, DVB-H data is transmitted in bursts instead of continuously. Use of discontinuous transmission (time slicing) enables receivers to power down between bursts, saving up to 90 per cent in energy. The 4k modulation mode ensures reliable mobile reception, even when travelling in a car at high speed. Added flags (TPS bits) indicate which DVB-H features are used by the receiver.

LCOS launch delay

Intel, which had announced the impending availability of LCOS (Liquid Crystal On Silicon) chips for TV projection systems at the Las Vegas Consumer Electronics Show in January, has delayed the launch of its chips. The company says it remains committed to the technology, but has given no indication of when production might start. The combination of IC and LC technology has proved to be difficult – several companies have been trying to perfect LCOS, which can provide excellent TV displays with large, compact screens.

Digital TV copying control

Japanese viewers have been complaining about steps taken by the national broadcaster NHK and the commercial broadcasting companies to control copying of digital TV programme material. Since earlier this year NHK and the commercial broadcasters have been transmitting specially-encoded programmes that can be recorded only once – further copying is prohibited. To record the programmes, viewers have to insert a smart card in their TV set and use a recorder that's compatible with a system known as Content Protection for Recordable Media (CPRM). The protection system has been developed by IBM, Intel, Matsushita and Toshiba.

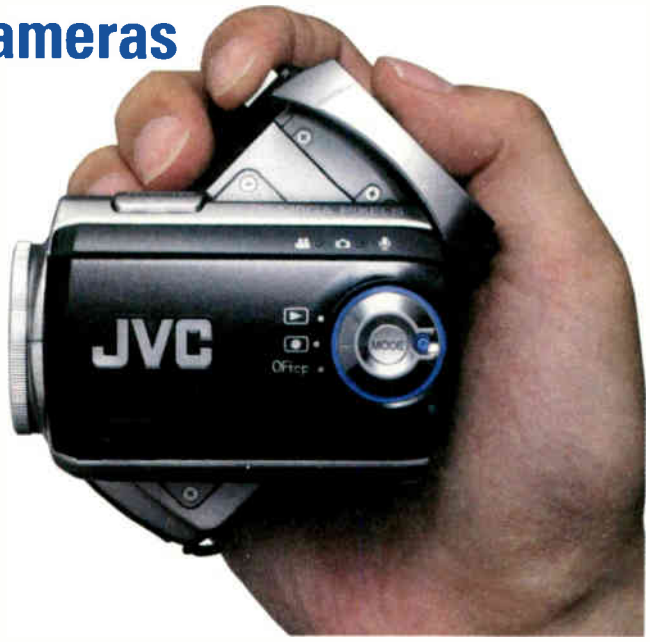
Satellite update

SES Astra has signed a new two-transponder deal with ITV, which already leases three transponders. The additional capacity will be used to expand ITV's digital offering, including more regional and interactive services. SES Astra has also signed a two-transponder contract with Channel 4, which will use the capacity for a variety of digital channels and for interactive TV services. The Astra satellite system currently delivers free-to-air, pay-broadcast and broadband services to over 94 million households in Europe, via DTH or cable transmission. The thirteen satellites transmit over 1,400 analogue and digital TV and radio channels, also multimedia and internet services.

Eutelsat's latest results, for the year ending June 30, reveal that revenues grew by 6·3 per cent to 762.2m Euros: net income was 269.8m Euros. Two new satellites, Hot Bird 7A and 8, are due to be launched in 2005 and 2006 respectively.

Intelsat has agreed to a $5bn takeover by a four-member private-equity consortium that consists of two UK and two US funds. At present Intelsat operates some 27 satellites. It had been up for sale since May, when plans for a stock market offering were shelved. The sale of PanAmSat to another consortium of private-equity groups is expected to go ahead following the agreement in principle of the controlling shareholder DirectTV, which is in turn controlled by Rupert Murdoch's media group News Corporation. PanAmSat has a fleet of over twenty satellites. It seems that current owners want to leave the satellite field, which is troubled by excess capacity, but that ownership is still attractive to some groups for the revenue streams generated.

JVC's media cameras



JVC has launched two palm-sized digital media cameras that can record up to an hour of DVD-quality MPEG-2 video or thousands of high-resolution stills using a 4GB Microdrive card – a removable hard-disk drive that measures just 43 x 36mm. Known as Everio, the cameras have four video recording modes, ultra-fine, fine, normal and economy. These provide recording times of 60, 90, 120 and 300 minutes respectively, at bit rates from 1·5Mbits/sec (economy) to 8·5Mbits/sec (ultra fine). Scanning is progressive in the economy mode, interlaced in the other modes. Stills are at VGA, XGA, SXGA or UXGA resolution in fine or standard quality, capacity varying from 5,595 at UXGA fine to 9,999 at lower resolutions.

Both models provide quick transfer of material to a PC and content saving to a DVD disc. The CCD image sensor has an effective resolution of 1·23m pixels for moving pictures, 2m pixels for still pictures. Other features include a 1·8in. LCD monitor, auto and manual focusing and a digital image stabiliser. There is also a voice mode which records .wav files with 16-bit, 48kHz PCM sampling at up to 1·5Mbits/sec, giving a recording time of five hours and 47 minutes.

No price details have been announced.

BBC deal with Channel 4

BBC Broadcast, a commercial arm of the BBC, has won a five-year contract with Channel 4 to provide all its 'access services' – subtitling, audio description and signing. By next January BBC Broadcast will be providing tailored services for Channel 4 from the Broadcast Centre in West London. More than 80 per cent of Channel 4's programming is subtitled for the benefit of those who are deaf or have impaired hearing. Substantial proportions of E4, Film Four and Film Four Weekly are likewise subtitled. With DTT Channel 4 (Freeview) nine per cent of programmes are also audio described and over three per cent are signed. Audio description is provided for the blind and visually impaired: a voice track is added to describe what is happening on screen, while dialogue, music and sound effects speak for themselves. In-vision signing is the translation of a programme's dialogue into BSL (British Sign Language) by an interpreter whose image is superimposed on the broadcast.

Sky+ news

BSkyB has launched a new service for Sky+ boxes, enabling viewers to record scheduled interactive programmes. The first programme available via the new service was the Sky Sports UEFA Champions League coverage on September 29: viewers were able to record any one of the eight live games.

The Sky+ programme planner has been upgraded to provide increased sorting capabilities. Viewers can now sort by A-Z, by programme genre, by recorded programmes still to be viewed, those that have been viewed and those still to be recorded.In addition Sky+ has been enhanced to make radio recording easier.

SACD + video

CS2CD, a US company, claims to have developed a version of the Super Audio Compact Disc that enables video to be added and is compatible with DVD players. SACD discs have two layers, one for 5.1 high-resolution surround sound and one that provides conventional stereo CD sound. It seems that MPEG-1 video would be included in the CD layer, along with the CD sound.

TEST REPORT:

The DigiFusion FVRT100 DVR

The FVRT100 is a hard-disk recorder for use with digital terrestrial TV reception. It's simple to use and includes a number of features. Roger Thomas provides a detailed assessment after buying one to replace his VHS recorder

It was time to replace my elderly analogue VHS machine, so I decided to buy a DigiFusion FVRT100 digital video recorder. The cost, from www.unbeatable.co.uk, was £227.98 including delivery. I already had a Pioneer TF100 set-top box for reception of Digital Terrestrial Television (DTT), but it seemed that a DVR, with dual tuners, was a better proposition. For one thing it simplifies the wiring between units. Instead of needing a scart connection between the TV set and both the VHS recorder and the STB, there is now only a single scart connection. The requirement for a coaxial cable loop-through remains, so that analogue broadcasts can still be received directly by the TV set if needed.

The FVRT100 is 360mm wide, 47mm high and 245mm deep, making it slightly smaller than my VHS recorder but only half the height. The size is similar to a DVD player, Sky digibox etc. A 12V mains adapter is used to provide power, the lead from this supply to the DVR having two RFI filters.

There are two scart sockets at the back of the unit. One is for connection to the TV set, with output options RGB, composite video and S-video. The best picture quality with my Samsung TV set was obtained using the composite-video option. The second scart socket can be used for connection to a DVD or VHS recorder for archiving. It carries the same video as the TV scart socket except for any on-screen menus. The DVR does not have an RF output.

There are twin phono sockets for audio (no digital audio output), also two coaxial sockets, one for the aerial input and the other for the aerial loop-through to the TV set. There is also, 'for factory use only', a 9-pin serial port connector. The DVR is manufactured in Turkey by Beko Electronik, which is part-owner of Fusion Digital Technology.

Photo 1: The remote-control unit that comes with the FVRT100 DVR.

Scart and coaxial leads are not supplied with the unit. This was not a problem for me as I was able to use existing cables, but if the installation is a new one these will be needed, at extra cost.

Initial observations

The only problem I have with the picture is that when a new channel

is selected the DVR defaults to 4:3 full-screen format, then quickly switches to my selected display option of 4:3 letterbox (16:9-style format with gaps along the top and bottom of the picture). This can be very noticeable with some TV programmes, as the picture fills the screen and moments later is reduced to the correct aspect ratio. Channel switching is slightly slower than with my Pioneer STB, and no now/next information is displayed.

The FVRT100 has a metallic silver finish. Its front panel is of simple design with only three buttons (channel up/down and standby) and a LED display. I much prefer this to a front panel that has numerous flashing LEDs and a plethora of buttons. The small, green four-digit LED display shows the time (dimmed) when the unit is in standby: when in use the channel number and current activity are displayed. There are also two square green LEDs to indicate when a recording is in progress or that the picture buffers are being used, a red LED for standby and a LED that shows remote-control activity.

The infra-red remote-control unit (see Photo 1) is rather small, just 170mm in length, and is a bit fiddly to use as the buttons are so small. The RC unit that came with by Pioneer STB is better ergonomically. Apart from audio mute and setting the audio level from the DVR, the DigiFusion RC unit cannot control the TV set (unlike the Pioneer unit). So you need to have both the DVR and the TV remote-control units handy.

DTT reception

I can receive digital TV from the Oxford transmitter, some 14 miles away, using a wideband set-top aerial. A group C/D aerial serves for analogue TV reception, but for digital TV reception a wideband aerial is needed as the channels used range from 29 (in group A) to 68 (group E). The set-top aerial has a dual row of flat elements and looks like a metallic Christmas tree. With the Pioneer STB the signal level was usually between 60-80 per cent.

The first test for the DVR was to check that it would receive all the channels using my existing aerial. It found all 69 channels but, unlike the Pioneer box, it does the scan in two passes. During the first pass the message 'searching for frequencies' is displayed. This seems to mean searching for multiplexes, and produced a 'found' count of six. The second pass is accompanied by the message 'searching for programmes'. The total found count reached 69, but the channel names are not listed. Scan time is similar to the Pioneer STB at about three minutes.

The channel figure of 69 is a bit misleading, as it includes radio stations, separate teletext services and TV channels that broadcast for only a few hours a day, time-sharing with other services, though they have their own channel numbers and names. The total also includes the ten encrypted channels broadcast by Top-Up TV (TUTV). This service also uses time-sharing, only five stations being available at any one time. The FVRT100 does not have the card interface that would be required for TUTV reception.

A nice feature is the aerial-alignment option, see Photo 2, which is selected from the setup menu. As I had already carried out aerial adjustment with the Pioneer STB I knew in which direction to point the aerial for best results, but this feature should simplify aerial positioning with a new installation. As the unit has two tuners, the signal strength of two multiplexes can be viewed simultaneously. The unit also displays the transmitter from which the DTT signal comes. To determine your local transmitter and the multiplex channel numbers, visit one of the DTT websites and enter your postcode.

The hard disk

The capacity of the internal hard disk is 40GB. This is low in comparison with the PC field, where even entry-level models come with higher-capacity disks and 200GB drives are common. But 40GB seems to be standard with current DVRs. It provides about 20 hours of programme storage. If you routinely record/archive several episodes of a particular series, or record films and sports events, the 20-hour disk-storage limit could be a problem. Twenty hours is adequate for simple time-shifting, where TV programmes are recorded, viewed then deleted.

Once the limit has been reached, with programmes already recorded or programmes scheduled to be recorded, the FVRT100 will not add anything more to the record list and comes up with an insufficient disk space message. I find that I record far more programmes than I ever did with my VHS machine, so hard-disk drive management is needed.

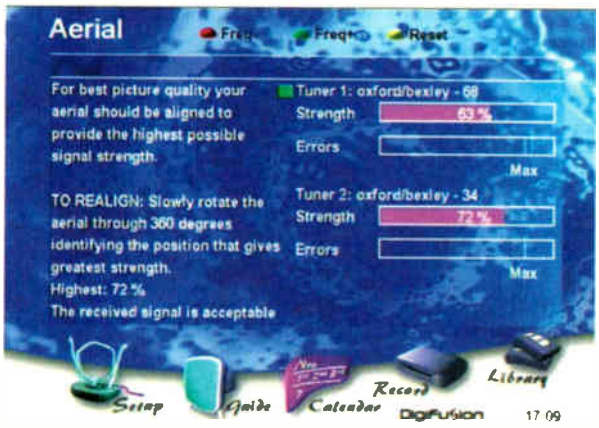


Photo 2: The aerial-alignment option that can be selected from the setup menu.

There are three levels of record quality. SP (Standard Play) records the original MPEG-2 video as broadcast and requires about 2GB per minute (this depends on the material being transmitted). The two other levels, LP (Long Play) and EP (Extended Play), use Fusion's SCT (Super Compression Technology). If the hard disk is becoming full up it's possible to compress existing recordings. The manual says that this takes four hours for each hour of programming, in the standby mode, so this is not a quick-fix to free disk space. There is an inevitable loss of video quality with LP or EP recording. Forty hours of programming can be stored with maximum compression (EP).

It's not possible to edit recordings. Radio stations can also be recorded, either via the EPG or with the record time set manually.

EPGs

An Electronic Programme Guide (EPG) is essential for the operation of a DVR. Instead of setting a timer manually to start and stop recording, you use the EPG list to select programmes. This is easier and more intuitive.

Freeview uses EIT (Event Information Table) to transmit EPG information. After a few false starts because of software problems a seven-day EPG service is being introduced throughout the UK. When the DigiFusion DVR became available Freeview's EPG was limited to now/next information. To overcome the initial lack of programme information the FVRT100 uses a proprietory EPG supplied by 4TV. This EPG data is transmitted by Crown Castle on channel 701, 4TVinteractive, of multiplex D. Fusion Digital Technology is not the only company that uses this service: many STBs that incorporate the SetPal chipset and the

Thomson DVR also use it.

The 4TV EPG provides seven days of programme information and was successfully loaded on the first night. The DVR is left in standby and the EPG is automatically updated daily at 3.00 a.m. The DVR's software can also be upgraded via 4TV – within a few days it was upgraded to version 1.6.4. At 3.00 a.m. the LED display changes from showing the time to OAD (Over Air Download). After fifteen minutes of downloading, the DVR takes itself out of standby and briefly powers down (no display, no fan but the standby LED flashes), then powers back up with increased disk/fan noise and 'hold' displayed for a few seconds. After that the unit goes back to standby with EPG displayed. The EPG data then takes about ten minutes to download. If a recording is in progress it's given priority over the AOD/EPG download. 4TV plans to increase the EPG to fourteen days.

There is no interaction between previously recorded programmes and the EPG. It is not for example possible to select a 'series pass' option, where all episodes of a particular series are recorded automatically. However I believe that 4TV could transmit this kind of programme detail. This is why the FVRT100 is a DVR rather than a PVR (Personal Video Recorder). Although the acronym PVR tends to be used for any recorder that has a hard disk, it should really be reserved for machines that can record programmes independently, based on what has previously been recorded, genres, user preferences etc.

The two tuners

With a VHS system the VCR and the TV set both have a tuner, so you can record one programme and watch another one. The DigiFusion DVR with its two built-in DTT tuners operates in a different manner. You can watch one channel while recording another, or record two different programmes at once and either watch one of them or watch a previous recording. The software prevents duplicate recordings of the same programme being made. As the two tuners are separate, the two broadcasts being recorded do not have to be from the same multiplex.

Although the acronym PVR tends to be used for any recorder that has a hard disk, it should really be reserved for machines that can record programmes independently, based on what has previously been recorded, genres, user preferences etc.

The rewind buffer

The FVRT100 automatically saves up to the previous thirty minutes of the channel you are watching. When the rewind buffer reaches the thirty-minute limit, the video first stored in the buffer is lost to make room for fresh live video.

If for example you were watching England in a crucial European football match and wanted to replay to see if there was a goal or a foul on the goalkeeper during the previous few minutes you can, by pressing the rewind/forward button, see a replay in the normal or in the reverse direction. By pressing the pause button before the fast forward or rewind button the playback will be in slow motion (at half speed or, by pressing the button a second time, quarter speed). After viewing the possibly disallowed goal you can either continue watching via the buffer (Fusion call this the delayed live mode) or, by pressing the fast-forward button, you can move through the buffer to catch up with live events. Each time the fast-forward or rewind button is pressed the playback speed is doubled, up to a maximum of 64 times the normal speed. Alternatively pressing the skip button takes you forward directly to the live TV. The audio is muted during fast-forward or slow motion.

This rewind feature is sometimes referred to as 'time-slip viewing'. A line is displayed along the bottom of the screen to show you where you are in relation to the constantly-updated buffer. In addition one of the square display LEDs will be on as a reminder that you are watching a recording instead of live TV.

There is no loss of picture quality when viewing from the rewind buffer. At present it's not possible to save from the buffer to the hard disk. When the record button is pressed the recording starts from live TV, not from any point in the rewind buffer. When the channel is changed the buffer is cleared and starts to fill up again. Thus the buffer does not record any channel hopping.

The pause buffer

If you want to see what's on any of the other channels without losing the current programme, pressing the pause button enables you to switch channels using the other tuner. The current picture is frozen: after viewing the other channels, pressing the left or right blue button returns you to the point where you left off, provided more than thirty minutes haven't elapsed – these buttons provide switching between the two tuners. The viewing options are then the same as with the rewind function.

These time-slip and pause features certainly add to the fun of using a DVR.

The main menu

Pressing the menu button brings up the main menu, see Photo 3, including the Multi Guide EPG

guide, though each option has its own button on the remote-control unit for direct access. The various functions are self-explanatory except perhaps the Calendar icon. This displays a calendar from which any date can be selected for reminders to be displayed at specified times. These text reminders can be displayed on a daily, weekly, monthly or yearly basis. Messages are entered by using the letters associated with the remote-control unit's number buttons, in a similar way to SMS texting with a mobile phone.

Calendar also shows what dates are in the EPG. Selection of one of these dates displays that day's listing.

Heat and noise

The DVR has an internal fan that runs all the time, even in standby, to keep it cool. The fan does make a noise. With normal daytime operation this is not noticeable but, in a quiet room with the TV set switched off, the constant noise may be audible and irritating. This wouldn't be obvious when considering a retail purchase, as the usual background shop sounds would mask it. Although not as loud, the noise sounds like a VHS recorder in permanent rewind or fast-forward.

The DidiFusion DVR is based on the ST Microelectronics 32-bit Omega chipset, which runs at 180MHz (the chipset is also used by other DVR manufacturers). The PCB design is neat, with several surface-mounted chips and discrete components, and is not densely packed. The disk drive is a 3·5in. Fireball 3 series 40GB type manufactured by Maxtor. It runs at 5,400 r.p.m. and is very quiet in operation: there is no audible increase in noise when recording or playing back. In my DVR the drive was date stamped 21 April 2004.

This problem of continuously running fans and heat is not confined to the DigiFusion DVR. In fact in many respects this unit is better than other DVRs, as part of the power supply is external. It does however mean that some thought is required as to where to locate the unit.

The top of the box gets slightly warm but the underside of the case gets hot. The cooling fan is hidden underneath the hard-disk drive. It sucks in air through holes in the underside of the case, air flowing out of the unit via vents at each side of the case. The disk drive is at the front of the case and seems to run all the time.

The hard-disk operating temperature range is 0-60°C, so I don't think that it is troubled by above-average temperature and needs its own cooling fan. None of the Omega chips or the other components, including voltage regulators, have heatsinks, and I would expect these to produce most of the heat. So the choice of fan location is rather puzzling and, unfortunately, the drive's IDC cable, which connects it to the PCB, partially blocks off the air flow to the PCB.

Upgrading the hard disk

It's unlikely that the DVR is designed exclusively around a 40GB hard disk, so replacement or upgrade of the hard disk should be possible. To increase the chance of successful replacement it would be advisable to use a higher-capacity model from the same manufacturer. The setup menu contains a hard-disk format option, which is protected by the 4-digit parental-lock PIN. Needless to say changing the hard disk is not encouraged by Fusion Digital Technology, and would void any warranty.

In conclusion

I've not described every option that the FVRT100 provides, as the manual is available from the Fusion Digital Technology website (support/manual section). Fusion has used an 'arty' image as the background for all the menu screens. This is not a problem with the main menu, but with some sub-menus that display a lot of textual information, such as the EPG or listing of recorded programmes, it's an unnecessary distraction. The background image impedes readability. Fusion could improve matters by making the image darker, so giving better contrast to the text, but it would be better to remove the graphic.

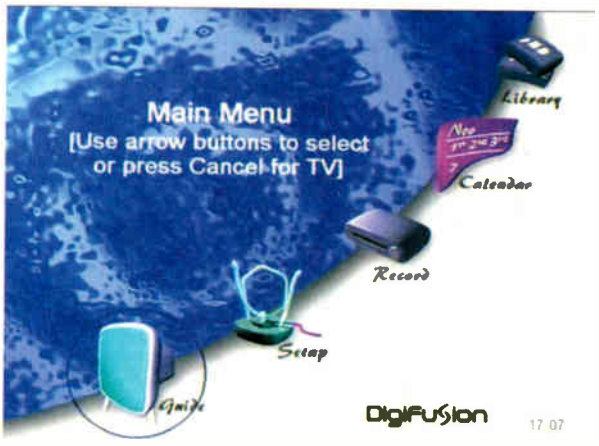


Photo 3: The main menu.

With a new device which is dependant on the software installed there is always the worry that this may be a rushed, inadequately tested version. So I was pleased to find that the software is stable and, apart from a few 'rough edges', works as advertised. This type of problem can usually be fixed by an OAD update. Fusion Digital Technology has responded positively to customer queries about software upgrades.

At present the only time when the DVR doesn't offer any advantage over VHS is when a recording is in progress. It's not possible to use the delayed live mode or to view the start of the recording while a programme is being recorded. Fusion hopes to update the FVRT100 software to provide viewing from the beginning while a programme is being recorded.

Owning a DVR will not change your life but will change your viewing habits. I find that I watch far less live TV because I watch recorded programmes and use the delayed-live mode features. My Pioneer box is on permanent loan to another member of the family, and my VHS recorder is no longer in use. Do I miss it? No! No more hunting around for a blank tape, or forgetting what has been recorded on a particular tape. Having used a DVR, there is no way that I would want to go back to using videotape.

The panel below provides details of relevant websites. ■

www.4TV.net	*EPG provider*
www.fusiondigitec.com	*Fusion Digital Technology website*
www.wolfbane.com/cgi-bin/tvd.exe	*Enter postcode for DTT reception and transmitter information*
www.dtg.org.uk/retailer/coverage.html	*Enter postcode for predicted DTT reception*
www.freeview.co.uk	*Information on Freeview*

Vintage repairs

The Collaro Conquest autochanger

Michael Maurice describes the operation of an autochanger mechanism from the classic era of UK audio equipment manufacture, the various faults that can arise and how to deal with them

Many years ago, in the 1950s and '60s, most consumer electronic equipment sold in the UK – radio and TV sets, record players, radiograms, tape recorders etc. – was manufactured here, for both the home market and for export. A few items, mainly higher-quality equipment, were built on the Continent and imported to the UK.

Industry background

At that time there were three major UK manufacturers of record-player turntables. Garrard was probably the most famous – it was certainly a leading brand. The company manufactured a range of turntables, from cheaper autochangers to the highly acclaimed 301 transcription unit. The Garrard 301 is still one of the most sought-after turntables, despite many examples being over forty years old. The turntables manufactured by BSR were very popular with budget record player manufacturers such as Dansette. Both these manufacturers continued to build turntables up to the later Seventies and early Eighties.

The other well-known manufacturer of turntables was Collaro, whose roots went back to the Thirties, possibly earlier. The factory was at Ripple Road, East London, and the company's turntables were considered to be some of the finest. Usually made in cream with a distinctive red turntable mat, Collaro autochangers were widely used in both record players and radiograms. Collaro was eventually bought by the US Magnavox company, and disappeared from the UK market at some time in the early-mid Sixties. Production of Collaro autochangers continued in the US for some time afterwards however: I understand that the last autochangers ever made were a US Collaro type!

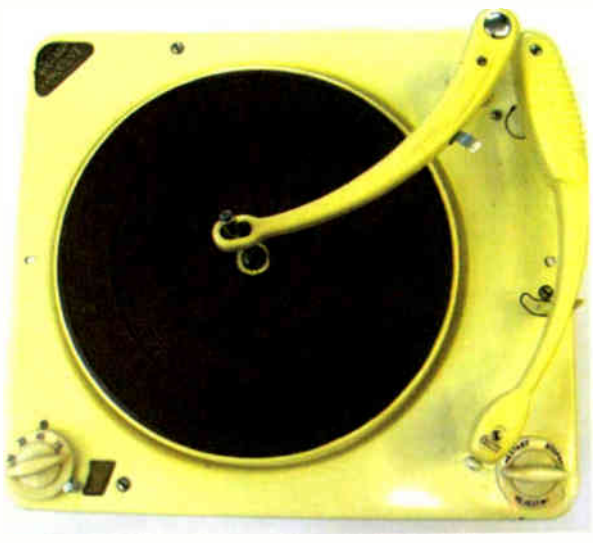


Photo 1: The Collaro Conquest autochanger unit.

Autochangers were popular because you could stack up to ten records on them. In the early days classical music was often recorded on a group of four or six 12in. 78 r.p.m. records, arranged so that you could play say half a symphony (a 12in. 78 has a typical playing time of five minutes) before turning the stack over and playing the other half. Autochangers were shunned by hi-fi enthusiasts, who thought that piling records on top of one another would not do them any good!

The Collaro Conquest

The Collaro Conquest, see Photo 1, was a popular autochanger of the Fifties and early Sixties. It might not have been the most reliable of units, but it was the one that the family had when I was a child. It was while I watched my father repair the unit that I became interested in electronics, thus leading to a hobby and subsequently a career. Our record player, a Murphy, was consigned to the bin some years ago. So, when one came up in the Vintage Audio section of the internet auction site eBay, I just had to bid for it.

Operation of the unit

The Conquest uses a system that became known as pickup arm scan setdown. The way it works is unique and somewhat unusual, the pickup arm doing a little dance to determine the record size. At switch on the arm is raised and moves towards the centre of the turntable, feeling the side of the unplayed record(s) in order to determine its size. Having done that it retracts back a bit, to allow the record at the bottom of the unplayed stack to drop on to the turntable. At the same time it is lowered slightly before moving to the beginning of the record then being lowered on to it.

If you want to play records of different sizes, you have to play the larger ones first. But a great advantage is that the mechanism plays records of all sizes automatically, including the 6in. and 8in. types of an earlier era.

The unit also features a constant cycle changing speed, i.e. it changes records independently of the turntable's speed. If no records are loaded, it returns to stop without the pickup being lowered on to the turntable, thus protecting the stylus. When all the records have been played the arm once again rises and moves towards the centre: not finding any records, it returns to its rest position and the machine switches off.

Mechanism description

Photo 2 shows the unit with the turntable removed. The motor shaft has a stepped pulley: moving the pulley up or down determines which step drives the turntable and thus the turntable's speed. The changer part is driven by a second pulley which drives a large cam wheel. The reason why a second pulley is used is that the speed of the changer mechanism is constant, not determined by the turntable speed as with Garrard and BSR turntables.

The cam wheel is connected to the pickup arm by a linkage on the top and the pickup lifting mecha-

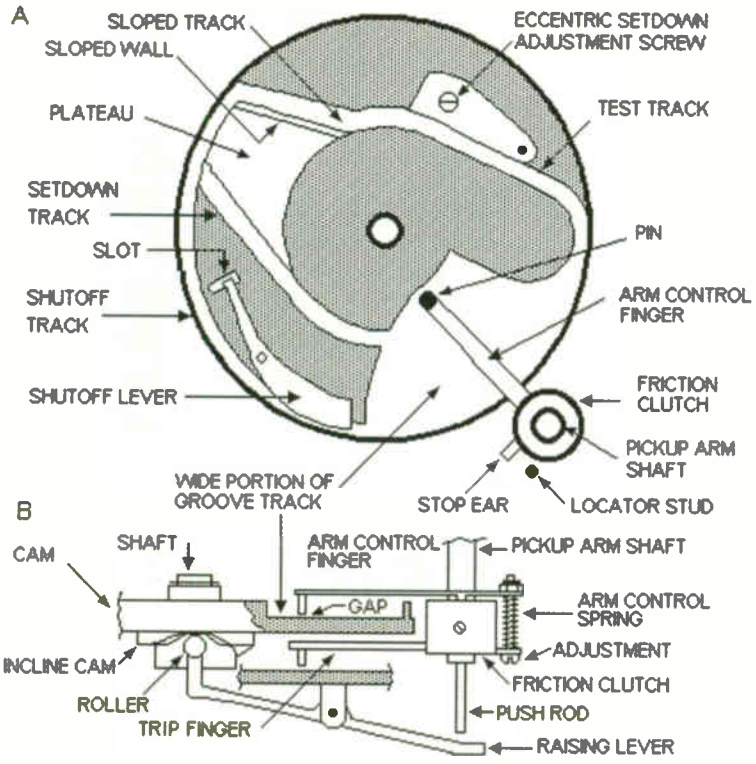


Fig. 1: The change cycle cam.

nism underneath. The pickup arm's rotational bearings form part of a friction clutch that enables the arm to be set down at the beginning of the record. This mechanism enables the pickup arm to gauge the record size very accurately, without the use of a third feeler arm or finger as used in Garrard and BSR changers.

The cam wheel is mounted on a subchassis together with the pulley and the pickup arm mechanism, see Photo 3. This subchassis is very easy to remove from the main deck – by disconnecting the pickup cable and removing the pickup arm. The entire subchassis comes away when the rubber idler wheel is removed (two screws) and five screws are removed, three near the turntable bearing and two at the pickup end. Figure 1 shows the change cycle cam.

Faults

These autochangers were not without their faults. One that I recall is the turntable not running at the selected speed: if you selected 33 r.p.m. it would rotate at 45 r.p.m., and if you selected 45 r.p.m. it would rotate at 78 r.p.m.! The cause was simply that the pulley had risen up the motor's shaft: all that was required was to push it back down again. Fascinating stuff for a six-year old!

Another fault that I recall is when the arm wasn't lifted high enough. This led to two problems. When the arm tried to determine the size of the record it would go underneath the record, scratching the underside. And when the record finished the arm scratched the record as it tried to return to the start. I believe the cause was that the casting which held the cam in place became loose from the main chassis.

I understand that these mechanisms were not altogether popular with some servicemen of the day – Don Bullock, eat your heart out! They can't have been all that bad. I'd rather repair them than the latest cassette decks!

Another fault I came across recently is the motor not turning freely, because of hardened grease and oil. To solve this one, remove the pulley, fan and armature and thoroughly degrease then relubricate. Once done, it will probably last another forty-five years.

Pickup and amplifier

The pickup arm is fitted with a crystal cartridge that you turn over to select either the 78 or the 33/45 stylus. The crystal cartridge requires a high amplifier input impedance, which well suits the valve amplifiers of the era. All amplifiers used valves at the time when the Conquest was manufactured. The quality of the record player depended on the number of valves used, though one- or two-valve amplifiers were the norm.

In conclusion

Compared with today's digital era, with CDs, DVDs, MP3 technology etc., mechanisms like the Collaro Conquest seem to be something from another planet! But they served us well, and were built to last – provided they received a bit of maintenance. How much of today's equipment will be around in 40-50 year's time, and will they have become collector's items?

While surfing on eBay I came across a website that describes the Collaro and other autochangers in detail. Those interested can go to http://mypage.iu.edu/~Irobins/collaro.htm

The Japanese began to market their products in earnest in the late Sixties and early Seventies. They were usually better built and more reliable. The introduction of the belt-driven turntable did much to reduce wow, flutter and rumble.

Unfortunately, as in many other industries, UK manufacturers failed to keep up with the technological advances that Japanese and German manufacturers were making and thus initiated their own demise. Nowadays the only time you see the names mentioned in this article, along with other great British audio brands such as Leak, Rogers and Dansette, is in the vintage section of eBay and other collectors' columns. ■

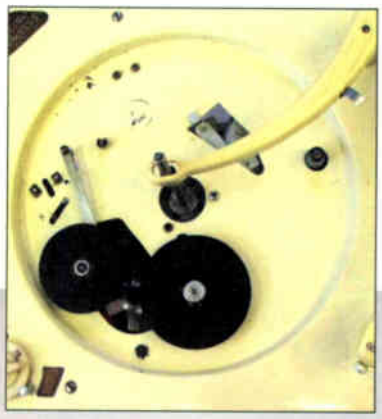


Photo 2: The autochanger unit with the turntable removed. The smaller pulley drives the turntable, the larger pulley driving the cam and autochanger mechanism.

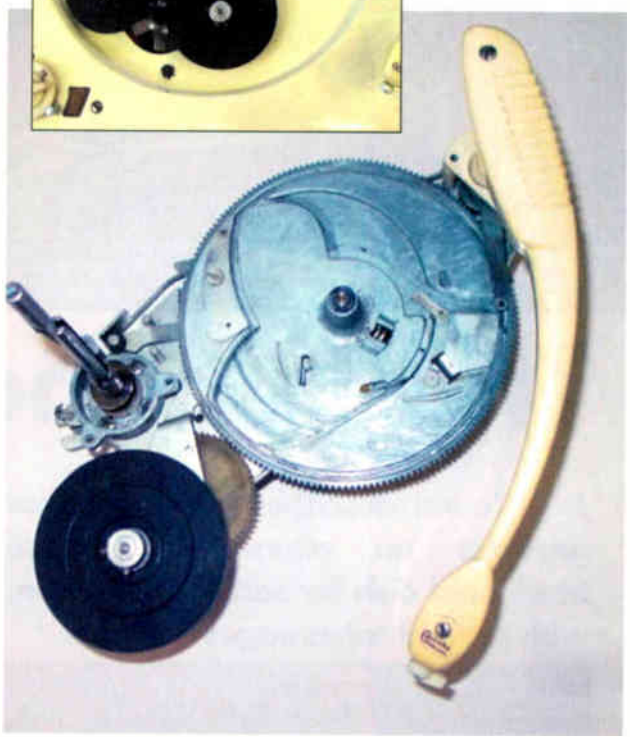
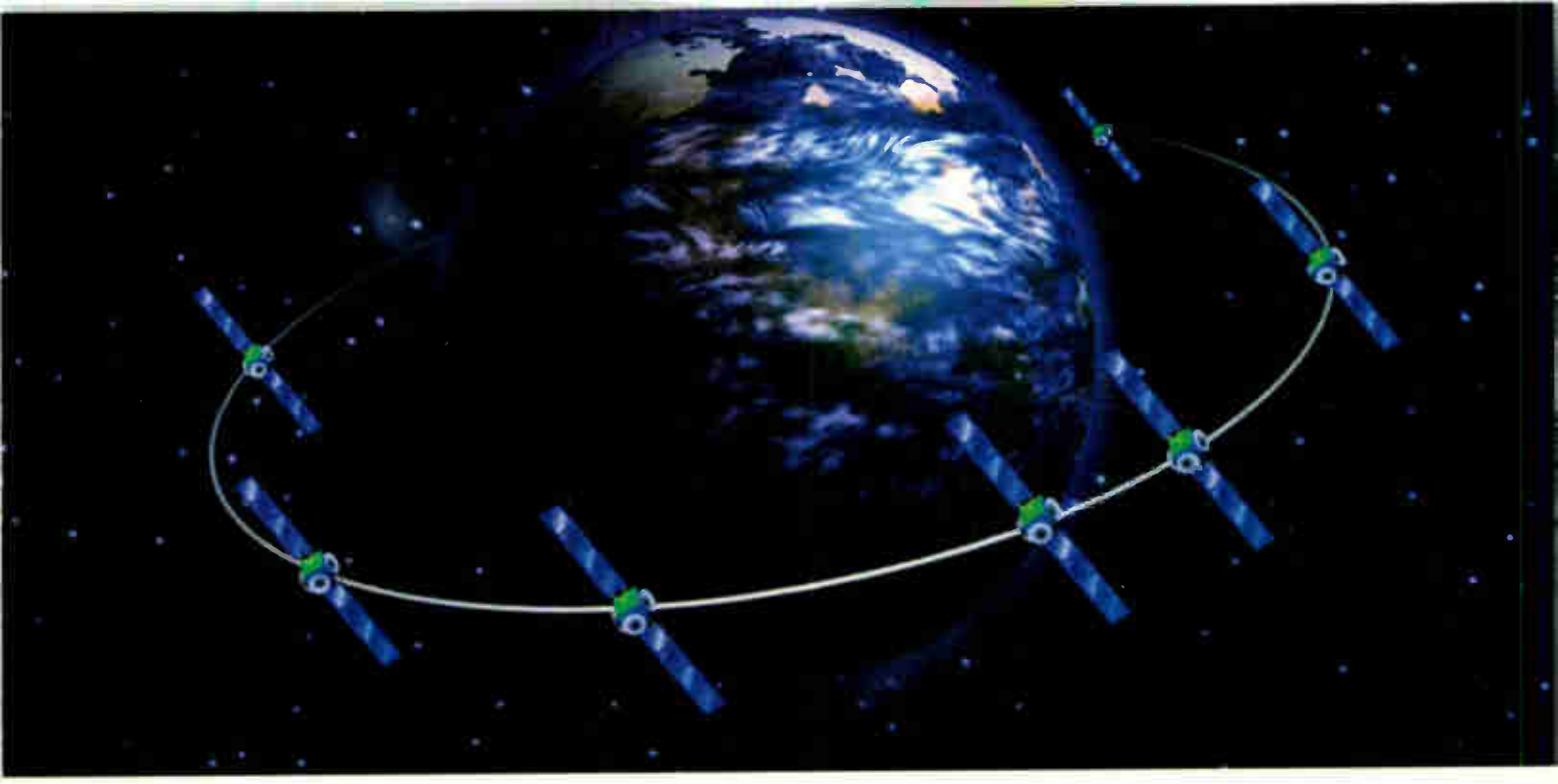


Photo 3: The autochange mechanism out of the unit. The pick-up arm and drive pulley have been refitted for the photo.



The Luneberg lens aerial

J. LeJeune describes an aerial that provides an alternative to the traditional dish for satellite reception, with several advantages

The Luneberg lens aerial is based on research carried out by R.K. Luneberg in the US in 1944. The basic idea is to use a spherical lens with a graded refraction index, that is beam refraction varies within the lens, to focus an incident beam. Its significance for satellite reception is, as we shall see, that signals from several satellites can be focused on LNBs without any need to move the focusing element.

Basics

The refraction index of the spherical Luneberg lens varies in the radial direction only. see Fig. 1. It doesn't have a normal 'optical' axis, see Fig. 2, but instead has a focal point at the opposite side of the lens, along a line that passes through the centre of the sphere, see Fig. 3. This feature has enabled various applications to be developed.

The graded refraction index presents manufacturing problems however. There is also the requirement that the refraction index at the surface of the lens must be the same as that of the surrounding medium, air (refraction index = 1). These obstacles are particularly difficult to surmount with visible light, using glass or plastic material for the lens. Other materials can be used at microwave frequencies however, while the requirements at these frequencies are less exacting. Certain materials can be given a graded permittivity, providing the graded refractive-index property required. This makes the Luneberg lens viable for microwave applications. As shown in Fig. 1 the lens

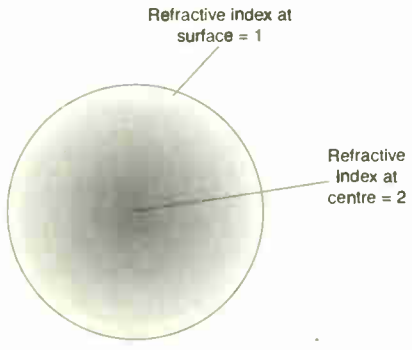


Figure 1: A graded-density spherical lens: the refractive index is 1 at the surface of the lens and 2 at the centre.

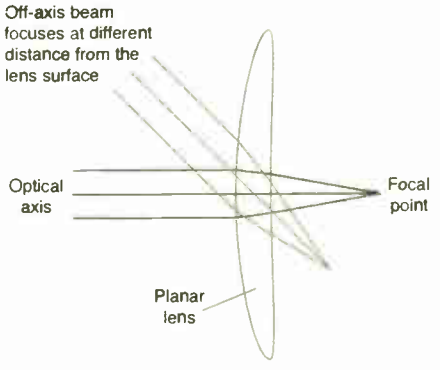


Figure 2: Focusing characteristics of a conventional planar optical lens.

has a refraction index of 1 at the surface increasing to 2 at the centre.

Applications

The lens can separate individual incoming beams and can focus beams from different directions with uniform gain, making it ideal for satellite signal reception. A spherical lens could be awkward for domestic satellite reception but a further development, a hemispherical lens mounted on a reflector plate, see Fig. 4, is a practical proposition. The hemispherical lens has the same properties as a complete sphere, while the reflector can double as a mounting plate, see Fig. 5.

The unique qualities of the lens find applications in radar systems, the control of guided missiles and for microwave reception aboard ships and by moving vehicles. JSAT Corporation and Sumitomo Electric Industries have pioneered a lens that's suitable for consumer applications, including direct-to-home satellite reception. Raven Manufacturing Ltd. of Accrington has recently introduced this technology in the UK.

For microwave applications the lens can be manufactured from foamed urethane polymers. The permittivity (dielectric constant) and hence the refractive index can be controlled by the simple method of varying the foam density with radius, the density increasing towards the centre. Urethane polymers have very low loss tangents, and the graduated density change is easily obtained. In addition the mechanical and dielectric properties are identical in all axes. A simple manufacturing method involves the application of successive layers of foam, each with decreasing density, until the outer layer equates to a refractive index of 1.

Practical satellite aerial

With the domestic satellite aerial design shown in Fig. 5 the LNB(s) are mounted on a curved rail that's pivoted at the ends to enable it to be moved up and down over the hemispherical surface of the lens. The LNB(s) can be moved along the curved rail. Alignment for maximum signal pick-up is simple: adjust the height of the rail then slide the LNB(s) along it. More than one LNB can be used to provide reception from several satellites, see Fig. 6. The entire assembly can be mounted on a wall, roof, chimney-stack or patio.

The LNBs are conventional and no radical retraining is required to install and operate an aerial of this type. These aerials are lighter than a conventional parabolic-dish assembly, and alignment of an LNB is simpler and easier than having to orientate a dish plus LNB. Good wind resistance and minimal effect from snow accumulation are added bonuses in comparison with the usual parabolic dish.

The lenses are manufactured in seven types, including five sizes from 40cm to 180cm, models for vehicles and ships and a transmitter version. ■

Figure 5: JSAT Corporation hemispherical Luneberg lens aerial design with three LNBs (at top left).

Figure 6: Reception from three satellites with the JSAT hemispherical Luneberg-lens aerial.

Left – Terrace wall Luneberg-lens aerial-mounting (vertical).

Right – Ability to be attached to any wall.

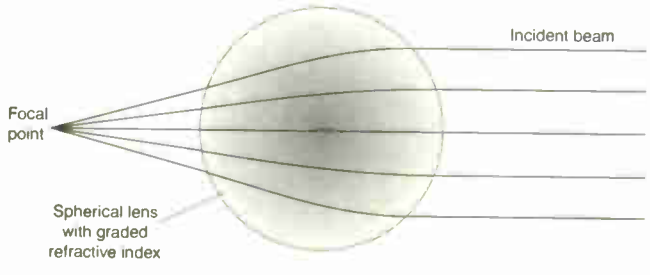


Figure 3: Focusing characteristic of a Luneberg spherical lens.

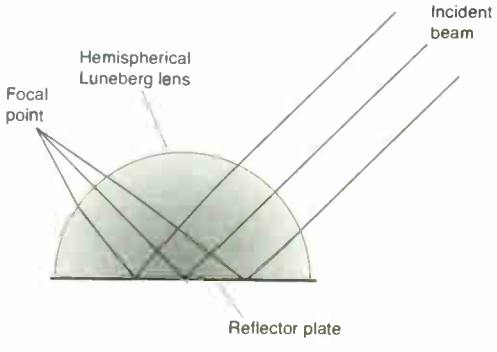


Figure 4: A hemispherical Luneberg lens with reflector plate. The reflector 'mirrors' the other half sphere, making it appear like an entire one.

Satellite TV distribution systems

This month Bill Wright deals with LNB choice and installation, dishes and fixings, cables and the signal levels required

In Part 1 last month we dealt with test equipment and workshop requirements, the basics of satellite TV reception, and the organisation and installation of a TV signal distribution system for a small block of flats. We also considered basic measurements for satellite TV reception – the carrier-to-noise ratio and the bit-error ratio. For a commercial distribution system the vital starting point is the carrier-to-noise ratio at the LNB, which is where we will begin this month.

Carrier-to-noise ratio at the LNB

Increasing the dish size will lift the signal levels by one or two dB at most. What's the point of that, you may reasonably ask, when the same could be achieved by a tad more gain in the multiswitch, when LNB gain figures vary by 4dB from one unit to another, and when every 10m of cable will lose 3dB? May I take a moment to dispel a myth? Larger dishes are not used to get a stronger signal for its own sake. Since the signal collected by the dish is, in effect, mixed with the background noise produced by the LNB, every extra smidgen of signal from the dish gives an equivalent improvement in the carrier-to-noise ratio, and this improvement continues through the whole system. Every extra 1dB of pure clean signal gathered by the dish improves the carrier-to-noise ratio by 1dB, all the way to the last outlet. At the LNB even a fraction of a dB improvement in the carrier-to-noise ratio matters, because it will improve the bit-error ratio significantly.

This brings us to a point that's central to the black art of satellite IF distribution. The main factor is almost always the carrier-to-noise ratio rather than the signal strength itself. Signal levels are generally much higher than they really need to be. Even if they aren't, it is easy to increase them, so they needn't be a concern. What we have to look after is the carrier-to-noise ratio. If it were not for this magazine's conservative editorial style, I would ask the editor to print that last sentence in bright colours and surround it with stars!

Even when, during subsequent amplification, the carrier-to-noise ratio is reduced, the figure at the LNB continues to have a direct influence on the carrier-to-noise ratio at the final outlets. At the LNB it should be possible to obtain bit-error ratio readings ranging from 2·0 E-5 to 6·0 E-6.

Choice of LNB

As the multiswitch has an input for each of the four sets of signals (see Table 1 last month), the LNB (see Fig. 11) should be a quattro (four fixed outputs) rather than a quad (four switchable outputs) type. Some multiswitches will send the appropriate voltage/tone to each of the four LNB outputs, enabling a quad-type LNB to be used, but this is an unnecessary complication – just something else to go wrong.

The noise generated in the LNB is the biggest factor in the carrier-to-noise equation. It's more significant than celestial background noise and, in a system that's even half-way properly planned, is much more significant than either amplifier or receiver noise. For receiver noise to become a serious factor the signal levels would need to be at least 15dB below what they should be.

So it's the LNB noise that matters. In 1986 I paid £300 for an LNB with a noise figure that is, by modern standards, laughable. Nowadays you can get a 'four fixed output' LNB with a noise figure of 0·7dB for £50. Interestingly, there seem to be small differences between samples of the same type of LNB. It's quite easy to slot a series of LNBs on to a dish in quick succession

(don't bother with the clamp – use your hand!) and compare the carrier-to-noise ratios. Don't compare signal levels alone, since small variations in LNB gain don't matter.

After LNB noise the next big factor in the carrier-to-noise equation is the LNB's ability to discriminate against signals of the 'other' polarisation. Good cross-polarisation rejection makes a lot of difference to the BER.

To compare LNBs, find a really strong, steady signal at a frequency where the other polarisation is quiet. You might need to look at 13°E or 19·2°E. Rotate each LNB on the mount to find the position where the received signal is at its strongest, then at its weakest. The two positions should be 90° apart, and the ratio between the two signal levels is the LNB's cross-polarisation rejection. Ignore absolute levels: it's the ratio that matters. There will be very slight cross-polarisation 'leakage' at the satellite but, if you are carrying out comparative tests between LNBs, this doesn't matter.

Polarisation offset and crosstalk

I don't need to tell you that accurate dish alignment is vital: what about polarisation offset? This is the rotation of the LNB in its holder to get the polarisation exactly right. It's known as 'skew adjustment'. Once you have carefully selected an LNB with good cross-polarisation rejection it is vital to set the skew precisely. It's not so much a case of maximising signals of one polarisation as of minimising those of the other polarisation.

When you are certain that the dish is aligned for maximum carrier levels, find a transponder where two overlapping channels with opposite polarisation are in use. Slacken the clamp and rotate the LNB very slowly while reading the BER (bit-error ratio). This calls for a bit of patience. After each adjustment, take your hand away and allow any slight movement of the LNB arm to stabilise. It takes the instrument a little while to recalculate the BER each time. Poor cross-polarisation rejection greatly reduces the carrier-to-noise ratio and thus the BER, so the easiest way of carrying out this adjustment accurately is to monitor the BER.

Accurate polarisation offset adjustment is essential for distribution-system installation. If the system starts with a poor carrier-to-noise ratio, it is more or less doomed to failure – even when everything that follows is perfect.

After careful skew adjustment, signals of opposite polarisation should interfere with each other to a minimum extent, and this should continue all the way through the system. Cross-polarisation interference can occur inside the multiswitch, with the result that the BER worsens more than it should between the input to the switch and the output. This is easy to measure. The acid test is to remove three IF inputs to the switch while monitoring the BER of the output from the fourth input. If the BER improves significantly, the switch is of poor quality or defective.

The terrestrial input to the multiswitch should have no effect on the satellite BER, and should not show up on the analyser across the satellite IF band. This check should always be carried out. If any nasty little spikes appear, the first thing to suspect is, strangely, the analyser itself! I've come across several analysers with which spurious traces occur in the satellite IF band when the input includes strong UHF signals. Test for this by connecting the analyser to the output from the switch via a UHF/sat diplexer or a diplexed outlet. Once the analyser has been exonerated, check that the UHF signal levels are not too high for the switch, then look for strong signals in the range 950-2,050MHz via the aerial feed. If these are the cause of the trouble, use channel filters at the UHF output as discussed later.

Dishes and fixings

I know that some installers will use a minidish for a distribution system, but this is wrong. Apart from the reasons given above, a distribution system should always be planned and installed to a high standard. The minidish is the smallest dish that Sky thought it could get away with for domestic use. Minidishes provide very little margin for snow and heavy rain, and are built to a price rather than for longevity. System installers should see the minidish as what it is: a piece of domestic kit, ideal for its intended use, but not suitable for a commercial installation.

The dish used should be physically strong and accurately constructed. My personal recommendation is the Hirschmann range of solid offset dishes. They are wonderfully easy to assemble and are very strong. You will have to pay a bit more but, when you set the higher cost against the savings made by the extra reliability, it's really a no-brainer. Please don't use one of the ultra-cheap dishes. I have been called to countless systems where the dish has moved in the wind, the LNB arm has come loose or the reflector has become distorted, not because of incorrect installation but simply because of the poor quality of the product. If you find that your have to tighten a fixing more and more because the dish just doesn't seem secure, only to have the metal bend and buckle, maybe you should have used a better product!

Because a lot of my dishes are fixed on ground stands and masts I stock only pole-mounted dishes. If I do fix to a wall I use a pair of substantial wall brackets and a short length of 2in. diameter mast, as shown in Figs. 12, 13 and 14. Some dishes intended for wall mounting have good strong bracketry: those

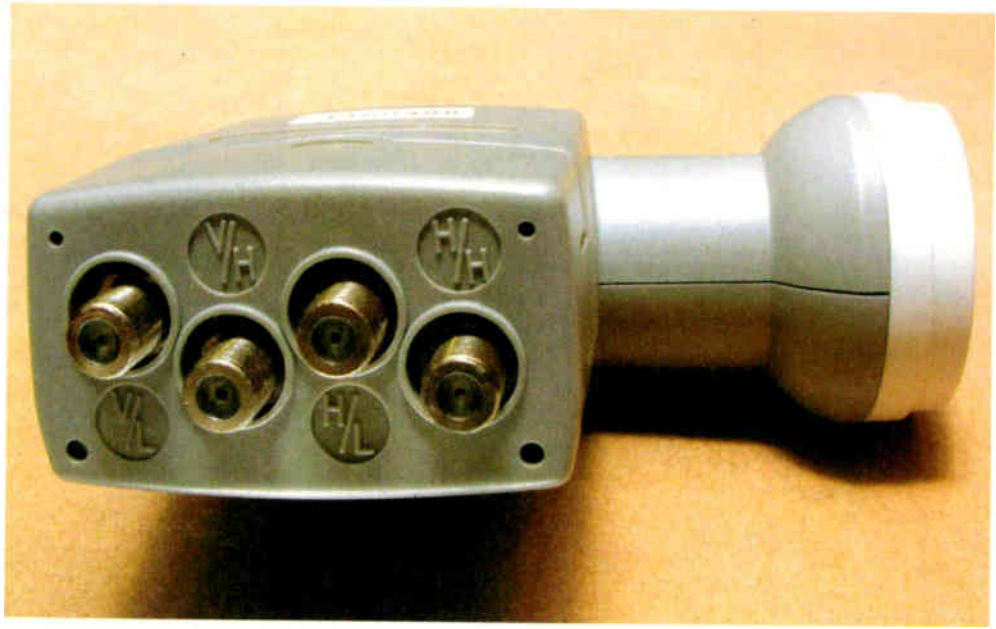


Fig. 11: A quattro LNB: the four fixed outputs are vertical low band, vertical high band, horizontal low band and horizontal high band.

Figs. 12 and 13: 65cm Hirschmann dishes fixed on T & K wall brackets.

Table 2: Suitable cables for distribution system use

Type	*Dielectric*	*Manufacturer/distributor*
CT100	Semi air-spaced polyethylene	Raydex
CTF100	Foam	Raydex
HYC100	Semi air-spaced polyethylene	Commtech
HYCF100	Foam	Commtech
QC100	Semi air-spaced polyethylene	Cavel/Ace
QF100	Foam	Cavel/Ace
WF100	Foam	Webro
H109F	Semi air-spaced polyethylene	Webro

All these cables have a copper inner conductor, copper braid and a copper foil wrap. They are just a few examples of the many makes available.

Fig. 14: A 75cm Hirschmann dish fixed on a pair of 600mm tripod stand-off brackets.

with a titchy little wall bracket should not be used. That sort of fixing is appropriate for domestic mini-dishes but not for anything larger.

If the dish is on a ground stand that relies on gravity to hold it in position the installation should be stable with substantial concrete anchors spaced well apart, as shown in Fig. 15. Fig. 16 shows an example of a bad installation.

Dish aesthetics

The sudden appearance of a satellite dish on a building can lead to surprisingly strong reactions from neighbours. A satellite dish is a relatively small fixture, of reasonably pleasing and harmonious shape, and it is of undoubtedly great use to the occupiers. In purely aesthetic terms it is certainly preferable to a massive TV aerial or an air-conditioning unit, and is arguably less offensive than a large security light, a CCTV camera, a basketball target or many of the other things that are fixed to the walls of residential buildings without a moment's thought. Alarm-system bell boxes are fixed in deliberately prominent positions on front elevations, are often painted in garish colours and sometimes have flashing lights, yet no one objects to their appearance. Huge yellow-and-black notices that warn local criminals to keep away, or threaten unwary souls who stop to buy a newspaper with wheel-clamping, are fixed in highly visible positions, and this is applauded by residents. Older apartment blocks glory in hideous external plumbing which is sometimes painted in a contrasting colour to show it off. Why then does the harmless satellite dish arouse such ire?

This isn't a matter of aesthetics of course, it's about cultural associations and straightforward, old-fashioned British snobbery. It's

true that in the early days those in social groups D and E took to Sky with greater enthusiasm than the rest of us. Satellite TV has broader appeal nowadays however and single dishes, sensitively positioned, have become as natural and inevitable a fixture on blocks of flats as gas flues.

Despite my rather cynical attitude towards the anti-dish brigade, I'm strongly in favour of installing dishes as unobtrusively as possible. It is certainly worthwhile spending some time in contemplation before actually commencing the installation. This is called "giving the job a good coat of looking at" and usually pays off. The only technical constraints are that the fixing must be secure, the dish must have a clear line-of-sight to the satellite, and there must be a cable route to the head-end. This leaves great scope for ingenuity, and it's surprising how often a good, tidy solution can be found.

Ideally the dish should be invisible or almost so. This isn't always possible of course but, even when the building faces south east, it is usually possible to find a location other than on the front wall. But beware of fixing to a side wall with the dish at right-angles to the masonry. This can look worse than a front-wall fixing, because the dish can be silhouetted against the sky. In addition the installation will be vulnerable to the strong gusts that can blow between buildings. Fixture to a north-facing wall with the dish on a mast that looks over the roof is usually a bad idea. After all the appearance of even the back of a building counts for something, and such an installation can look really terrible.

Before installing a dish it's best to discuss the proposed location with all concerned. A digital camera is a useful tool here. Take a shot of the building and simulate the proposed dish, using a photo-editing program. Special rules apply to listed buildings and conservation areas.

If residents have installed their own dishes, it's worth making the point that these will be removed and that one 75cm dish looks better than a dozen 55cm ones.

Although we've become used to hiding the dish as best we can, a curious counter-culture that can make this unnecessary or even undesirable has arisen in recent years. To Mr Modern and his partner, looking for an apartment property, certain appurtenances on the front of the building suggest coolness and high technology. First amongst these are CCTV cameras in ugly housings, followed by complicated door-entry systems and, of course, a rather large dish. It is apparently cool these days to live in a building that's rigged up like the Russian Embassy.

Cable

Judging from the emails I received following publication of my Coaxial Cable Quality article (January 2004), it seems a lot of people have found out the hard way that use of the wrong cable can cause serious problems. The frequency of satellite IF signals extends up to 2,050MHz: at these frequencies, poor-quality cable can be very lossy indeed.

It's essential to use good-quality cable. Raydex CT100 or a direct equivalent type is fine. Beware of cable that's sold as 'CT100-type': it usually has a cheap aluminium instead of a copper foil wrap. There are cables on the market with the words 'satellite' and 'digital' printed all the way along them. It proves nothing. This confusion, deliberately caused by sellers of inferior cable, means that you should personally inspect any cable that electricians are going to install on your behalf. I have had large buildings wired for me with poor-quality cable that has been labelled 'CT100'. This is pretty disastrous, because it can be impossible to make the system work if the cable runs are long. Table 2 lists suitable cable types.

All cable throughout the system should be CT100 or equivalent. The only exceptions are the next size up, CT125, for any very long downleads, or CT167 for tap-off lines and trunks (of which more later). The dish should if possible be close to the head-end: if it is more than about 20m away it is worth using CT125 for the four cables. Long downleads to the master outlets should be avoided if possible, but the building's layout often means that one or two downleads will be 30m or more in length – an example might be a sheltered housing scheme where the warden's house adjoins the main building. In such a case use CT125 cable for the long downleads. As it is difficult to connect CT125 cable to the outlet, there should be a change to CT100 cable close to the outlet, possibly in the roof space. Connect the two cables together with type F plugs and an F line connector. If in any doubt about the dryness of the location, wrap the joint with self-amalgamating tape. Do not use the CT63 cable now available for domestic Sky installations.

Treat the cable carefully. The signals will be affected if the cable is

Figure 15: This 65cm dish and log-periodic UHF aerial are fixed on to a steel groundstand. The groundstand is bolted to three concrete slabs which stand on rubber sheeting to protect the roof membrane.

Figure 16: A groundstand with a small base and no diagonal supports has very little strength. It should be used to support only a very modest load, and even then it needs to be bolted to a large piece of concrete, not to a pair of path edgings like this. It was possible to push this installation over with one finger!

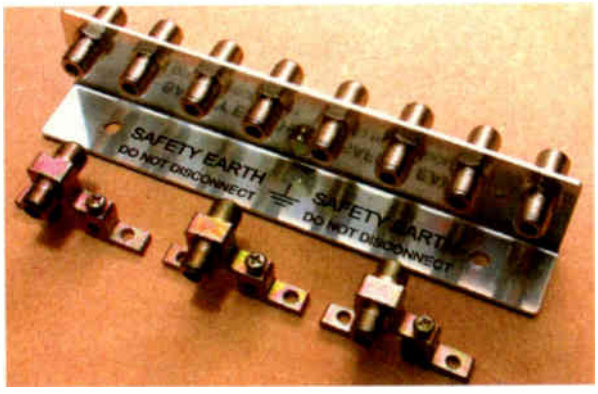


Fig. 17: At the rear, an eight-way earth-bonding strip; in the foreground, three one-way earth tags.

kinked, squashed or forced into a sharp bend. The ends of the cables installed during the 'first fix' must be sealed, because wet plaster will subsequently be applied to the walls near the backboxes. Cable ends left hanging down external walls ready for the dish should also be sealed.

Cables that run underground, even in a duct, must have a totally waterproof outer sheath. Such cables are usually distinguished by their green colour.

Earth bonding

It has for many years been the practice to use isolating outlet plates for communal TV systems. They have high-voltage capacitors in series with both conductors to provide safety isolation. Systems that use voltage and tone switching are obviously incompatible with such outlets so, as an alternative, these systems rely on earth bonding.

To protect the dwelling, every downlead is earth-bonded at its point of exit from the head-end or repeater. The theory, or hope, is that even if all active components were to be removed the earth bonding would remain intact. The earth conductor must have a cross-sectional area of 4mm. Resistance between any outlet and ground must be negligible. The relevant BS number is EN50083. The usual type of earthing rail has a row of F line connectors through which each downlead is routed, as shown in Fig. 17.

Fig. 18: A Sky receiver's signal-test display. Some residents may query the low signal-strength indication, but this has no real significance.

Sky+

Sky+ needs two independent feeds from the dish. With a distribution system this means two downleads and two multiswitch ports. It adds considerably to the cost, and at the moment many clients are balking at this. One solution for new-build projects is to install the extra downlead only, terminated at a single backbox next to the master socket. Fit a blank plate and, if any residents ask for Sky+, the outlet and multiswitch can be fitted – at a price.

Signal levels

Forget all you know about UHF system planning! Satellite IF distribution is quite different. All the signals originate from the LNB, which is analogous to a very high-gain UHF masthead amplifier that receives an adequate signal. By 'adequate' I mean 'not good'. This means that the carrier-to-noise ratio set by the LNB represents the best possible figure throughout the system: you can worsen it further down the system, but you can't improve it. The carrier-to-noise ratio will probably be only 10dB above threshold.

Compare this with a UHF system. The signals originate from an aerial of course and, if the field strength is good, the carrier-to-noise ratio at the aerial's terminals will be very high indeed – probably higher than you can measure. Assuming that there are no catastrophic errors at the head-end, such as the signal levels being reduced to pathetic levels and then reamplified, the only significant source of noise will be the tuners in the TV sets, VCRs and DVDRs. Thus as long as the system delivers adequate signal levels to each outlet everything should be fine.

But a satellite IF system has the noise sitting there, probably only 20dB below the carriers. So it's essential that the carrier-to-noise ratio is kept as high as possible throughout the system. Signals must enter amplifiers within the window where the balance of amplifier thermal noise and cross-modulation is optimal. Table 3 summarises the differences between UHF and satellite IF signal-level planning.

Satellite IF signal levels at the outlets can be very low indeed, compared to the LNB output, before receiver noise becomes a bigger factor than LNB noise. In other words, the LNB output signal levels are much higher than the receiver actually needs. The signal levels of the various transponders and LNB gain vary quite a bit, but a typical level at the LNB output would be 10-15dBmV. Receiver threshold also varies, but –20dBmV is typical. It is therefore possible to attenuate the LNB output by as much as 25 or 30dBmV before receiver noise becomes a serious factor and the receiver's BER starts to fall. So it is not necessary to provide signal levels equivalent to those at the LNB at each outlet. This might seem odd at first, but think of a UHF system where the aerial signals are very strong, perhaps 25dBmV or more. There would be no need to supply signals at that strength to the outlets.

This means that our little twelve-outlet system (see Fig. 2 last month) might need no satellite IF amplification other than that inside the multiswitch to compensate for the switch's internal loss. The total cable run from the LNB to the outlets via the multiswitch might be 30m, which means a loss of 9dB at 2,050MHz using CT100 cable. Even so the signal levels presented to the receivers will still be well above receiver threshold.

Fig. 18 shows a Sky receiver's signal-test display. As you can see, the signal-strength reading is low. This might cause protests from residents who regard themselves as clued up, especially if they had a dish with a short downlead at their previous address. In fact all multiplexes were entering the receiver at about 50dBμV, which is perfectly adequate. After taking the photograph I attenuated the dish feed a further 10dB with no effect on reception, though the signal-strength bar dropped to zero! You have to make the point to residents that it's the quality reading that matters.

Despite the ability of digital satellite receivers to operate satisfactorily with low signal input levels, it is not wise to plan a system so that the receivers are fed with signal levels which are not much above threshold. There are several reasons for this.

A good allowance must be made for rain fade. This is the attenuation of microwave signals caused by moisture in the atmosphere. The LNB is a straightforward frequency changer and amplifier. It does not have AGC, so variations in the off-air 11GHz signals will be mirrored exactly in the satellite IF signal levels. Levels can drop 6dB or more during heavy rain.

It's reasonable to plan the system on the basis that every outlet has about 0dBmV, or 60dBμV. This is over 10dB below the LNB output, but still a long way above the receiver threshold. The great advantage of this latter point is that you will avoid

Table 3: Comparison of the UHF and IF satellite aspects of a typical signal distribution system

Aspect	*UHF system*	*Satellite IF system*
C-n ratio at source	Normally very good (aerial)	Effort needed to ensure that the c-n ratio is adequate (LNB)
Most significant system c-n factor	Masthead amplifier (if used) or distribution amplifier at front-end	LNB/dish performance
Signal level at source	Varies. Often similar to outlet plate level	Always much higher than is necessary at the outlet plates
Typical downlead loss	1·7dB per 10m for group B	2dB per 10m at the bottom of the band, 3dB per 10m at the top of the band
Equalisation ratio	1:1·1 across ten channels (negligible) 1:1·4 if full band used	1:1·5 always needed
Adjustment of individual channel levels	Can normally be done easily where required	Not possible within a normal budget
Cross-modulation	It can be necessary to run the main amplifier at only 6dB below the cross-modulation threshold because of analogue signal levels	Not normally a problem with digital-only systems

many of the call-backs that are caused by things beyond your control. No matter how careful you are, there will always be response dips, or 'suck-outs' as the Americans call them, at some outlets. These are caused by multiswitch, connector, cable and wall plate peculiarities. If the signal levels are generally rather high these dips probably won't have any effect, a they are rarely more than 10dB deep.

Next month

We've now polished off the compact block of twelve flats. Next month we'll turn to a slightly more difficult installation. This will bring us to pre-amplifiers and other topics.

Sony's HDV camcorder

The Sony high-definition camcorder Model HDR-FX1E represents a significant advance in consumer camcorder technology. George Cole has been able to try one out. He reports on the new HDV format and the performance it achieves

There have been a number of landmarks in the development of consumer camcorders. DV (Digital Video) and MiniDV (smaller cassette) were a major advance in 1995. The launch of the Sony HDR-FX1E marks another significant step forward, being the world's first consumer camcorder to provide a high-definition (1,080 lines interlaced) recording mode. I had the opportunity to try one out recently, and found that there is without doubt a massive advance in picture quality.

It's a little over twenty years since Sony launched the first consumer camcorder, the BMC-100 Betamovie. It seems somewhat primitive in comparison with today's camcorders, having no playback facility or electronic viewfinder, but it was a tremendous technical achievement at the time. Since then a succession of new formats has resulted in smaller, lighter and smarter camcorders with ever-improving picture and sound quality, and digital recording has now replaced analogue as the norm. The world is now moving towards the adoption of high-definition TV, so it was inevitable that a high-definition consumer camcorder format would emerge at this time.

The HDV format

In July 2003 Canon, JVC, Sharp and Sony announced a new consumer camcorder format called HDV (High Definition Video). These companies represent a significant proportion of the camcorder market, so it's a safe bet that HDV will become the standard for high-definition consumer camcorders. Table 1 shows the basic HDV specifications.

The companies that have developed the HDV format have made it backwards compatible with the MiniDV format. This means that current digital camcorder users can move on to HDV without having to junk their existing recordings or transfer them to HDV. Backwards compatibility has been achieved by using cassettes that have the same dimensions as MiniDV tapes, also the same tape speed and track pitch.

An HDV camcorder can record HD video on standard DV tape, but a higher-grade tape is also available. HDV and DV recordings can both be made on the same cassette. Although HDV recordings contain four times as much information as DV recordings, the powerful compression system used means that both file sizes are the same. As a result, an hour of HDV recordings can be stored on a standard-sized 60-minute cassette.

By keeping to the same basic DV cassette specification, it's relatively easy for HDV manufacturers to incorporate DV recording and playback in an HDV camcorder. It looks as if all HDV camcorders will incorporate this feature, in the same way that all S-VHS camcorders and video recorders can play and record in the VHS mode.

The basic HDV format specification is in fact based on JVC's GR-HD1, an NTSC camcorder that was launched in 2003 and records in the 720-line progressive scan mode. HDV includes a variety of scan modes which manufacturers are free to incorporate in their products as they see fit. The progressive-scan mode can be set to 25, 30, 50 or 60 frames per second. The HDV specification also includes 1,080-line interlaced scanning at 50Hz or 60Hz. The aspect ratio is 16:9. There's no 4:3 option for HDV recording, but

when an HDV camcorder records in the DV mode there are 4:3 and 16:9 options.

MPEG-2 compression is used, and the data rate is 19Mbits/sec in the 720p mode and 25Mbits/sec in the 1,080i mode. Error correction works across multiple tracks rather than single tracks, which is claimed to improve the error correction drastically. Users are free to switch between HDV and DV while recording, and 1,080i pictures can be down-converted to a 576-line interlaced format for display on a standard TV set.

The audio track has two-channel stereo sound with MPEG-1 Layer II encoding, an improvement over the MP3 format. Sampling rate is 48kHz with 16-bit quantisation, the audio bit rate being 384kbits/sec. At the HDR-FX1E presentation a Sony representative claimed that HDV audio is "as good as CD": some audiophiles may take issue with this!

Why HDV?

The launch of the HDV format raises the questions why bother when there is no European HDTV system in operation and, in addition, how can users of the HDR-FX1E view high-definition recordings with today's TV sets? Sony points out that HDTV in Europe is closer than we might think.

Europe's first HDTV service, Euro 1080, has been in operation since January 1 via Astra 1H (19·2°E), using transponder 88 (12·168GHz). It's at present regarded as a demonstration service, intended for point-of-sale demonstrations in stores, and at cinemas. Transmission is in the 1,080i (1,080 lines interlaced), 50Hz mode, with MPEG-2 compression. It has recently been rebranded and provides two channels, HD1 which offers about 500 hours of sport, music, lifestyle and opera content on a looped basis; and an events channel, HDe, that broadcasts major sports events to demonstration cinemas around Europe. Astra owner SES launched an HDTV demonstration channel on September 1, also via the 1H satellite.

European broadcasters are gearing up for HDTV. BSkyB has announced plans to launch an HDTV service in 2006, with premium content such as sport and movies. The BBC has no official plans for an HDTV service, but has been building up HD content by filming some major costume dramas, sport and music events (such as The Proms) in HD form, and has demonstrated HDTV via the Freeview DTT service – the test transmission used Windows Media 9 compression, which enables data rates of 6-8Mbits/sec to be used in comparison with the 15-18Mbits/sec required for MPEG-2. Broadcasters are also looking at the use of MPEG-4 compression for HDTV services. In the UK the DTT spectrum is at present too crowded to include an HDTV service, but this could change when the analogue services are finally switched off and some fourteen frequencies become available. This autumn Sony is running an HD demonstration roadshow at fifteen venues around the UK, where the public will be given the chance to see HD images sourced from a Blu-ray player on a 50in. plasma screen.

In Germany Premiere plans to launch three HDTV channels in November 2005, showing sports, films and documentaries. In France TF1 is broadcasting HDTV programmes via satellite and plans to launch an HD DTT channel by the end of 2005. TPS Star is also to launch an HD service next year. There is speculation that eight of France's 36 DTT channels could be allocated to HDTV. Industry forecasts suggest that there could be some 17·4m HDTV households by 2008.

HDTV has now been available for five years in the US, both via satellite and DTT. Since July 2004 all new large-screen sets (36in. and above) have had to include a built-in digital tuner. In 2007 products such as VCRs, DVD recorders and all TV sets will have to have an integrated digital tuner. The aim in the US is to switch off analogue transmissions in 2006, though many believe that it will be much later than this. Nevertheless HDTV coverage already extends to over 99 per cent of the population and, at October 2003, there were 1,060 HDTV stations on air in the US.

But what about viewing HD content? Watch out for more and more flat-panel displays described as "HDTV-ready", i.e. able to display images with HD resolution. Sony says that its latest range of Wega Engine TV sets are HD compatible. It includes two LCD models (KLV-21SG2 and KLV-26H96) and four plasma models (KE-P42XS1, KE-P37XS1, KDE-P42XS1 and KDE-P37XS1 – the latter two incorporate a digital TV tuner).

The HDR-FX1E

The HDR-FX1E HDV camcorder is an impressive-looking piece of equipment that weighs 2kg without battery and tape. Sony says that a Handycam version is under development. It has three 1·12 Megapixel (1·07 effective) CCD image sensors and uses a Carl Zeiss Vario-Sonnar T lens. Other features include a 12x optical zoom, an optical image stabiliser, a 3·5in.hybrid 16:9 LCD monitor and six preset modes. AV (in/out) connections consist of IEEE 1394 (iLink), component video and S video. There are also microphone,

Sony's new HDV camcorder.

Table 1: Main HDV format specifications

Storage medium	Same as DV format, DV or MiniDV cassette
Video signal	720/25/30/50/60 lines/Hz progressive or 1,080/50/60 lines/Hz interlaced
Number of pixels	1,280 x 720 with progressive scanning, 1,440 x 1,080 with interlaced scanning
Aspect ratio	16:9
Video compression	MPEG-2 video (profile and level MP@H-14)
Luminance sampling frequency	74·25MHz with progressive scanning, 55·7MHz with interlaced scanning
Video sampling format	4:2:0
Video quantisation	8 bits for both luminance and chrominance
Video bit rate after compression	About 19Mbits/sec with progressive scanning, 25Mbits/sec with interlaced scanning
Audio compression	MPEG-1 Audio Layer II
Audio sampling frequency	48kHz
Audio quantisation	16 bits
Audio bit rate after compression	384kbits/sec
Audio mode	Two-channel audio
System data format	MPEG-2 systems
Stream type	Transport stream with progressive scanning, packetised elementary stream with interlaced scanning
Stream interface	IEEE 1394 (MPEG-2TS)

headphone and LANC jacks. USB streaming is also possible.

Despite its size the HDX-FX1E is comfortable to hold, and an optional shoulder mount makes it more so. There's a wide range of manual options, including focus, exposure, white balance, gain and shutter speed. When you open up the LCD screen the electronic viewfinder becomes inactive: this is done to save battery power. Likewise when the LCD is folded away the viewfinder comes into operation. A neat touch is that many of the controls are duplicated at the top of the carrying handle. This is very useful when, for example, taking shots from a low angle.

Sony allowed a group of us to wander around Lake Como, Italy with the camcorder and record a variety of footage. This was viewed on a large-screen plasma TV set. Picture quality was superb, with vibrant colours and super-fine detail – it really is a leap forward in home video. There are also various useful effects, including a very neat system that enables you to set up and store two different shots in the camcorder's memory and then merge the two seamlessly.

A number of editing software companies were present at the launch, including Adobe, Apple and Pinnacle. They were showing updated versions of their products designed for HDV use. Sony also demonstrated a number of its Vaio PCs that are HD-ready. Although HDV images have the same file size as DV images, a PC has to work harder to decompress the footage then display it. So you need quite a powerful PC to handle HDV material.

During a question and answer session I asked why it had been decided to use tape rather than disc for the HDV format – a professional version of HDV is disc-based. The answer given was that tape is more affordable and provides higher storage capacity, so it makes good sense to use tape. One puzzle was whether the HDR-FX1E can play back 720-line progressive-scan recordings, though it doesn't offer 720p recording. We were told that it can.

The HDR-FX1E goes on sale this autumn, priced at about £3,000. So it certainly isn't a mass-market product at this stage. But more affordable and compact HDV camcorders can be expected to appear during the next year or so.

On paper at least HDV looks like the next step for consumer camcorders, but it could face competition from camcorders that use alternative storage technology – a hard disk, solid-state memory or an optical-disc system (a Blu-ray camcorder is a possibility). Any competing format would have to use a high-capacity recording medium that's affordable: at present tape is still the most cost-effective option.

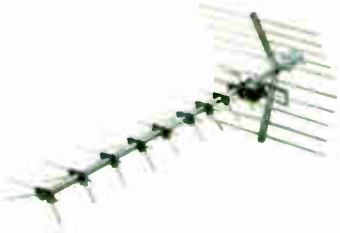
I have to report that after using an HD camcorder and seeing the results, going back to standard-definition products is like going from colour to black-and-white. ■

An HDV recording displayed on a plasma screen.

Grandata Ltd

distributor of electronic components

48 Element Digital Compatible Aerial



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For poor to weak strength signal areas

Robust design for low wind loading - 2 peices boom with aluminium wire rod elements

Supplied with F connector and clamp for horizontal and vertical (fits up to 57mm masts)

Ideal for areas with bad picture ghosting

Supplied part assembled - no tools required

Order Code : 27884R **Price : £ 20.00 + vat**

Carriage charged at £ 6.00 + vat

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UHF TV and FM radio antenna preamplifiers designed for professional aerial installers.

1 way amplifiers come with screw terminals

2 and 4 way ampliflers come with F connectors

Requires 12V DC power supply connected via a downlead

Description	Gain	Order Code	Price
1 way UHF TV Masthead Amplifier	15dB	27830R	£ 4.30 + vat
1 way UHF TV Masthead Amplifier	26dB	27831R	£ 4.50 + vat
2 way UHF TV Masthead Amplifier	10dB	27837R	£ 9.00 + vat
4 way UHF TV Masthead Amplfier	10dB	27838R	£ 9.50 + vat
4 way UHF TV & FM Masthead Amplifier	10dB	27839R	£ 10.00 + vat
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A range of Aerial amplifers designed to allow distribution of TV , Satellite and FM signal without the loss of picture and sound quality.

Available with intergrated Digital bypass - to allow the use of SKY™ digieye (B).

Main Operated , comes with full instructions

Description	Gain	Order Code	Price
2 way	18dB	SLX2	£ 8.00 + vat
2 way with Bypass	6dB	SLX2B	£ 9.25 + vat
4 way	12dB	SLX4	£ 13.00 + vat
4 way with Bypass	6dB	SLX4B	£ 14.00 + vat
6 way	12dB	SLX6	£ 18.00 + vat
6 way with Bypass	6dB	SLX6B	£ 19.00 + vat
8 way	12dB	SLX8	£ 18.50 + vat
8 way with Bypass	6dB	SLX8B	£ 20.00 + vat

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Combines TV , FM , DAB , CCTV & Satellite signals on to one down cable for feeding into a triplexed faceplate.

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Integrated digitial bypass for Sky™ digital feature - Intergrated UHF pre-amplifier - Intergrated power supply

Fully screened - Available in 4 way and 8 way distribution

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8 way System
Order Code : 27856R
Price : £ 45.00 + vat

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Coax Plug Aluminium

Order Code : PLG51
Bag of 10
Price : £ 1.25 + vat
Bag of 100
Price : £ 9.00 + vat

Screw Type Coax Plugs

Order Code : PLG62
Bag of 10
Price : £ 1.60 + vat
Bag of 100
Price : £ 12.50 + vat

Twist on F Connectors

Order Code : PLG101
Bag of 10
Price : £ 1.00 + vat
Bag of 100
Price : £ 6.00 + vat

Screened Triplexed Outlet with UK Faceplate

Flush Outlet with satellie F outlet , TV (male) and FM (female) coaxial outlets

Intergral filter seperates FM , UHF and satellite signal from one downlead

For use with the above distribtuion systems

Order Code : 27965U
Price : £ 4.50 + vat

Satellite Finder

Allows the user to find the best azimuth / elevation settings for a satellite dish , resulting in the best signal reception / picture and sound quality

Compact design - Backlit meter scale - Audible signal strength reading

Adjustable level control - Adjustable sensitivity adjustment

Frequency Range : 950 - 2250Mhz

Order Code : 27860R **Price : £ 10.00 + vat**

K.P. House , Unit 15 , Pop In Commercial Centre , Southway , Wembley , Middlesex . HA9 0HB England

Tel: (020) 8900 2329 Fax : (020) 8903 6126 Email : sales@grandata.co.uk

Aerial Installation Accessories

Grandata Ltd

distributor of electronic components

Transistors / Linear IC's

Part No.	Price
2N2222	£0.23
2N2223	£7.50
2N2369	£0.15
2N2484	£0.15
2N2646	£0.40
2N2857	£1.75
2N2904	£0.20
2N2905	£0.20
2N2906	£0.18
2N2907	£0.18
2N3019	£0.28
2N3053	£0.18
2N3054	£0.40
2N3055	£0.50
2N3055H	£0.75
2N3375	£15.00
2N3439	£0.40
2N3440	£0.45
2N3441	£1.75
2SA1015	£0.10
2SA1016	£0.15
2SA1020	£0.20
2SA1085	£0.50
2SA1266	£0.25
2SA1294	£4.50
2SA1295	£3.00
2SA1302	£3.00
2SA1306	£1.10
2SA1360	£0.45
2SA1492	£2.60
2SA1706	£0.25
2SA1943	£2.75
2SA673	£0.15
2SA872A	£0.20
2SA968	£0.55
2SA970	£0.25
2SA985	£0.35
2SB1109	£0.20
2SB1186	£0.55
2SB1237	£0.20
2SB1243	£0.40
2SB1342	£2.00
2SB1370	£0.25
2SB1429	£2.20
2SB1560	£4.00
2SB324	£0.40
2SB554	£1.50
2SB560	£0.25
2SB631	£0.40
2SB648	£0.15
2SB649	£0.35
2SB681	£1.00
2SB688	£0.70
2SB717	£0.15
2SB772	£0.25
2SB795	£0.25
2SB817	£1.75
2SB824	£0.60
2SB861	£1.10
2SB892	£0.25
2SB942	£0.15
2SB986	£0.30
2SC1384	£0.20
2SC1740	£0.10
2SC1815	£0.10
2SC1846	£0.35
2SC1969	£1.60
2SC2023	£0.70
2SC2026	£0.30
2SC2078	£0.95
2SC2166	£0.80
2SC2238	£0.45
2SC2240	£0.15
2SC2259	£0.40
2SC2314	£0.70
2SC2335	£0.35
2SC2362	£0.10
2SC2412	£0.50
2SC2546	£0.10
2SC2577	£0.60
2SC2621	£0.30
2SC2625	£1.90
2SC2632	£0.35
2SC2655	£0.50
2SC2688	£0.15
2SC2837	£0.90
2SC2921	£2.50
2SC2922	£3.00
2SC2988	£1.00
2SC3052	£0.15
2SC3182	£1.20
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2SC3203	£0.25
2SC3225	£0.50
2SC3262	£2.80
2SC3264	£3.90
2SC3281	£2.00
2SC3303	£0.20
2SC3306	£1.30
2SC3423	£0.60
2SC3467	£0.70
2SC3506	£1.00
2SC3591	£2.00
2SC3688	£2.00
2SC3795	£0.30
2SC3851	£1.00
2SC3852	£0.25
2SC3856	£0.60
2SC3940	£0.40
2SC3953	£0.20
2SC4123	£1.10
2SC4124	£1.10
2SC4137	£0.40
2SC4138	£0.75
2SC4278	£0.60
2SC4429	£2.75
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2SC5027	£1.00
2SC5143	£2.00
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2SC5200	£3.25

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2SC5387	£3.50
2SC5411	£3.50
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2SC710	£0.15
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2SD1207	£0.10
2SD1407	£0.60
2SD1441	£2.20
2SD1554	£1.70
2SD1555	£1.50
2SD1556	£2.25
2SD1577	£2.50
2SD1651	£1.50
2SD1763A	£0.60
2SD1878	£1.60
2SD1879	£2.75
2SD1880	£3.60
2SD1887	£2.25
2SD2144	£0.35
2SD2253	£2.75
2SD2391Q	£0.45
2SD2498	£2.25
2SD2499	£1.50
2SD2539	£2.75
2SD2553	£4.00
2SD2599	£1.50
2SD551	£1.70
2SD600	£0.30
2SD667	£0.20
2SD669	£0.35
2SD718	£0.65
2SD756	£0.40
2SD837	£0.40
2SD863	£0.23
2SD882	£0.25
2SD921	£3.20
2SD947	£0.40
2SD965	£0.35
BFQ162	£1.00
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BFQ252A	£0.60
BFQ255A	£0.75
BFQ262A	£0.75
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BFR91	£0.99
BFY50	£0.14
BFY51	£0.14
BFY56	£0.25
BFY64	£0.25
BFY90	£2.00
BU108	£1.00
BU1508AX	£1.30
BU1508DX	£1.05
BU180	£1.00
BU184	£1.00
BU208A	£0.75
BU208D	£1.30
BU226	£1.20
BU2506DF	£0.90
BU2506DX	£1.00
BU2508A	£1.00
BU2508AF	£1.10
BU2508AX	£1.30
BU2508D	£1.30
BU2508DF	£1.20
BU2508DX	£1.50
BU2520AF	£1.70
BU2520AX	£1.40
BU2520DF	£2.25
BU2520DX	£2.00
BU2522AF	£2.00
BU2522AX	£1.50
BU2525A	£3.25
BU2525AF	£2.20
BU2525AW	£2.50
BU2525AX	£1.90
BU2525D	£2.40
BU2525DF	£1.75
BU2527AF	£4.00
BU2527AX	£2.50
BU2527DF	£2.00
BU2527DX	£2.00
BU2532AL	£3.25
BU2708AF	£2.00
BU2708AX	£2.00
BU2708DF	£2.00
BU2708DX	£2.00
BU2720AX	£2.00
BU2720DF	£2.00
BU2720DX	£2.00
BU2722AF	£3.30
BU2725AF	£2.00
BU2725DF	£2.00
BU2727A	£2.00
BU2727AF	£2.00
BU2735AS	£11.00
BU326A	£0.75
BU406	£0.60
BU406D	£0.85
BU407	£0.55
BU407D	£0.75
BU408	£0.60
BU408D	£0.75
BU409	£0.85
BU415A	£1.70
BU415B	£1.70
BU426A	£0.70
BU4508AF	£2.00
BU4525AX	£3.00
BU505	£0.90
BU505D	£0.90
BU505DF	£0.90
BU506	£1.00
BU506DF	£1.00
BU508AF	£0.60
BU508APH	£0.60
BU508AXI	£0.90
BU508D	£0.75

Part No.	Price
BU508DF	£0.85
BU508DFI	£2.00
BU508DR	£1.30
BU808DF	£2.10
BU808DFI	£2.50
BU826A	£1.60
BUH1015	£4.25
BUH1215	£4.50
BUH515	£2.00
BUH515D	£2.50
BUH517	£2.75
BUH517D	£1.75
BUH715	£4.25
BUK436 / 800B	£2.75
BUK437 / 400B	£2.75
BUK437 / 600B	£3.00
BUK438 / 800B	£3.10
BUK444 / 500B	£2.00
BUK444 / 800B	£2.00
BUK445 / 600B	£2.00
BUK446 / 800B	£4.00
BUK454 / 800A	£2.00
BUK455 / 600B	£2.00
BUK456 / 200B	£2.00
BUK456 / 600A	£2.00
BUK456 / 60A	£2.00
BUK456 / 800A	£2.00
BUK457 / 600B	£2.00
BUK555 / 60B	£2.00
BUL310	£1.25
BUL381	£1.50
BUL381D	£1.25
BUT11A	£0.35
BUT11AF	£0.35
BUT11AX	£0.50
BUT12	£0.80
BUT12A	£0.80
BUT12AF	£0.90
BUT18	£0.80
BUT18A	£0.80
BUT18AF	£0.65
BUT56A	£0.65
BUT56AF	£2.00
BUZ71	£0.75
BUZ71AF	£1.00
BUZ72A	£1.00
BUZ72AF	£1.00
BUZ73A	£1.50
BUZ73AF	£0.60
BUZ76A	£1.10
BUZ77A	£2.00
BUZ77B	£2.50
BUZ80	£1.35
BUZ80AF	£2.00
BUZ83	£2.00
BUZ90	£1.50
BUZ900	£10.00
BUZ900P	£10.00
BUZ901	£15.00
BUZ905	£10.00
BUZ905P	£10.00
BUZ906	£16.00
BUZ90A	£1.80
BUZ90AF	£2.80
BUZ91A	£2.60
BUZ93	£1.50
IRF120	£2.25
IRF130	£4.75
IRF140	£5.50
IRF230	£5.50
IRF240	£4.25
IRF250	£3.75
IRF251	£6.50
IRF3205	£2.00
IRF330	£6.00
IRF340	£3.25
IRF350	£7.50
IRF440	£5.50
IRF450	£6.50
IRF510	£0.70
IRF520	£0.75
IRF530	£0.75
IRF540	£1.00
IRF5450	£5.00
IRF5740	£3.00
IRF5840	£3.00
IRF610	£0.80
IRF611	£1.20
IRF620	£1.00
IRF630	£0.75
IRF630S	£2.00
IRF634	£1.25
IRF640	£1.50
IRF644	£2.00
IRF650	£2.00
IRF710	£1.50
IRF720	£0.85
IRF730	£1.25
IRF740	£0.90
IRF740F	£3.00
IRF820	£0.90
IRF830	£0.85
IRF830F	£1.60
IRF840	£0.85
IRF840F	£1.75
IRF9140	£10.00
IRF9230	£4.00
IRF9510	£1.50
IRF9511	£1.50
IRF9520	£1.50
IRF9530	£1.25
IRF9531	£2.00
IRF9540	£1.75
IRF9541	£2.00
IRF9610	£0.95
IRF9620	£0.85
IRF9622	£2.00
IRF9630	£1.30
IRF9640	£2.30
IRFBC20	£1.10
IRFBC30	£1.20
IRFBC40	£2.10
IRFBE30	£2.25

Part No.	Price
IRFD120	£1.00
IRFD9120	£1.20
IRFD9220	£1.00
IRFF120	£3.00
IRFIBC40	£1.00
IRFIBC40G	£2.00
IRFP054	£4.00
IRFP064	£5.00
IRFP140	£2.50
IRFP150	£2.40
IRFP240	£3.00
IRFP250	£2.80
IRFP260	£3.50
IRFP340	£2.50
IRFP350	£3.25
IRFP360	£8.00
IRFP450	£2.70
IRFP460	£4.00
IRFP9140	£4.50
IRFP9240	£3.00
IRFPC40	£3.00
IRFPC50	£4.50
IRFPC60	£6.00
IRFPE40	£5.50
IRFPE50	£4.50
IRFPF40	£5.50
IRFPF50	£4.50
IRFS740	£1.75
IRFS840	£1.25
IRFZ42	£2.75
IRFZ44	£1.60
IRFZ46N	£1.50
IRFZ48	£2.75
MJ1000	£1.00
MJ10001	£7.00
MJ10005	£4.00
MJ1001	£2.00
MJ10012	£2.00
MJ10016	£7.00
MJ11015	£2.50
MJ11016	£3.00
MJ11032	£8.00
MJ11033	£8.00
MJ15003	£2.50
MJ15004	£3.00
MJ15015	£2.50
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MJ15022	£4.00
MJ15023	£4.00
MJ15024	£3.00
MJ15025	£3.00
MJ2955	£0.55
MJE13004	£1.00
MJE13005	£0.60
MJE13007	£1.00
MJE13009	£1.00
MJE15028	£2.00
MJE15029	£2.00
MJE15030	£2.50
MJE15031	£4.00
MJE16002	£3.00
MJE18004	£1.25
MJE18006	£1.20
MJE18008	£1.50
MJE243	£0.60
MJE253	£0.85
MJE340	£0.25
MJE350	£0.80
MJF16206	£4.50
MJF18004	£1.75
MJF18006	£2.00
MJF18008	£1.75
MJF18204	£2.50
MJW16018	£5.50
MJW16206	£6.00
MJW16212	£5.00
P16NE06	£1.25
P16NE06F	£1.50
P3NA60	£1.50
P4NB100	£3.50
P4NB80	£2.50
P4NB80FP	£2.00
P4NB90FP	£4.00
P4NC60	£1.75
P4NC60FP	£2.00
P5NB60FP	£2.00
P5NB80	£2.50
P5NB80FP	£3.00
P6N60	£2.00
P7NB40	£1.75
P7NB60FP	£2.00
P9NB60	£2.00
P9NB60FP	£4.00
S2000A	£1.75
S2000A3	£1.75
S2000AF	£0.90
S2000N	£1.50
S2055A	£1.75
S2055AF	£1.75
S2055N	£1.50
S2530A	£1.00
STA301A	£2.00
STA341M	£1.80
STA401A	£2.20
STA402A	£2.00
STA403A	£2.70
STA434A	£2.70
STA441C	£2.20
STA451C	£2.80
STA471A	£2.00
STA8012	£2.70
STA901M	£2.80
STK0025	£4.20
STK0039	£6.00
STK0040	£5.20
STK0049	£5.10
STK0050	£8.00
STK0059	£5.00
STK0080	£6.00
STK0100 II	£12.00
STK015	£4.40
STK020	£11.00
STK025	£4.00

Part No.	Price
STK040	£7.00
STK078	£18.00
STK080	£5.50
STK082	£20.00
STK084	£6.00
STK085	£9.00
STK086	£10.00
STK1039	£4.60
STK1040	£5.00
STK1049	£5.00
STK1050	£6.50
STK1060	£6.50
STK2025	£6.20
STK2028	£5.00
STK2029	£6.00
STK2030	£7.00
STK2038	£7.00
STK2058 IV	£16.00
STK2101	£5.00
STK2110	£3.50
STK2129	£7.50
STK2230	£7.00
STK2240	£7.40
STK2250	£6.50
STK2260	£9.50
STK3044	£5.00
STK3082	£4.00
STK3152 II	£9.00
STK3156	£5.00
STK350-030	£7.00
STK392-020	£8.00
STK392-040	£12.00
STK392-110	£8.00
STK400-040	£8.00
STK401-040	£7.00
STK401-050	£8.00
STK401-080	£9.00
STK401-120	£10.00
STK401-130	£7.50
STK401-140	£12.00
STK4017	£4.00
STK4019	£3.00
STK402-040	£7.00
STK402-070	£7.00
STK402-071	£7.00
STK402-090	£8.00
STK4021	£3.80
STK402-100	£9.00
STK402-120	£9.00
STK4024 II	£5.50
STK4025	£5.30
STK4026	£4.80
STK4026II	£4.80
STK4036	£4.70
STK4036V	£8.00
STK4038	£6.80
STK4040 II	£6.50
STK4042 II	£8.00
STK4046	£9.50
STK4048	£12.80
STK4048V	£12.00
STK4050 II	£16.00
STK405-030	£7.00
STK405-040	£6.50
STK405-050A	£12.00
STK405-070A	£8.00
STK405-090	£7.00
STK4050V	£15.00
STK405-100	£7.00
STK405-120	£11.00
STK4060	£4.00
STK4065	£6.50
STK407-040	£7.00
STK407-050	£8.50
STK407-070	£8.50
STK407-090	£8.50
STK407-710	£8.50
STK4101	£5.00
STK4111	£3.00
STK4112	£3.00
STK411-210	£10.00
STK411-220	£10.00
STK411-230	£12.00
STK411-240E	£14.00
STK412-010	£12.00
STK412-040	£10.50
STK4121	£4.80
STK412-150	£18.50
STK412-170	£18.00
STK4122	£5.60
STK4130 II	£5.00
STK4131	£3.00
STK4132 II	£6.00
STK4133 II	£7.50
STK4140 II	£4.00
STK4141 II	£4.20
STK4141 V	£6.00
STK4142	£5.30
STK4147 II	£14.50
STK4150 II	£8.50
STK4151	£6.80
STK4151V	£10.00
STK4151X	£10.00
STK4152	£6.50
STK4154V	£14.00
STK4161	£6.50
STK4161V	£8.50
STK4162	£5.50
STK4164 II	£11.75
STK4171	£6.50
STK417-120A	£10.00
STK417-130	£15.00
STK4171V	£8.00
STK4172 II	£6.80
STK4181	£6.80
STK4181V	£7.00
STK4182 II	£9.00
STK4191	£9.00
STK4191 X	£14.00
STK419-130	£15.00
STK419-140	£16.00
STK419-150	£10.00
STK4191V	£8.00

Part No.	Price
STK4192	£7.00
STK4197 II	£9.50
STK4199 II	£6.50
STK4204 II	£7.00
STK4211 II	£10.00
STK4211 V	£8.00
STK4221 II	£8.00
STK4231 II	£10.50
STK4241 V	£12.50
STK4272	£4.00
STK4273	£5.00
STK4274	£3.00
STK4301	£3.00
STK433	£3.00
STK4332	£3.00
STK435	£3.00
STK4352	£2.50
STK436	£4.30
STK4362	£4.50
STK437	£4.00
STK4372	£3.50
STK439	£5.00
STK4392	£4.00
STK442-110	£8.50
STK442-120	£11.00
STK442-130	£11.00
STK443	£7.00
STK4432	£4.00
STK457	£3.00
STK459	£5.60
STK461	£6.00
STK463	£9.50
STK465	£9.00
STK470-040	£10.00
STK4773	£8.20
STK4793	£5.50
STK4803	£9.00
STK4813	£5.50
STK4833	£8.50
STK4843	£7.20
STK4873	£4.00
STK488-010	£8.00
STK488-020	£6.50
STK488-050	£8.00
STK4893	£10.00
STK490-010	£7.00
STK490-040	£5.00
STK490-070	£8.00
STK490-310	£7.00
STK501	£5.50
STK5314	£3.00
STK5315	£4.00
STK5323	£4.00
STK5324	£2.00
STK5325	£3.00
STK5326	£3.00
STK5330	£4.00
STK5332	£1.50
STK5333	£3.00
STK5335	£2.00
STK5336	£2.80
STK5337	£2.00
STK5339	£4.00
STK5342	£1.00
STK5343	£1.00
STK5352	£2.50
STK5353	£2.50
STK5361	£3.75
STK5362	£4.00
STK5364	£1.50
STK5371	£2.50
STK5373	£2.20
STK5383	£3.00
STK5392	£5.00
STK5422	£3.75
STK5431	£4.10
STK5434	£3.50
STK5436	£3.00
STK5441	£2.60
STK5443	£3.00
STK5446	£3.50
STK5451	£3.90
STK5461	£3.00
STK5462	£2.30
STK5464	£2.50
STK5466	£3.00
STK5467	£4.00
STK5468	£3.00
STK5471	£5.00
STK5472	£2.00
STK5474	£2.50
STK5476	£2.00
STK5477	£4.00
STK5478	£1.75
STK5479	£2.60
STK5481	£3.00
STK5482	£1.50
STK5483	£3.00
STK5486	£3.50
STK5488	£3.50
STK561	£3.00
STK563	£3.00
STK5632	£2.40
STK5720	£2.50
STK5725	£2.50
STK5730	£2.50
STK583	£3.20
STK6316	£3.00
STK6324B	£3.80
STK6327	£4.00
STK6328A	£2.80
STK6431	£3.80
STK6607	£4.00
STK6722	£5.50
STK6732	£5.00
STK6822	£6.00
STK6875	£3.50
STK6932	£3.60
STK6962	£2.75
STK6972	£1.80
STK6981B	£3.50
STK6982	£3.00
STK6982H	£3.20

Part No.	Price
STK7216	£2.80
STK7217	£1.50
STK7225	£5.00
STK7226	£17.00
STK7233	£7.00
STK7251	£5.00
STK7253	£6.50
STK730-010	£5.00
STK730-020	£5.00
STK730-060	£6.50
STK730-080	£6.00
STK730-090	£6.00
STK730-110	£6.50
STK7308	£2.00
STK7309	£2.80
STK7310	£2.70
STK7340S II	£3.00
STK7410	£2.00
STK7410 II	£2.00
STK7348	£2.00
STK7356	£4.25
STK7358	£4.40
STK7359	£4.25
STK7360S	£3.75
STK7390T	£7.00
STK7390S	£2.50
STK7402	£4.00
STK7404	£2.00
STK7408	£4.00
STK7410	£6.50
STK7458	£12.50
STK746	£4.50
STK752	£0.70
STK7554	£3.00
STK7561	£6.50
STK7561A	£7.00
STK7562	£10.00
STK7563	£4.00
STK7563F	£4.00
STK7573	£1.80
STK7576	£15.00
STK760	£4.00
STK761	£1.00
STK770	£2.80
STK7703	£10.00
STK7707	£4.00
STK772	£5.00
STK772B	£3.00
STK780	£2.70
STK78603	£5.00
STK78617	£24.00
STK795	£1.60
STK79917	£4.00
STK8050	£16.00
STK8250	£5.00
STK8260	£7.50
STK8280	£4.00
STR10006	£4.50
STR10008	£6.00
STR1096	£2.75
STR11006	£3.25
STR1195	£3.50
STR12006	£3.50
STR1229	£3.25
STR13006	£4.20
STR15006	£4.00
STR16006	£5.00
STR17006	£5.00
STR20005	£4.50
STR20012	£3.00
STR20013	£3.00
STR20015	£3.00
STR2005	£3.00
STR2012	£2.60
STR2013	£2.20
STR2015	£3.50
STR2024	£3.00
STR2105	£4.00
STR2124	£6.75
STR30110	£3.30
STR30115	£2.75
STR30120	£2.50
STR30123	£3.50
STR30125	£2.50
STR30130	£2.50
STR3105	£4.50
STR3113	£2.25
STR3115	£4.00
STR3123	£4.00
STR3125	£4.80
STR3126	£3.50
STR3130	£5.00
STR3135	£2.50
STR3212	£2.75
STR3214	£2.75
STR3215	£2.75
STR3315	£2.75
STR370	£2.50
STR371	£3.00
STR380	£3.50
STR381	£3.50
STR383	£3.10
STR384	£3.50
STR40090	£3.50
STR40115	£3.00
STR4090A	£6.50
STR41090	£3.30
STR4142	£4.50
STR4211	£3.15
STR43111	£4.00
STR440	£3.00
STR441	£9.50
STR44111	£3.50
STR44115	£4.75
STR442	£9.00
STR450A	£5.00
STR451	£8.00
STR45111	£4.00
STR4512	£4.00
STR452	£4.00
STR453	£4.00
STR454	£3.00
STR455	£4.00

Part No.	Price
STR456	£3.00
STR457	£4.00
STR470	£2.00
STR50020	£3.50
STR50092	£5.50
STR50103A	£2.60
STR50112A	£3.00
STR50113	£4.00
STR50115	£5.00
STR50130	£3.50
STR5015	£5.00
STR50213	£3.00
STR50215	£3.50
STR50330	£3.00
STR5100	£5.50
STR51041	£3.50
STR51213	£3.00
STR51424	£7.00
STR5214	£4.75
STR53041	£2.50
STR5315	£5.75
STR54041	£3.20
STR5412	£1.25
STR55041	£3.00
STR56041	£5.50
STR58041	£2.50
STR59041	£3.00
STR80001	£5.25
STR6008X	£5.75
STR6020	£1.20
STR61001	£3.00
STR7001	£6.00
STR80145	£3.00
STR81145	£2.00
STR81159	£4.00
STR8124	£3.00
STR83145	£2.00
STR83159	£4.00
STR9005	£2.00
STR9012	£2.00
STR90120	£4.25
STRD1005T	£3.00
STRD1206	£3.50
STRD1406	£3.50
STRD1706	£2.30
STRD1806	£3.60
STRD1816	£3.50
STRD1906	£3.50
STRD3035	£2.30
STRD4412	£2.00
STRD4420	£2.00
STRD4512	£3.00
STRD5095A	£6.00
STRD5441	£4.75
STRD5541	£3.00
STRD6008	£3.00
STRD6009E	£3.00
STRD6108	£4.50
STRD6202	£4.00
STRD6601	£3.50
STRD6602	£4.75
STRD6801	£2.50
STRD6802	£2.50
STRF5654	£6.00
STRF6454	£6.50
STRF6523	£7.00
STRF6524	£4.00
STRF6535	£6.50
STRF6552	£2.00
STRF6653	£7.00
STRF6654	£4.50
STRF6655	£4.50
STRF6656	£8.00
STRF6707	£8.00
STRG6153	£5.50
STRG6351	£5.00
STRG6352	£6.00
STRG6651	£9.00
STRG6653	£5.00
STRM 6511	£7.50
STRM6511	£7.50
STRM6523	£5.00
STRM6545	£5.00
STRM6546	£5.50
STRM6547	£4.50
STRM6549	£5.00
STRM6559	£3.00
STRS5041	£3.00
STRS5041	£3.00
STRS5141	£3.00
STRS5141	£3.00
STRS5241	£3.00
STRS5241	£5.50
STRS5641	£3.50
STRS5703	£6.00
STRS5706	£6.00
STRS5707	£7.00
STRS5717	£3.00
STRS5741	£5.00
STRS5841	£5.50
STRS5941	£6.00
STRS6301	£3.00
STRS6302	£4.00
STRS6307	£3.50
STRS6308	£4.80
STRS6309	£6.00
STRS6525	£12.00
STRS6533	£4.00
STRS6545	£4.50
STRS6705	£5.00
STRS6706	£6.00
STRS6707	£6.00
STRS6708	£5.75
STRS6709	£5.00
STRZ1502	£11.00
STRZ2152	£10.00
STRZ2752	£6.50
STV0042A	£6.80
STV0056A	£9.00
STV2102B	£5.00
STV2110B	£5.00
STV2112B	£8.50
STV2116A	£7.50

Grandata Ltd

distributor of electronic components

Part No.	Price
STV2118B	£7.00
STV2145	£3.00
STV2151A	£10.00
STV2155	£12.00
STV2160	£6.00
STV2246	£7.00
STV2246C	£7.00
STV2248	£7.00
STV5109	£4.50
STV5112	£3.00
STV5180D	£3.25
STV5730A	£10.00
STV6400	£4.80
STV7778S	£5.50
STV8223B	£2.75
STV8224A	£4.00
STV8225	£2.75
STV9306	£3.00
STV9379	£2.60
STV9379A	£2.60
STV9379F	£4.50
STV9379FA	£4.25
STV9422P	£6.50
SVI2004C	£43.00
SVI3101D	£34.00
SVI3102D	£34.00
SVI3204B	£36.00
SVI3205B	£31.00
TA8201AK	£1.20
TA8202	£2.50
TA8202K	£2.50
TA8205AH	£1.20
TA8207K	£1.75
TA8208H	£1.20
TA8210AH	£1.20
TA8211AH	£2.00
TA8213K	£4.50
TA8214K	£1.10
TA8215	£3.00
TA8215H	£2.00
TA8215L	£3.00
TA8216H	£3.00
TA8217P	£0.80
TA8218AH	£4.25
TA8220H	£3.50
TA8221AC	£6.00
TA8221AH	£5.00
TA8223K	£2.25
TA8225H	£4.75
TA8232H	£4.00
TA8233H	£3.00
TA8238K	£2.00
TA8248K	£2.00
TA8251AH	£7.00
TA8255AH	£4.00
TA8256H	£4.50
TA8403K	£1.15
TA8410K	£2.00
TA8410P	£0.60

Part No.	Price
TA8424F	£1.50
TA8427K	£2.00
TA8428K	£3.50
TA8432	£2.00
TA8432K	£0.80
TA8445K	£1.00
TA8449P	£3.50
TA8605N	£1.70
TA8606N	£3.50
TA8607P	£1.60
TA8611AN	£1.00
TA8701AN	£1.40
TA8718N	£4.00
TA8720	£1.20
TA8721SN	£2.00
TA8725AN	£7.00
TA8739P	£3.50
TA8808BN	£8.00
TA8859CP	£4.00
TA8867AN	£3.50
TDA1170N	£0.85
TDA1170N SGS	£4.00
TDA1170N TFK	£3.50
TDA1420	£8.00
TDA1470	£12.00
TDA1514A	£12.00
TDA1547	£2.50
TDA1552Q	£3.50
TDA1553AQ	£3.25
TDA1553CQ	£3.00
TDA1554Q	£3.00
TDA1555Q	£2.00
TDA1556Q	£3.25
TDA1557Q	£3.00
TDA1558Q	£3.00
TDA1560Q	£3.50
TDA1561Q	£3.50
TDA1562Q	£5.50
TDA1580	£4.25
TDA1599	£4.00
TDA1670A	£1.40
TDA1675	£2.50
TDA1675A	£2.00
TDA16833	£2.00
TDA16846	£2.00
TDA1701	£10.00
TDA1770	£7.50
TDA1771	£2.00
TDA1870A	£1.40
TDA1872A	£1.90
TDA1908A	£0.80
TDA1910	£0.50
TDA1940	£1.00
TDA1941	£3.00
TDA2003	£0.65
TDA2004	£0.70
TDA2005	£0.50
TDA2006	£0.50
TDA2007	£1.20

Part No.	Price
TDA2008	£1.00
TDA2009	£1.00
TDA2010	£0.75
TDA2020	£0.70
TDA2030	£0.80
TDA2030H	£1.00
TDA2040	£1.40
TDA2048	£3.25
TDA2050V	£2.00
TDA2051V	£1.50
TDA2052V	£2.00
TDA2054M	£0.80
TDA2107	£0.50
TDA2140	£5.20
TDA2148	£0.50
TDA2170	£8.00
TDA2501	£1.80
TDA2506T	£8.00
TDA2507	£2.50
TDA2510	£4.50
TDA2520-1	£9.00
TDA2521	£8.00
TDA2522	£3.00
TDA2523	£8.50
TDA2525	£4.50
TDA2530	£1.70
TDA2548	£0.75
TDA2549	£1.10
TDA2558	£1.00
TDA2560Q	£5.00
TDA2574V	£3.50
TDA2576A	£9.00
TDA2577A	£2.00
TDA2578A	£2.50
TDA2579A	£2.10
TDA2652	£48.00
TDA2653A	£4.50
TDA2710-1	£4.00
TDA2820M	£1.00
TDA2822M	£0.30
TDA3190	£1.20
TDA3301B	£16.00
TDA3303	£2.00
TDA3501	£1.60
TDA3502	£3.00
TDA3504	£1.00
TDA3507	£4.50
TDA3521	£7.50
TDA3560	£3.00
TDA3561	£1.00
TDA3561A	£3.00
TDA3561B	£1.30
TDA3562	£2.60
TDA3562A	£2.60
TDA3563	£2.60
TDA3563A	£4.00
TDA3564	£2.80
TDA3565	£2.20
TDA3566	£15.00

Part No.	Price
TDA3566A	£3.00
TDA3567	£1.50
TDA3569	£3.00
TDA3570	£1.50
TDA3576B	£10.50
TDA3650	£6.75
TDA3651	£2.00
TDA3651A	£3.50
TDA3652	£1.50
TDA3652TX10	£3.00
TDA3653	£1.50
TDA3653B	£0.80
TDA3653C	£0.85
TDA3653CQ	£1.50
TDA3654	£1.50
TDA3654Q	£1.50
TDA3724	£1.50
TDA3725	£3.00
TDA3730	£2.00
TDA3740	£2.60
TDA3750	£4.00
TDA3770	£7.75
TDA3771	£2.40
TDA3803A	£3.40
TDA4400	£1.10
TDA4420	£0.75
TDA4421	£2.00
TDA4422	£2.00
TDA4427	£3.00
TDA4429T	£20.00
TDA4431	£0.55
TDA4474	£1.60
TDA4480	£3.00
TDA4481	£0.80
TDA4482	£11.00
TDA4483	£1.00
TDA4500	£2.30
TDA4501	£2.80
TDA4502	£4.00
TDA4502A	£4.00
TDA4503	£1.80
TDA4504B	£8.00
TDA4505A	£1.50
TDA4505E	£6.50
TDA4510	£2.00
TDA4556	£2.00
TDA4557	£1.80
TDA4560	£1.80
TDA4565	£1.50
TDA4566	£2.50
TDA4580	£10.00
TDA4600	£2.00
TDA4600II	£1.60
TDA4601	£1.20
TDA4601D	£0.65
TDA4605	£1.90
TDA4610	£2.40
TDA4650	£3.00
TDA4651	£8.00

Part No.	Price
TDA4665	£1.00
TDA4670	£2.50
TDA4671	£1.80
TDA4680	£2.20
TDA4681	£1.75
TDA4685	£1.80
TDA4686	£5.00
TDA4687	£5.00
TDA4700A	£4.00
TDA4710H	£4.50
TDA4714C	£3.50
TDA4716C	£4.50
TDA4720	£6.60
TDA4725	£7.50
TDA4780	£6.00
TDA4800	£3.00
TDA4810	£2.70
TDA4850	£2.00
TDA4851	£1.70
TDA4852	£3.25
TDA4854	£3.50
TDA4855	£2.60
TDA4856	£3.00
TDA4858	£3.50
TDA4860	£1.00
TDA4861	£1.80
TDA4866	£1.25
TDA4880	£4.50
TDA4918A	£17.00
TDA4930	£5.00
TDA4935	£1.50
TDA4940	£1.00
TDA4941	£0.60
TDA4942	£1.10
TDA4950	£1.00
TDA4951	£1.00
TDA5010	£3.00
TDA5400	£6.00
TDA5500	£4.00
TDA5610-2	£7.50
TDA5620	£2.00
TDA5702	£13.00
TDA5830-2	£11.00
TDA6101Q	£1.20
TDA6103Q	£1.00
TDA6106Q	£1.25
TDA6107Q	£3.00
TDA6108JF	£3.00
TDA6111Q	£2.25
TDA6120Q	£5.50
TDA6130	£2.25
TDA6160-2S	£4.75
TDA6160-2X	£2.50
TDA7052	£1.20
TDA7262	£3.25
TDA7263	£3.50
TDA7263M	£4.00
TDA7264	£2.50
TDA7265	£5.00

Part No.	Price
TDA7266	£1.80
TDA7269	£5.00
TDA7269A	£2.75
TDA7293V	£5.50
TDA7294V	£5.50
TDA7295	£4.00
TDA7296	£5.00
TDA7297	£3.50
TDA7300	£5.50
TDA7302	£4.50
TDA7310	£8.00
TDA7312	£4.50
TDA7313	£1.50
TDA7318	£2.00
TDA7330A	£2.00
TDA7340	£8.00
TDA7350	£1.50
TDA7359	£3.00
TDA7360	£1.50
TDA7362	£4.50
TDA7365	£1.50
TDA7370V	£1.30
TDA7372A	£4.50
TDA7374V	£3.50
TDA7375V	£5.25
TDA7376B	£10.00
TDA7377	£4.50
TDA7381	£11.00
TDA7384A	£8.00
TDA7385	£10.00
TDA7386	£11.00
TDA7391	£4.25
TDA7393	£10.00
TDA7394	£2.00
TDA7396	£2.50
TDA7429S	£4.25
TDA7431	£7.00
TDA7439	£4.00
TDA7560	£10.00
TDA8000	£2.50
TDA8116	£3.50
TDA8120B	£3.00
TDA8137	£2.00
TDA8138	£2.00
TDA8138A	£1.30
TDA8138B	£0.75
TDA8139	£0.75
TDA8140	£6.50
TDA8143	£1.60
TDA8145	£1.20
TDA8146	£1.20
TDA8153	£10.00
TDA8170	£3.00
TDA8171	£2.30
TDA8172	£2.00
TDA8173	£1.00
TDA8174AW	£2.00
TDA8177	£3.00
TDA8177F	£3.50

Part No.	Price
TDA8179S	£7.50
TDA8180	£6.00
TDA8190	£1.45
TDA8205	£4.00
TDA8212	£1.50
TDA8214B	£10.50
TDA8215B	£2.25
TDA8215H	£3.00
TDA8217	£2.25
TDA8303	£1.25
TDA8304	£4.00
TDA8305	£2.00
TDA8305A	£2.00
TDA8310	£6.00
TDA8350Q	£2.75
TDA8351	£2.00
TDA8354Q	£2.75
TDA8356	£2.00
TDA8360N3	£8.00
TDA8361AN3	£8.00
TDA8361N3	£9.00
TDA8362AN	£12.00
TDA8362AN3	£7.50
TDA8362BN3	£8.50
TDA8362N3	£12.00
TDA8362N4	£9.00
TDA8362N5	£12.00
TDA8366N2	£15.00
TDA8366N3	£11.50
TDA8370	£5.50
TDA8372A	£16.50
TDA8374	£10.00
TDA8375A	£12.50
TDA8380A	£1.00
TDA8390A	£3.00
TDA8440	£1.30
TDA8442	£2.00
TDA8443	£2.10
TDA8444	£1.00
TDA8560Q	£4.25
TDA8561Q	£5.25
TDA8562Q	£5.00
TDA8563Q	£4.75
TDA8565Q	£11.00
TDA8566Q	£5.50
TDA8567Q	£4.00
TDA8568Q	£6.00
TDA8569Q	£8.00
TDA8571J	£6.00
TDA8579	£1.50
TDA8702	£1.50
TDA8703	£5.00
TDA8708	£3.00
TDA8709	£3.50
TDA8808T	£1.20
TDA8809T	£1.80
TDA8840	£7.00
TDA8841	£7.00
TDA8842	£7.00

Part No.	Price
TDA8843	£15.00
TDA8844	£10.00
TDA9102C	£1.50
TDA9103	£1.70
TDA9105	£3.00
TDA9109	£10.00
TDA9141	£6.25
TDA9143	£2.00
TDA9144	£12.00
TDA9151	£11.00
TDA9160A	£9.50
TDA9162	£11.00
TDA9170	£7.00
TDA9176	£6.50
TDA9177	£8.00
TDA9210	£2.00
TDA9302H	£1.00
TDA9350	£27.50
TDA9351	£14.00
TDA9353	£14.00
TDA9403	£0.80
TDA9500	£7.50
TDA9503	£7.00
TDA9513	£1.50
TDA9610H	£5.50
TDA9614H	£8.00
TEA1060	£2.25
TEA1061	£0.80
TEA1062	£0.55
TEA1062A	£3.00
TEA1064	£1.10
TEA1064A	£1.30
TEA1067	£1.50
TEA1068	£3.50
TEA1080P	£1.00
TEA1081	£1.60
TEA1087	£0.20
TEA1090	£5.00
TEA1091	£3.00
TEA1093	£4.75
TEA2018A	£1.20
TEA2019	£6.00
TEA2025B	£0.75
TEA2026CV	£10.50
TEA2028	£3.25
TEA2028B	£3.75
TEA2029A	£2.00
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VALUE	CODE	PRICE	PER PACK
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220uF	CAP163	£0.70	10
470uF	CAP164	£0.80	10
10 Volts			
100uF	CAP118	£0.45	10
220uF	CAP165	£1.00	10
470uF	CAP29	£1.20	10
680uF	CAP166	£1.20	10
1000uF	CAP119	£1.50	10
2200uF	CAP120	£2.10	10
3300uF	CAP167	£1.60	5
16 Volts			
22uF	CAP121	£0.35	10
33uF	CAP122	£0.35	10
47uF	CAP123	£0.35	10
100uF	CAP124	£0.60	10
150uF	CAP168	£0.65	5
220uF	CAP125	£0.80	10
330uF	CAP30	£1.75	10
470uF	CAP31	£1.75	10
680uF	CAP32	£2.10	5
1000uF	CAP33	£2.10	10
1200uF	CAP169	£1.50	5
1500uF	CAP170	£1.50	5
2200uF	CAP34	£5.25	10
3300uF	CAP35	£5.00	5
4700uF	CAP36	£6.10	10
6800uF	CAP171	£4.50	5
25 Volts			
10uF	CAP37	£0.45	10
15uF	CAP172	£0.45	10
22uF	CAP38	£0.45	10
33uF	CAP126	£0.40	10
47uF	CAP39	£0.48	5
68uF	CAP127	£0.55	10
100uF	CAP40	£0.70	10
120uF	CAP128	£0.85	10
150uF	CAP41	£0.95	5
220uF	CAP42	£1.20	10
330uF	CAP43	£1.40	5
470uF	CAP44	£1.90	10
680uF	CAP45	£3.15	5

VALUE	CODE	PRICE	PER PACK
25 Volts....continued			
1000uF	CAP46	£3.65	10
1500uF	CAP47	£3.90	5
2200uF	CAP48	£2.00	2
3300uF	CAP49	£2.20	2
4700uF	CAP50	£3.65	2
6800uF	CAP51	£3.90	2
35 Volts			
1uF	CAP130	£0.40	10
3.3uF	CAP131	£0.40	10
4.7uF	CAP132	£0.45	10
10uF	CAP52	£0.50	10
22uF	CAP53	£0.45	10
33uF	CAP54	£0.50	5
47uF	CAP55	£0.85	10
68uF	CAP133	£0.55	10
100uF	CAP56	£0.85	10
150uF	CAP57	£0.95	5
220uF	CAP58	£1.45	5
330uF	CAP134	£1.60	10
470uF	CAP135	£1.75	10
680uF	CAP59	£6.50	10
1000uF	CAP60	£4.35	10
1500uF	CAP173	£4.00	5
2200uF	CAP61	£2.45	2
3300uF	CAP62	£10.00	5
4700uF	CAP136	£3.50	2
40 Volts			
2200uF	CAP174	£1.80	2
2200uF	CAP175	£2.00	1
50 Volts			
0.47uF	CAP176	£0.35	10
1uF	CAP137	£0.35	10
2.2uF	CAP138	£0.35	10
3.3uF	CAP139	£0.35	10
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6.8uF	CAP177	£0.45	10
10uF	CAP63	£0.50	10
22uF	CAP64	£0.70	10
33uF	CAP141	£0.85	10
47uF	CAP65	£0.85	10
68uF	CAP142	£0.90	10

VALUE	CODE	PRICE	PER PACK
50 Volts....continued			
100uF	CAP66	£0.85	10
220uF	CAP67	£1.75	10
330uF	CAP68	£2.45	10
470uF	CAP69	£4.35	10
680uF	CAP70	£4.90	5
1000uF	CAP71	£5.25	10
1500uF	CAP143	£4.50	5
2200uF	CAP72	£3.25	2
3300uF	CAP144	£3.25	2
63 Volts			
0.22uF	CAP145	£0.45	10
0.33uF	CAP178	£0.35	10
0.47uF	CAP73	£0.35	10
1uF	CAP74	£0.35	10
1.5uF	CAP179	£0.35	10
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10uF	CAP78	£0.50	10
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33uF	CAP81	£0.85	10
47uF	CAP82	£0.95	10
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68uF	CAP83	£1.30	5
100uF	CAP84	£1.20	10
150uF	CAP85	£2.80	5
220uF	CAP86	£2.80	10
330uF	CAP87	£4.00	10
470uF	CAP88	£5.25	10
680uF	CAP89	£5.00	10
1000uF	CAP90	£5.40	5
2200uF	CAP182	£2.20	1
4700uF	CAP183	£4.00	1
100 Volts			
0.1uF	CAP184	£0.80	10
0.22uF	CAP185	£0.80	10
0.33uF	CAP186	£0.80	10
0.47uF	CAP91	£0.50	5
1uF	CAP92	£0.85	10
1.5uF	CAP93	£0.70	5

VALUE	CODE	PRICE	PER PACK
100 Volts....continued			
2.2uF	CAP94	£0.50	5
3.3uF	CAP95	£0.50	5
4.7uF	CAP96	£0.50	5
6.8uF	CAP187	£0.80	10
10uF	CAP97	£0.95	10
22uF	CAP98	£1.05	10
33uF	CAP99	£1.55	5
47uF	CAP100	£1.75	10
68uF	CAP188	£1.30	5
100uF	CAP101	£2.10	10
220uF	CAP102	£6.00	5
330uF	CAP189	£3.00	2
470uF	CAP103	£6.00	5
680uF	CAP190	£3.00	2
1000uF	CAP191	£3.00	1
160 Volts			
0.47uF	CAP192	£0.45	10
1uF	CAP193	£0.45	10
2.2uF	CAP146	£0.45	10
3.3uF	CAP194	£1.00	10
4.7uF	CAP195	£1.00	10
10uF	CAP147	£1.40	10
22uF	CAP148	£1.80	10
33uF	CAP149	£2.30	10
47uF	CAP196	£2.20	5
100uF	CAP150	£3.25	5
220uF	CAP197	£3.00	2
470uF	CAP198	£3.25	1
200 Volts			
22uF	CAP199	£1.60	5
100uF	CAP151	£3.25	5
220uF	CAP200	£2.50	1
330uF	CAP201	£2.50	1
250 Volts			
0.47uF	CAP202	£0.60	10
1uF	CAP152	£0.60	10
2.2uF	CAP203	£1.30	10
3.3uF	CAP104	£1.75	10
4.7uF	CAP204	£2.00	10
10uF	CAP105	£2.60	10
22uF	CAP153	£2.30	10

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250 Volts....continued			
33uF	CAP206	£1.75	5
47uF	CAP106	£4.35	10
100uF	CAP154	£4.50	5
220uF	CAP155	£2.00	2
330uF	CAP206	£2.50	1
350 Volts			
1uF	CAP156	£0.70	10
2.2uF	CAP207	£1.20	10
3.3uF	CAP157	£1.50	10
4.7uF	CAP208	£1.10	5
10uF	CAP158	£2.25	10
22uF	CAP159	£3.40	10
33uF	CAP209	£2.60	5
47uF	CAP210	£1.50	2
100uF	CAP211	£3.00	2
330uF	CAP212	£5.00	1
400 Volts			
0.47uF	CAP213	£0.60	10
1uF	CAP107	£2.15	5
2.2uF	CAP108	£2.25	5
3.3uF	CAP214	£2.25	5
4.7uF	CAP109	£3.15	5
10uF	CAP110	£4.00	5
22uF	CAP111	£2.50	2
33uF	CAP215	£2.50	2
47uF	CAP112	£3.50	2
68uF	CAP216	£3.50	2
100uF	CAP160	£4.00	2
150uF	CAP217	£3.20	1
220uF	CAP161	£7.00	2
560uF	CAP162	£4.00	1
450 Volts			
1uF	CAP113	£2.80	5
2.2uF	CAP114	£3.20	5
3.3uF	CAP218	£3.20	5
4.7uF	CAP115	£4.95	5
10uF	CAP116	£5.50	5
22uF	CAP117	£4.15	2
33uF	CAP219	£3.00	2
47uF	CAP220	£2.00	1
100uF	CAP221	£3.00	1

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14SLTX	STANDBY	MODKIT37
1799Y	STANDBY	MODKIT37
2002	PSU	ONWAKIT
2009B	PSU	ONWAKIT
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2099TX	STANDBY	MODKIT37
BTV17	STANDBY	MODKIT37
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CTV701	PSU	ONWAKIT
CTV840	PSU	ONWAKIT
CTV841	PSU	ONWAKIT
CTV485	PSU	ONWAKIT
AKAI		
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CT2159U	PSU	ONWAKIT
CT2162UNT	PSU	ONWAKIT
CT2863UNT	PSU	ONWAKIT
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CF25C22C	FRAME	MODKIT35
CF28A50F	FRAME	MODKIT36
CF28C22F	FRAME	MODKIT35
CF28C28F	FRAME	MODKIT36
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2019R	PSU	ONWAKIT
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COMPACT 11	PSU	MODKIT47
F16 CHASSIS	FRAME	GOODKIT1
F16 CHASSIS	LINE	GOODKIT1
F16	PSU	GOODKIT1
F16	VIDEO	GOODKIT1
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HIT14RC	PSU	ONWAKIT
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AV29SX1EN1	FIELD O/P	JVCKIT1
AV29SX1PF	FIELD O/P	JVCKIT1
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C14T1EK	PSU	ONWAKIT
C21ET1EK	PSU	ONWAKIT
CS21M3EK	PSU	ONWAKIT
MATSUI		
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1496R/T (BUZ90)	PSU	MODKIT44
1498	PSU	ONWAKIT
2086	PSU	ONWAKIT
2096R/T (H3N90)	PSU	MODKIT43
2096R/T (BUZ90)	PSU	MODKIT44
2098	PSU	ONWAKIT
21V1N (BUZ90)	PSU	GRUNDIGKIT2
21V1T(MJF18004)	PSU	GRUNDIGKIT3
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TVR185T	STANDBY	MODKIT39
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CT21AX1B	PSU	MITSKIT3
CT21A3STX	TDA 8178S	MITSKIT1
CT21AV1BS	PSU	MITSKIT3
CT25A2STX	TDA 8178S	MITSKIT1
CT25A3STX	TDA 8178S	MITSKIT1
CT25A4STX	TDA 8178S	MITSKIT1
CT25A6STX	TDA 8178S	MITSKIT1
CT25AV1B	PSU	MITSKIT3
CT25AV1BS	PSU	MITSKIT3
CT25AV1BD	PSU	MITSKIT3
CT25AV1BDS	PSU	MITSKIT3
CT28AV1B	PSU	MITSKIT3
CT28AX1BD	PSU	MITSKIT3
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CT29B2	TDA 8178S	MITSKIT2
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CT33B3	TDA 8178S	MITSKIT2
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TX29XD70	VERT OUTPUT	PANKIT2
TX-W26D3	VERT OUTPUT	PANKIT2
PHILIPS		
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28PW5407/05	PSU	MODKIT50
28PW6006/05	PSU	MODKIT50
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G90B CHASSIS	SOPS	PHILKIT10
G110 CHASSIS	SOPS	PHILKIT3
GR2.1 CHASSIS	SOPS	PHILKIT1
GR2.2 CHASSIS	SOPS	PHILKIT1
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SAMSUNG		
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CI6844	FRAME	SAMKIT2
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SHARP		
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51CS05H	PSU	SHARPKIT1
56FW53H	PSU & DOLBY	MODKIT45
59CS03H	PSU	SHARPKIT2
59CS05H	PSU	SHARPKIT2
59CSD8H	PSU	SHARPKIT2
59DS03H	PSU	SHARPKIT3
59FW53H	PSU & EW	MODKIT49

MAKE & MODEL	KIT TYPE	CODE
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66CS05H	PSU	SHARPKIT2
66CSD8H	PSU	SHARPKIT2
66FW53H	PSU & DOLBY	MODKIT45
66FW53H	PSU & EW	MODKIT49
66FW54H	PSU & DOLBY	MODKIT45
66FW54H	PSU & EW	MODKIT49
76FW53H	PSU & DOLBY	MODKIT45
76FW53H	PSU & EW	MODKIT49
76FW54H	PSU & DOLBY	MODKIT45
76FW54H	PSU & EW	MODKIT49
DA-100 CHASSIS	PSU & EW	MODKIT49
SONY		
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ICC8 CHASSIS	FRAME	THOMKIT3
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T514	RC1986/HL
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CUC1892	RC160/HL
CUC5200	RC160/HL
CUC5301	RC160/HL
CUC5302	RC160/HL
CUC5303	RC160/HL
CUC5305	RC160/HL
CUC5310	RC160/HL
CUC5312	RC160/HL
CUC5350	RC160/HL
CUC5360	RC160/HL
CUC5361	RC160/HL
CUC5511	RC160/HL
CUC6300	RC160/HL
CUC6310	RC160/HL
CUC6851	RC160/HL
CUC6880	RC160/HL
CUC6890	RC160/HL
CUC7851	RC160/HL
CUC7880	RC160/HL
CUC7890	RC160/HL

Part No.	Code
HITACHI	
CL2560	RC220/HL
CL2564TA	RC220/HL
CL2565	RC220/HL
CL2860TA	RC220/HL
CL2864TA	RC220/HL
CL2865	RC220/HL
CLE877A	RC220/HL
CLE902A	RC220/HL
CLE902B	RC220/HL
CP2146TAN	RC220/HL
CP2546TAN	RC220/HL
CP2565TA	RC220/HL
CP2841TA	RC220/HL
CP2846TAN	RC220/HL
CP2865TA	RC220/HL
TVC2528TN	RC220/HL
TVC25TN	RC220/HL
TVC28TN	RC220/HL
J.V.C.	
AV21BD5	RC665/HL
AV21BF5	RC665/HL
AV21BT7	RC665/HL
AV21F1EG	RC665/HL
AV21JT5	RC665/HL
AV21TS1	RC665/HL
AV21TS2	RC665/HL
AV21TS4	RC665/HL
AV24WT2	RC665/HL
AV24WT5	RC665/HL
AV25BD3	RC665/HL
AV25FX11	RC665/HL
AV25FX11EG	RC665/HL
AV25GS1	RC665/HL
AV25S4	RC665/HL
AV25S4E	RC665/HL
AV25VM1	RC665/HL
AV25VM1EN	RC665/HL
AV28GS1	RC665/HL
AV28S1E	RC665/HL
AV28S4E	RC665/HL
AV28VM1EN	RC665/HL
AV28WR2	RC665/HL
AV28WT1	RC665/HL
AV29SX1	RC665/HL
AV29SX2	RC665/HL
AV32WP2	RC665/HL
HRS7000	RC665/HL
RMC863	RC665/HL
RMC761	RC665/HL
RMC771	RC665/HL
RMC792	RC665/HL
RMC793	RC665/HL
RMC794	RC665/HL
RMC795	RC665/HL
RMC870	RC665/HL
TS2E	RC665/HL
MATSUI	
14V1T	RC160/HL
14VIT	RC160/HL
20V1R	RC160/HL
20V1T	RC160/HL
20VIT	RC160/HL
CUC731	RC160/HL
MITSUBISHI	
14M1	RC1725/HL
CT1447	RC1725/HL
CT14M1	RC1725/HL
CT14MSIEM	RC1725/HL
CT15MS1ETX	RC1725/HL
CT1903	RC1725/HL
CT2028	RC1725/HL
CT2030	RC1725/HL
CT2030BM	RC1725/HL
CT2030LM	RC1725/HL
CT2040	RC1725/HL
CT2040LM	RC1725/HL
CT21A2STX	RC1725/HL
CT21A3STX	RC1725/HL
CT21A5EST	RC1725/HL
CT21A5LST	RC1725/HL
CT21A5ST	RC1725/HL
CT21A5STX	RC1725/HL
CT25A2	RC1725/HL
CT25A3	RC1725/HL
CT25A3STX	RC1725/HL
CT25A4	RC1725/HL
CT25A4STX	RC1725/HL
CT25A5EST	RC1725/HL
CT25A5ST	RC1725/HL
CT25A5STX	RC1725/HL
CT25AL1	RC1725/HL
CT25B2	RC1725/HL
CT25B2STX	RC1725/HL
CT25B3	RC1725/HL
CT29A4	RC1725/HL
CT29AS1	RC1725/HL
CT29B2	RC1725/HL
CT29B3	RC1725/HL
CT29B3EST	RC1725/HL
CT29B4EST	RC1725/HL
CT33B3	RC1725/HL
PHILIPS	
21PT1653/00	RC437/HL
21PT442A	RC437/HL
21PT520	RC437/HL
21PT523B	RC437/HL
21PT530	RC437/HL
21PT5301	RC437/HL
21PT5322	RC437/HL
21PT570A	RC437/HL
21PT700B/00	RC437/HL
21ST1130 /02B	RC437/HL
21ST1636	RC437/HL
21ST1730	RC437/HL
21ST2430	RC437/HL
21ST2436	RC437/HL
21ST2630/02B	RC437/HL
21ST2637	RC437/HL
21ST2730	RC437/HL
21ST2731	RC437/HL
21ST2931	RC437/HL

Part No.	Code
21ST2937	RC437/HL
24PW6302	RC437/HL
25CT2764	RC437/HL
25ET2764	RC437/HL
25MN1350	RC437/HL
25MN1355	RC437/HL
25MN1370	RC437/HL
25MN1553	RC437/HL
25MN1560	RC437/HL
25MN1570	RC437/HL
25PT405A	RC437/HL
25PT415A	RC437/HL
25PT425A	RC437/HL
25PT440A	RC437/HL
25PT4501	RC437/HL
25PT450A	RC437/HL
25PT4512	RC437/HL
25PT451A	RC437/HL
25PT452A	RC437/HL
25PT472 /A/B	RC437/HL
25PT480 A/B/C	RC437/HL
25PT481 /B	RC437/HL
25PT492A	RC437/HL
25PT510 /A/B	RC437/HL
25PT512C	RC437/HL
25PT520 /A	RC437/HL
25PT530	RC437/HL
25PT5301	RC437/HL
25PT530C	RC437/HL
25PT532A	RC437/HL
25PT540	RC437/HL
25PT5403	RC437/HL
25PT540A	RC437/HL
25PT541	RC437/HL
25PT550 /A/B	RC437/HL
25PT562A	RC437/HL
25PT570B	RC437/HL
25PT572A	RC437/HL
25PT620B	RC437/HL
25PT700	RC437/HL
25PT7001	RC437/HL
25PT702	RC437/HL
25PT720	RC437/HL
25ST1627	RC437/HL
25ST1666	RC437/HL
25ST1667	RC437/HL
25ST1704	RC437/HL
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25ST2967	RC437/HL
27CE7596	RC437/HL
28DC2070	RC437/HL
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28MN1370	RC437/HL
28MN1570	RC437/HL
28PT400A	RC437/HL
28PT420A	RC437/HL
28PT4401	RC437/HL
28PT440A	RC437/HL
28PT450A	RC437/HL
28PT4513	RC437/HL
28PT452A	RC437/HL
28PT470 /A	RC437/HL
28PT472 /A/B	RC437/HL
28PT482A	RC437/HL
28PT490A	RC437/HL
28PT510 /A/B	RC437/HL
28PT511	RC437/HL
28PT522 /A	RC437/HL
28PT530 /A/B	RC437/HL
28PT532 /A	RC437/HL
28PT5401	RC437/HL
28PT541	RC437/HL
28PT550 /A/B	RC437/HL
28PT552A	RC437/HL
28PT560A	RC437/HL
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28PW6202	RC437/HL
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28ST1181	RC437/HL
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29PT550	RC437/HL
29PT5501	RC437/HL
29PT600A	RC437/HL
29PT6433	RC437/HL
29PT6773	RC437/HL
29PT702 /A	RC437/HL
29PT720	RC437/HL
29PT721	RC437/HL
32PW6322C	RC437/HL
33CE7533/33R	RC437/HL
33CE7536/30R	RC437/HL

Part No.	Code
33CE7536/42R	RC437/HL
33CE7539	RC437/HL
37ZZ3233	RC437/HL
41CE8743	RC437/HL
41CE8749/13B	RC437/HL
41KE8417	RC437/HL
41KE8487/16B	RC437/HL
46CE8760/19M	RC437/HL
46CE8761	RC437/HL
46CE8765/19B	RC437/HL
46CE8766	RC437/HL
46KE8637/16B	RC437/HL
46KE8657/18B	RC437/HL
46KE8687/16B	RC437/HL
4822.015.30017	RC437/HL
4822 218.20918	RC437/HL
4822 218 21018	RC437/HL
4822 218.21079	RC437/HL
4822 218 21093	RC437/HL
4822 218 21102	RC437/HL
PT150A	RC437/HL
PT520A	RC437/HL
PT530A	RC437/HL
PT532A	RC437/HL
PT700A	RC437/HL
RC0311	RC437/HL
RC031201	RC443/HL
RC0764/01	RC443/HL
RC22401	RC443/HL
RC283509	RC443/HL
RC5601	RC437/HL
RC5915	RC437/HL
RC6502	RC437/HL
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RC6512	RC437/HL
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RC7301/01	RC443/HL
RC730101	RC443/HL
RC7500	RC437/HL
RC7502	RC437/HL
RC7503	RC437/HL
RC7512	RC437/HL
RC751201	RC437/HL
RC751501	RC437/HL
RC7535	RC443/HL
RC7535/01	RC443/HL
RH6622/01	RC437/HL
RH662201	RC437/HL
RH6820/01	RC437/HL
RH682001	RC437/HL
RP420	RC437/HL
RT230	RC437/HL
SANYO	
2527	RC815/HL
14M1	RC815/HL
14MT1	RC815/HL
14MT2	RC815/HL
21B1	RC815/HL
21BI	RC815/HL
21D1	RC815/HL
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28XP1	RC815/HL
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C14EA80H	RC815/HL
C14EA90B	RC815/HL
C14EA90M1	RC815/HL
C14EA95	RC815/HL
C14EA97MT2	RC815/HL
C20EE10	RC815/HL
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C21EF25	RC815/HL
C21EF34	RC815/HL
C21EF35N	RC815/HL
C21EF45NB	RC815/HL
C21EF50	RC815/HL
C21EF57B	RC815/HL
C21ES35MT2	RC815/HL
C21ES57DZ	RC815/HL
C25EG25	RC815/HL
C25EG34	RC815/HL
C25EG35N	RC815/HL
C25EG65NB	RC815/HL
C25EG77NB	RC815/HL
C25EP57DZ	RC815/HL
C25EP57NB	RC815/HL
C28EH25	RC815/HL
C28EH34	RC815/HL
C28EH64	RC815/HL
C28EH65NB	RC815/HL
C28EH75MT2	RC815/HL
C28EH85	RC815/HL

Part No.	Code
C28ER14S2	RC815/HL
C28ER57DZ	RC815/HL
C28H1	RC815/HL
C28W1	RC815/HL
C28WP1	RC815/HL
CB5156	RC815/HL
CB5949	RC815/HL
CB5959	RC815/HL
CBP2572H	RC815/HL
CBP2576	RC815/HL
CBP2580	RC815/HL
CBP2872	RC815/HL
CBP2876	RC815/HL
CEM2876	RC815/HL
CEP1768T	RC815/HL
CEP2151	RC815/HL
CEP2168	RC815/HL
CEP2177	RC815/HL
CEP2181	RC815/HL
CEP2570	RC815/HL
CEP2572	RC815/HL
CEP2576	RC815/HL
CEP2577T	RC815/HL
CEP2578S	RC815/HL
CEP2578SPIP	RC815/HL
CEP2581D	RC815/HL
CEP2582	RC815/HL
CEP2596	RC815/HL
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CEP2876	RC815/HL
CEP2877T	RC815/HL
CEP2878SPIP	RC815/HL
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CEP2896	RC815/HL
CEP3382	RC815/HL
CEP6032TX	RC815/HL
JXHJ	RC815/HL
JXHM	RC815/HL
JXRC	RC815/HL
JXRG	RC815/HL
JXSA	RC815/HL
JXTA	RC815/HL
JXYB	RC815/HL
JXYC	RC815/HL
JXZB	RC815/HL
RCEDO	RC815/HL
SXMR	RC815/HL
SXMRA	RC815/HL
SONY	
KL37W2	RC522/HL
KL50W2	RC522/HL
KP41S5	RC523/HL
KP46S4	RC523/HL
KP53S4	RC523/HL
KPS4613	RC522/HL
KV1442	RC522/HL
KV1446TA	RC522/HL
KV1462UB	RC522/HL
KV16	RC522/HL
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KV19XMB	RC522/HL
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KV19XMD	RC522/HL
KV19XMTA	RC522/HL
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KV2092AM	RC522/HL
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KV2092PT	RC522/HL
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KV2096EC	RC522/HL
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KV21VX1MT	RC522/HL
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KV21XRTA	RC522/HL
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KV28WX2	RC522/HL
KV29C2	RC522/HL
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KV29X1D	RC523/HL
KV32WS3	RC522/HL
KV32WX2	RC522/HL
KVA2111	RC522/HL
KVA2112U	RC522/HL
KVA2511A	RC522/HL
KVA2512U	RC522/HL
KVA2531	RC522/HL
KVA2931	RC522/HL
KVA2941A	RC522/HL
KVA3410B	RC522/HL
KVA3411A	RC522/HL
KVA3413	RC522/HL

Part No.	Code
KVB2511D	RC523/HL
KVB2513	RC522/HL
KVB2521A	RC522/HL
KVB2531	RC522/HL
KVB2911A	RC522/HL
KVB2913A	RC522/HL
KVB2921A	RC522/HL
KVB2931	RC522/HL
KVC2121A	RC522/HL
KVC2160	RC522/HL
KVC2173B	RC522/HL
KVC2181	RC522/HL
KVC250	RC522/HL
KVC2501	RC522/HL
KVC2503	RC522/HL
KVC2508	RC522/HL
KVC2509	RC522/HL
KVC2521D/MKII	RC522/HL
KVC2531	RC522/HL
KVC2560	RC522/HL
KVC2570	RC522/HL
KVC2571	RC522/HL
KVC2573	RC522/HL
KVC2581D	RC522/HL
KVC290	RC522/HL
KVC2901	RC522/HL
KVC2923E/MKII	RC522/HL
KVC2960	RC522/HL
KVC2970	RC522/HL
KVC2971	RC522/HL
KVC2973	RC522/HL
KVC2981D	RC522/HL
KVC2991	RC522/HL
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KVD2931A	RC522/HL
KVE2531A	RC523/HL
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KVE2941A	RC522/HL
KVE2951A	RC522/HL
KVE2961A	RC522/HL
KVE3431A	RC522/HL
KVE3433	RC522/HL
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KVM1451D	RC523/HL
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KVM19	RC522/HL
KVM2120	RC522/HL
KVM2130	RC522/HL
KVM2131D	RC522/HL
KVM2170D	RC523/HL
KVM2171D	RC523/HL
KVM2531A	RC522/HL
KVM2541	RC522/HL
KVP14D	RC522/HL
KVS2913	RC522/HL
KVS2951	RC523/HL
KVS3411A	RC522/HL
KVS3413	RC522/HL
KVS3431	RC522/HL
KVV1410D	RC522/HL
KVW2813	RC522/HL
KVX210	RC522/HL
KVX2101	RC522/HL
KVX2181	RC522/HL
KVX2501	RC522/HL
KVX2532UB	RC522/HL
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RM684	RC512/HL
RM685	RC512/HL
RM686	RC512/HL
RM687	RC522/HL
RM687B	RC522/HL
RM687C	RC522/HL
RM694	RC512/HL
RM717A	RC522/HL
RM811(NOPIP)	RC523/HL
RM817	RC522/HL
RM820	RC512/HL
RM833	RC523/HL
RM836	RC523/HL
RM838	RC522/HL
RM841	RC512/HL
RM842	RC523/HL
RM846	RC523/HL
RM860	RC522/HL
RM862	RC522/HL
RM864	RC523/HL

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10593640	LOT1148	£19 00
10593640 P2	LOT1148	£19.00
106122 8	LOT1814	£16 50
10612280	LOT1814	£16 50
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10655220	LOT1545	£19 00
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10669900	LOT2184	£16 00
10669900-P1	LOT2184	£16 00
106966 6	LOT2184	£16 00
10696660	LOT2184	£16 00
10696660 P1	LOT2184	£16 00
11030936351000	LOT2262	£22 00
11030936351136	LOT2262	£22 00
11040102331136	LOT2262	£22 00
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057 834 TR 2	LOT2238	£26 00
058 434 TR 4	LOT2238	£26 00
058.834 TR 1	LOT2238	£26.00
058.834 TR 2	LOT2238	£26 00
058.834 TR 5	LOT2238	£26 00
3311159	LOT2238	£26 00
3311167	LOT2238	£26 00
3311187	LOT2238	£26 00
3313110	LOT2238	£26 00
58.834	LOT2238	£26 00
M 12-130	LOT2238	£26 00
M 12-133	LOT2238	£26 00
M 12-138	LOT2238	£26 00
M 12-157	LOT2238	£26 00
M12130	LOT2238	£26 00
M12133	LOT2238	£26 00
M12138	LOT2238	£26 00
M12157	LOT2238	£26 00
RO 682	LOT2238	£26 00
RO 685	LOT2238	£26 00
TR 682	LOT2238	£26 00
TR 685	LOT2238	£26 00
FERGUSON		
473197	LOT304	£11 00
06 D-3-084-001	LOT23	£8 00
06 D-3-087-001	LOT23	£8 00
06 D-3-088-001	LOT84	£5 00
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1342 0062	LOT1148	£19 00
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10588080	LOT1505	£19.00
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151281 4	LOT1505	£19.00
15128140	LOT1505	£19.00
153144 6	LOT1505	£19.00
15314460	LOT1505	£19.00
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Samsung DVD-HD935

There was no video output from this unit's scart and composite-video output sockets, though there was a signal of sorts at the component-video Y output socket. After spending many years in the trade you develop a nose for things that don't 'feel' right – and this one didn't. I suspected that the owner might have been playing with the unit's software, probably as a result of something he'd read in DVD Hackers' Weekly. . .

A quick call to Samsung technical, who are always helpful, confirmed my suspicion. They had come across this problem before, and it could be cured by a forced system reset. To do this, start with the front-panel display reading 'no disc'. Then press and hold the front-panel 'stop' and 'play' buttons simultaneously for five seconds.

After carrying out this procedure, default scart output was restored along with access to all the normal menus. A final test, with a DVD disc inserted, proved that all was now well. **G.D.**

Sony SLV-D950GI

The problem with this machine was intermittent DVD playback failure, with freezing up. The cause was the motor-feed assembly H210, not the optical pickup. The white-labelled motor (Johnson brand) should be replaced with a Mabuchi brand one, which has the code printed on the motor casing itself – the part no. is 9-885-037-22. **C.B.**

Sony HCD-SC5

This unit would intermittently freeze with the DVD function keys not working. Oscilloscope checks revealed a possible problem with the AV decoder chip IC306 on the DVD board. If C2 (not C1) is printed on this IC, check the bus clock waveform at pin 203. This should be clearly rectangular. If not, fit the new type, part no. 6-703-540-01. This restores normal DVD operation. **C.B.**

Sony DVP-NS700V

When this unit was powered off and back on again with a disc inside, the front speaker level would change to 0dB but would continue to show the originally set value. The cause of the problem was IC107 on board MB101. A replacement and a look at the new check-sum number, which showed 2830 in the "syscon diagnosis" while the unit was in the test mode, restored the correct speaker display level. **C.B.**

Sony HCD-S880

This unit would play DVD and SACD discs but not CDs. The cause of the trouble was on the DVD board, where the ceramic chip capacitor C428 (3,300pF, 16V) was faulty. A replacement restored normal CD playback. **C.B.**

Panasonic DVD-S35

When this unit was switched on the tray would open and close with the loading/sled motor running continuously. The reason was that the 3·3V surface-mounted regulator IC6251 was faulty, with no output. **A.R.**

LG FFH-DV25AD

The problem with this DVD micro hi-fi was intermittent loading and failure to read a disc and eject it. Replacement of the loading belt and a clean up provided a cure. **J.S.O.**

JVC XV522SL

If there is no picture/freeze frame while the unit is reading a disc, suspect the spindle motor (part no. FXL-V6SPSV-2C). Check the resistance reading of the motor: if this is less than 13Ω, fit a replacement. A temporary check, to prove that the fault is caused by the spindle motor, is to connect a battery across its terminals (with the motor out of circuit) to clear muck from the commutator. This should restore operation, proving that the motor is the cause of the trouble. **J.C.**

Panasonic DVD-RV31

If the picture freezes when the machine has warmed up, resolder the spindle motor and the components next to it. This usually restores normal operation. If the fault persists, the spindle motor may have to be replaced. **J.C.**

An electronic stethoscope

There are all sorts of uses for stethoscopes: they can for example be helpful for activity detection when fault-finding. Ian Field presents a simple but efficient design that allows for flexibility in component selection

This project sprang from humble beginnings, the original idea being to strip an old mono audio-cassette recorder to obtain the parts required, including the record amplifier. The plan to use them for an electronic stethoscope was quite simple. The electret microphone would have a 'stirrup' superglued to the diaphragm, to increase its sensitivity to vibration and decrease its sensitivity to sound pressure waves. This modification wasn't a complete failure, but the result was extremely fragile. The record amplifier turned out to be totally unsuitable. Mains hum and pick up of local radio were problems, and the circuit seemed to produce vast amounts of hiss. Matters weren't helped by the fact that the amplifier had built-in HF boost.

The amplifier

So I had to start afresh. Various types of amplifier were tried, with the emphasis being on op-amps as these are supposed to be easy to use as building blocks. But the hum and noise problems persisted. More out of desperation than anything else, I decided to try using the TL431 adjustable shunt regulator chip. Fig. 1 shows the basic circuit that evolved.

The TL431 is in fact a voltage comparator with a built-in reference voltage of 2·5V. If the gain of the device is rolled-off hard enough, using negative feedback, it can be used in a linear mode, much like a TTL or CMOS inverter. For this purpose a comparatively low resistance is required between the output and the input. The advantage of a TL431 is that within its normal operating range it will try to keep its regulation input (pin 1) at 2·5V, a voltage with which a typical electret microphone seems to be happy.

Initial experiments with a TL431 as the audio amplifier were carried out using a 35Ω loudspeaker as the cathode load and a 12V supply. An electret microphone was connected between the regulation input (pin 1) and ground, with a variable 47kΩ resistor between pin 1 and the output, pin 2, to provide negative feedback. Adjustment of the variable resistor enabled the voltage across the loudspeaker to be set at half the supply voltage (12V/2 = 6V). With just a resistor from its cathode to its input for negative feedback the TL431 produces very little useable gain. But if the resistor is split in two and the junction is decoupled with a capacitor, only DC feedback is applied. This sets the operating conditions. The AC feedback is shunted to ground, with the result that there is a very large AC gain.

Even with this crude arrangement howl-round was a problem – until the speaker was provided with longer leads so that it could be placed farther from the microphone.

This circuit worked, but the TL431 tended to run a little on the warm side. So a very crude power amplifier was added, allowing the TL431 to be run with a larger cathode resistor (RV2).

Output stage

As the TL431 has an output resistance of only 200Ω, there is little danger of selecting an output amplifier with too low an input impedance. Constructors may therefore like to choose their own power amplifier. Something like an LM386 1W amplifier, or even some op-amps will drive headphones. Alternatively the MOSFET amplifier I cobbled together for the project can be used, see Fig. 1, or scaled down for lower power, depending on whether headphones or a loudspeaker is to be used.

The MOSFET amplifier shown was hastily put together with parts that happened to be available. The circuit has no particular elegance – it was built around the first small speaker transformer I found in the junk box. This had a primary-winding DC resistance of 17·2Ω. At half the supply voltage (12/2 = 6V) the current is 348mA. The 2SK2098 MOSFET used can just about handle the dissipation without a heatsink but, to be on the safe side, a current compensating resistor (R1) was included in series with the device's source. Its value was selected to produce a voltage drop somewhere between this MOSFET's typical and maximum gate threshold voltages, which are 1·5V and 2·7V respectively. At 348mA a 6·8Ω resistor, the value used in the prototype, develops 2·37V.

R2 biases the gate from the low-value potential divider RV1, giving the amplifier a high input resistance. Its value is not critical but must be high, say 2·2MΩ. The value of RV1 is also non-critical: it should be at least 10kΩ but not more than a tenth of the value of R2. When the source decoupling capacitor C1 (at least 100μF) and the supply decoupling capacitor C5 (at least 470μF) have been added the MOSFET can be set up, by adjusting RV1, to produce about 6V across the primary winding of T1. Once the ratio of the upper and lower sections of the potentiometer has been determined, it can be replaced with two fixed resistors.

This trial-and-error approach is much easier than providing hard-and-fast values that may not suit the load the constructor has ready to hand. If a transformer is to be used, measure its DC resistance and calculate the standing current required to develop half the supply voltage across the winding.

Bias compensation (R1) is as just outlined. The resistor should produce between the MOSFET's typical and maximum gate threshold voltages at the standing current. C2 provides signal coupling from the volume control VR2 to the gate of Q1.

Once the MOSFET output stage has been set up it can be tested by touching the gate terminal with a finger: this should produce a very loud buzz from the speaker.

Headphones

Ultimately the battery capacity will determine the current drawn by the power amplifier. So the use of a pair of Walkman-type headphones is recommended for portable applications. Two pairs of headphones were tried in the workshop, a pair of Sennheiser HD26 headphones

Component guide

C1	100µF
C2	0·1µF
C3	220 or 330µF
C4	See R5
C6	At least 470µF
R1	Depends on Q1's load current. For 17·2Ω load, 6·8Ω; for 64Ω load, about 32Ω
R2	About 2·2MΩ
R3	By experiment, with 12V supply, 1·2kΩ. See text
R4	By experiment, with 12V supply, 13kΩ. See text
R5	May not be needed. Prototype unit picked up talk radio. Cured by adding R5 5·6kΩ and C4 1·5nF
RV1	At least 10kΩ, not over 47kΩ. Once the optimum bias for the gate of Q1 has been established, RV1 can be replaced with a pair of fixed resistors of suitable ratio
RV2	Volume control, 200 or 220Ω. Should be rated at 0·2W.
Q1	A 2SK2098 was used in the prototype. An IRF640 will probably work as well. For battery operation it is recommended to adjust to a lower drain current and use a 2N7000
Q2	See text. Will be included with an electret microphone
U1	TL431. Monitor power supplies are a good source
T1	See text
L1	See text
X1	A piezoelectric transducer or electret microphone. The latter will include Q2. See text

which measured 32Ω per ear (64Ω in series), and a pair of Philips SBC-HS405 super-bass headphones which measured 16Ω per ear (32Ω in series).

These units have much smaller diaphragms than a conventional loudspeaker, so 'dumping' half the supply voltage across the coil is likely to 'slam' it. The load current operating point should therefore be set lower, by adjusting RV1. A suitable MOSFET would be the 2N7000 or similar. With this device the maximum gate threshold voltage is 3V, so the value of the series resistor R1 should be increased accordingly. With a load resistance of 32Ω R1 should be about 15Ω, while with a load resistance of 64Ω it should be about 32Ω.

The mic amplifier

Moving back to the TL431 microphone amplifier U1, I determined the values of the feedback resistors R3 and R4 for a 12V supply by connecting a 47kΩ variable resistor between pins 1 and 2, with the electret microphone connected between pins 1 and 3 (ground). The variable resistor was adjusted for 6V across the 200Ω load resistor RV2 (volume control). With the type of microphone used the resistance value came out at 14·16kΩ. This has to be split in two to allow the AC feedback shunt C3/L1 to be added. The ratio between the two fixed resistors was a guesstimate. For R3 1·2kΩ should not load the cathode signal unduly, and at 13kΩ for R4 the input impedance shouldn't be reduced too much

The same principle can be used to set up the TL431 for a 9V supply if desired. Simply use a 47kΩ variable resistor to obtain 4·5V across the 200Ω load resistor RV2, then split the resultant resistance value in a similar ratio.

The AC shunt C3/L1 calls for some explanation. The DC path via R3 and R4 provides a large amount of negative feedback that stabilises U1's cathode voltage at half the supply voltage. Without C3/L1, the series combination of R3 and R4 would also provide AC negative feedback to pin 1 of U1. C3 shorts out the AC negative feedback so that the gain provided by the TL431 chip for AC signals is not cancelled. The quality of C3 has an important bearing on circuit operation – but not in the way you would think! A poor quality electrolytic capacitor will have a high ESR and probably high internal inductance, both of which cause poor HF performance. This can in fact be a good thing, since the poor HF performance will roll off the stage gain at HF. The most predictable way to control this is to use a fair- to good-quality component in the C3 position and add a small inductor (L1) in series. L1 can be between 100-1,000µH; anything above about 470-680µH

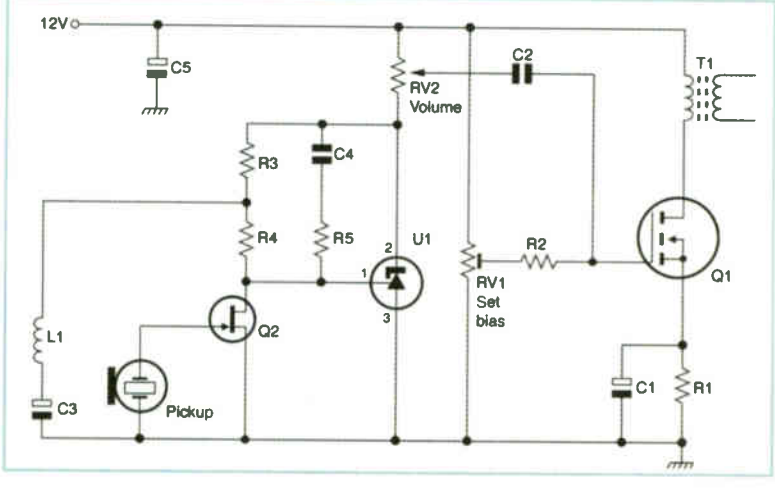

Fig. 1: Basic circuit of the electronic stethoscope. See text for component details.

starts to cut into the AF response. In some situations the added inductor can worsen radio pickup. The prototype picked up a local talk radio station. The series *CR* network C4/R5, in addition to or instead of L1, will roll off the HF response. The C4/R5 combination is probably the easiest way of designing a tailored response curve should anyone wish to do so.

The microphone

As mentioned at the beginning, the transducer presented a few difficulties. It's possible to superglue a 'stirrup' to the diaphragm of an electret microphone, but this arrangement is extremely fragile. The following modification was devised. A length of 6BA spacer was superglued over the hole in the front of the microphone, a length of spring was pushed over the end of the spacer and a threaded spacer was pushed into the end of the spring. A length of pencil graphite was dropped into the two spacers and a screw was run into the threaded spacer to tension the graphite rod against the diaphragm. It's difficult to damage the diaphragm with this method, but sensitivity is not very high and the screw tension requires careful trial-and-error adjustment.

The various experiments carried out with electret microphones resulted in a collection of damaged units that could, at any rate, be cut open to salvage the special JFET preamplifier built into each one. Further experiments proved that almost any piezoelectric transducer can be used, with an electret microphone JFET. An old record-player crystal pickup worked very well, as did the piezoelectric crystal from an electronic cigarette lighter – you have to strip away the spring-loaded 'clicker' to get at the small plastic moulding that contains the crystal. For greater sensitivity the crystal can be taken from its moulding and fitted into a home-made housing such as a pen tube with a loading spring.

Piezoelectric sounder discs also work well when a loading weight is glued to the back of the crystal. Sounder discs usually work best when they are bonded to the surface being monitored. They are well suited to bugging applications when glued to a resonant surface (a wall will do), and may also provide a way of converting an acoustic musical instrument into one with an electric pickup.

The following JFETs are listed as 'condenser-microphone' types: 2SK65 (Idss 0·04-0·8mA); 2SK68A (Idss 0·5-12mA); 2SK123 (Idss 0·13-0·175mA); 2SK156 (Idss 0·06-0·8mA); 2SK266; 2SK331 (Idss 0·06-0·8mA); 2SK376 (Idss 0·06-0·8mA); 2SK456 (Idss 0·06-0·5mA); 2SK596 (Idss 0·1-0·8mA); 2SK624 (Idss 0·095-0·385mA); 2SK625 (Idss 0·06-0·5mA); 2SK645 (Idss 0·1-0·315mA); 2SK660 (Idss 0·06-0·5mA); 2SK692 (Idss 0·06-0·3mA); 2SK879 (Idss 0·3-6·5mA); 2SK997 (Idss 0·1-0·5mA); 2SK1108 (Idss 0·04-0·6mA); 2SK1227; 2SK1578 (Idss 0·1-0·8mA); 3SK62 and 3SK71 (dual source with Idss <0·5mA).

The following JFETs are not listed as microphone types or found in scrap microphones but have been used successfully as piezoelectric transducer preamplifiers: 2SK34 (Idss 0·6-24mA); 2SK168 (Idss 4-20mA); 2SK152 (Idss 9·5-42mA); 2N4340 (Idss >1·2mA).

LETTERS

Send letters to "Television", Highbury Business, Media House, Azalea Drive, Swanley, Kent, BR8 8HU or email t.winford@highburybiz.com using the subject heading 'Television Letters'.

Please send plain text messages. Do NOT send attachments. Be sure to type your full name, address, postcode, telephone and email address (if any).
Your address and telephone number will not be published but your email address will unless you state otherwise.

Vintage repairs

I was interested in J. LeJeune's article on tuning indicators in the September issue. There appear to have been two types of Tuneon (tune-neon) indicator. The one in which the length of the neon glow gave an indication of tuning had three electrodes, anode, cathode and primer. With the other type, in which the neon glow itself varied to give an indication of tuning, there were just two electrodes, cathode and anode. An extra electrode was required to get the length of the glow to change.

Fig. 1 shows the circuit connections for the three-electrode type of Tuneon indicator. The anode was connected via a resistor of 30kΩ-100kΩ to the decoupling resistor (typical value 20kΩ) in the HT feed to the gain-controlled IF amplifier valve. The primer electrode was connected to the HT line via a resistor with a value of about 2MΩ, while the cathode was either connected to chassis or to a potential divider across the HT supply to apply a suitable bias.

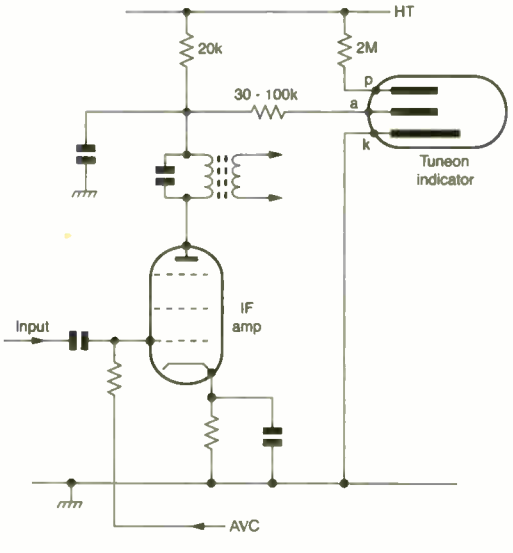

Fig1: circuit connections to the three-electrode Tuneon tuning indicator.

The button-type two electrode Tuneon indicator had its cathode connected to chassis while its anode was connected via a surge-limiting resistor of about 10kΩ to the decoupling resistor in the IF amplifier's anode circuit. Two or three surge-limiting resistors in series might be used to provide taps for the neon tuning indicator feed, with possibly selection by means of a switch. The idea was to select the resistance value that provided a barely perceptible glow under no-signal conditions.

I have a Tuneon in stock, as I service vintage radios. Instability was the problem with a pre-war French radio I have just repaired. The metalising on the EF6 IF valve was open-circuit, a common fault, but in addition the power factor of the HT smoothing was high and had to be decoupled. I changed all the HT smoothing capacitors and carried out performance checks while my friend John attended to the mechanical work and the cabinet.

We get many interesting old radios in for repair, also TV sets. I have just repaired three old TV sets, a 12in. Vidor, a 17in. Pye Model 17RTL and a 17in. Pilot Spacesaver. I use 405-line tapes as a signal source, with a Ferguson 3V29 VCR and a home-made three-transistor modulator. The tapes are obtained from a friend and are digitally standardised, so the sync pulses are very clean. Most early TV sets didn't have flywheel line sync.
Jim Littler,
Wigan, Lancs.

Hitachi projector spares

We recently had an Hitachi projector that was just out of warranty brought in for repair. The customer thought that the lamp had failed, because the projector started up with no display. So we told him the price of a replacement lamp. As this gave him a bit of a shock, we suggested that we check the projector first. He agreed, and we found that the ballast power supply had failed. Reference to the Hitachi Esta CD revealed that this is a known fault and that a modification kit is available. We ordered one from Chas Hyde & Son, as we are not official Hitachi repairers.

When the kit arrived it contained ten of each part required to carry out the repair which, to my relief, was completed using one of each part. I queried this with CHS, as Hitachi wouldn't speak to me, and was told that the kit is sold only in packs of ten. What a way to sell a kit! Do they think we engineers are idiots and sometimes need ten attempts to carry out a repair?!

If anyone out there has an Hitachi projector, Model CPS317, CPX32 etc., I can supply the ballast kit complete with instructions at a fraction of the standard price or the price of the parts bought separately. Enquires to
DoctorTelevision@aol.com
Brian Booth,
Doctor Television, Luton.

Correction

In the editing of my article "Is there life after TV repair?" (October, pages 736-7) a short section, as follows, was omitted:

http://traderonlineforum.com

However you trade on the internet, it's essential to have your own website where you can put information and take payments. I've found that the cheapest deal is at

The above should have appeared immediately before the following line:
www. betterwebspace.com

In addition, in case any of my old colleagues at Brother Industries take exception about this, I did not claim to be the quality-control manager. What I wrote was Q.A. manager. The Q.A. stands for quality assurance, a different job altogether. Quality control relates to the quality of incoming parts, quality assurance the quality of outgoing, finished products.
Martin T. Pickering, B.A.,
SatCure Distribution.
gen5@satcure.co.uk

TDK tapes

I was astonished to read Steve Roberts' letter in the October issue on a problem

with TDK videotapes. As I watch far too much TV, I buy videotapes in packs of five or ten. I use TDK tapes almost exclusively, because I trust the brand, and have never encountered or seen the problem mentioned by Steve. None of the cassettes here (and there are plenty of them!) had a label on as received. They have all been bought in TDK boxes, film wrapped, from established high-street stores.
Graham Hankins,
Birmingham.

Storing circuit diagrams

Circuit diagrams can be a problem to store, being of all shapes and sizes, and can be very time consuming to sort through. I have solved the problem by using the anti-tamper rings from a variety of food products. Roll the circuits up, like a serviette, and use the plastic rings to hold them. Jot the model number on each roll. The rolls can be stored in a suitable stout box, on its side.
Jon Douglas,
Newcastle upon Tyne.

Tuning indicators

According to J. LeJeune (September) "tuning indicators were never necessary with the AM radio receivers that graced the nation's homes from the Twenties to the Seventies". On the contrary tuning indicators were and still are necessary, for the simple reason that many people are incapable of tuning in a radio set properly without a visual aid. Visit many shops today and you will find an off-tune transistor radio stridently spitting out sibilants without anyone behind the counter being aware that something is amiss. On occasions I've been so offended aurally that I have taken it upon myself to tune a set in properly, whereupon the shopkeeper has been astonished by the vast improvement in sound quality. This failure on the part of listeners has been evident for more than seventy years, since the second flowering of the superhet receiver in the early Thirties, and was the reason why a great deal of time and effort went into the development of effective visual tuning indicators. They were not just a sales gimmick, as J. LeJeune implies.

From the beginning of broadcasting in the UK until the early Thirties the TRF receiver reigned supreme. Superhets had a limited but brief popularity in the mid-Twenties, but what appeal they possessed on the grounds of sensitivity was negated by the advent of screen-grid valves in late 1927. These made it possible to build very sensitive TRF sets, but obtaining good selectivity remained a problem. This and the absence of an audio volume control as we know it led to listeners deliberately mistuning their sets as a way of reducing the sound output – because the tuning response was broad, there was little audible degradation. The increasing congestion of the airwaves during the late Twenties and early Thirties however brought about the renaissance of the superhet, as a means of obtaining 'knife-edge' selectivity. If the purchaser of a new superhet receiver tried the method of volume control he had adopted with a TRF set the result would be appallingly bad sideband screech, for which he blamed not himself but the receiver manufacturer. Obviously in this situation a visual aid to correct tuning was a boon, not a showy, useless extra.

The advent of variable-mu valves made true automatic volume control possible (it had been tried unsuccessfully in America ten years earlier) and, with it, tuning indicators. One of the first, and deservedly popular, was EMI's 'fluid-light' system, which the listener saw as a strip of green celluloid whose illumination varied as the station was tuned in. Control of the illumination, which was provided by a small lamp, was by means of a form of milliamp meter that was connected in the HT supply to the anode of the IF amplifier valve. Various versions of this type of indicator were employed by other radio manufacturers.

In the mid-Thirties MO-V introduced two types of neon tuning indicator (Tuneon), one a long tubular type with illumination of variable length, the other a 'button' lamp whose brightness varied with the tuning of the set. They cost 4/- and 2/6 respectively. Cossor marketed a similar type of indicator to the first, at the same price – given that MO-V had a large financial interest in the Highbury firm, this was perhaps not surprising.

At about the same time Pye introduced a variable light-level indicator in which the current through a small lamp was controlled by a small saturated-core transformer in the anode circuit of the IF amplifier. It was quite effective in its own way, but it and all the other systems were swept aside when the cathode-ray type of indicator was introduced in the late Thirties.

It quickly became known as the 'magic-eye' indicator, and versions were produced by most of the major valve manufacturers. A second-generation type (EM4), made by Philips/Mullard, featured dual sensitivity for local and distant stations, with a Maltese-cross display. Another type (EFM1) incorporated an AF amplifier. Many varied and interesting 'magic-eyes' were developed on the Continent after World War II. Most were not introduced in the UK, the exceptions being the EM80/81 and others in this series and the little DM70. The latter was intended for use in battery sets, but also found its way into a fair number of mains receivers.

To sum up, by the time that World War II broke out the visual tuning indicator had proved to be a very useful and popular adjunct to domestic radio receivers. It was not confined to just the most expensive models!
Chas E. Miller, Editor,
The Radiophile,
Woodseaves, Stafford.
01785 284 696.

Editorial comment: We don't doubt the usefulness of tuning indicators, but wonder how widely they were used by set-makers. A trawl through early post-war radio circuits revealed few that included a tuning indicator. A check through the model specifications listed in the 1939 *Trader Yearbook* (mostly 1938 models) revealed a surprising number that included a CR indicator, though they were decidedly in the minority.

DX and Satellite Reception

Terrestrial DX and satellite TV reception reports. Broadcast and satellite TV news. The use of in-line amplifiers for satellite TV reception. Roger Bunney reports

*Tellytrack offers horse racing from the UK, Middle and Far East via Europe*Star (45°E).*

August produced some remarkably hot weather early in the month but ended with torrential downpours. According to Solent TV local news it had been the wettest August since 1912. At one time we would look forward to a settled high-pressure system during September, with a good tropospheric opening. Unfortunately this hasn't happened for several years: maybe 2004 will be different.

Fortunately there was some Sporadic E reception throughout August, and some excellent tropospheric reception earlier during the hot weather. There were no reports of MS reception during the Perseids meteor shower, but there's been a little DX DAB reception. First the SpE log:

1/8/04	RAI (Italy) ch. IA.
2/8/04	RAI chs. IA, B; Tele-A and TGA (both Italian stations) ch. E2–; ETV (Estonia) ch. R2; TVE (Spain) chs. E2, 3; SLO (Slovenia) ch. E3; HRT (Croatia) ch. E4; ARD (Germany) ch. E2.
3/8/04	RAI IA; C+ (Canal Plus, France) L2.
4/8/04	YT (Ukraine) R1, 2.
7/8/04	TVE E2-4; RTP (Portugal) E3; NRK (Norway) E2-4; SVT (Sweden) E2-4; YLE (Finland) E3.
8/8/04	RAI IA; TGA and Tele-A E2–; TVE E2.
9/8/04	RAI IA, B; Tele-A E2–; TVE E2; RTP E3.
11/8/04	YT R1, 2; SVT E2, 4; YLE E3, 4.
16/8/04	RTP E3; YT R1; LRT (Latvia) R1.
19/8/04	YT R1.
25/8/04	RAI IA plus many unidentified transmissions.
26/8/04	TVE E2.

Very strong tropospheric signals were received across much of the UK during late July and early August. July 28 and 29 were particularly active, with many Benelux and some German stations received in Band III and at UHF, though not extending as far as Denmark. Tropospheric propagation returned on August 4 until the 6th, again with Benelux, German and Danish (chs. E33 and E40) stations and possibly Sankt Chrischona ch. E49 (Switzerland, with French language). During this period Cyril Willis (King's Lynn) added to his DAB-DX total with Wrotham, Kent and two Continental multiplexes, one from Brussels and the other from the Netherlands. This was with a Triax five-element, wideband Band III aerial and a preamplifier. DAB-DX does work!

Satellite sightings

From mid-August the 2004 Olympic Games from Greece dominated the eastern sky. Not unexpectedly, the Greek Hellas Sat 2 (39°E) carried the bulk of the reports from Athens. Roy Carman lent Edmund Spencer a Coship blind-search receiver. With his 80cm dish Edmund picked up numerous signals at 39°E. There was for example the BBC feed 'SNG REV VIS', carrying 'BBC LINK 21', at 11·187GHz V. This was a reverse (non-broadcast) feed for cueing etc. It used the very low SR (Symbol Rate) of 2,726, with FEC (Forward Error Correction) at 7/8. By August 14 Roy had found 24 Olympic downlinks via 39°E, with others via Sesat (36°E) and Eurobird 2 (28·5°E).

I noted RTL and other broadcasters using Eutelsat W1 (10°E) and W2 (16°E) for news reports back to their respective networks. An interesting three-channel Olympic multiplex fired up via Europe*Star (45°E) prior the start of the Games and carried occasional reports throughout the period. It was operated by Athens Broadcast Services at 11·602GHz V (SR 13.328, FEC 5/6) and was on air 24 hours a day. The three services were identified as BB1, BB2 and BB3. A feature was an impressive live view of the Acropolis. Alan Richards (Skegness) was also on the Olympics trail. He found a BBC feed in MPEG 4:2:2 form via E-Bird (33°E), a German feed via Astra (19·2°E) and a French feed via Eutelsat W3A (7°E).

Unrest in Iraq turned to outright war in places, particularly Najaf. There have even been hostilities in Basra, where the UK

forces are stationed. Aggression seemed to be particularly high on August 21, when the ABC Scopus feed via Intelsat 10-02 (1°W) at 11·672GHz V (5,632, 3/4, NTSC) carried live night-time pictures of the Baghdad skyline from a locked-off camera, with tracer bullets flying across the arc, the familiar 'tapa tapa tapa' from AK47s and the 'chonk chonk chonk' of US machine guns. Note that the Scopus feed frequency occasionally changes. On the same night CBS News Baghdad ran a down-load of locals watching football on an outdoor communal TV set. At the end of the match heavy gunfire broke out and the watchers had to run for cover. Such is evening life in down-town Baghdad. This was via Eutelsat W2 (16°E) at 12·544GHz H (5,632, 3/4).

Evening life in Peterborough is less violent! On the 24th an Anglia contract truck, BT TES-42, provided a short item for the evening magazine programme, a report on a local football match of some importance. After the statutory colour bars the crew switched off and I thought "they're on their way home". No so. About forty minutes later the frequency livened up as TES-42 switched on again, the engineer back from his supper break, and provided full coverage of the match. The downlink was via Telecom 2D (8°W) at 12·581GHz V (5,632, 3/4), match coverage from 'Anglia TV OB1'.

At the time of writing (late August) Eutelsat 2F3 (21·5°E), in an inclined orbit that swings over 3·5°, is providing maximum signal access every twelve hours. The evening peak occurs at about 6 p.m. BST – the time advances slowly each day. I was lucky on Friday August 13 with a rare reception from the BBC South satellite truck, which was providing live interviews from Battle, East Sussex. Over the next two days a re-enactment army group was to replay the Battle of Hastings. The UKI-705 BBC South feed was received at 12·559GHz H (5,632, 3/4).

The 1°W slot was host to The Northern Ireland Kite Festival, held at Port Stuart Strand. On August 20 the presenter for the BBC NI evening TV magazine programme attempted to describe the festival, to be held over the weekend, while holding a human-size torso kite – extremely difficult on a beach in a strong wind! Two uplinks were in operation, the main plus a fully-redundant standby: they appeared as UKI-912 Chain A and BBC-UKI-847A, at 11·484GHz V and 11·475GHz V respectively (5.632, 3/4).

There is increasing activity via the Russian Express AM22 satellite at 53°E, with TV channels that provide programmes for the Ukraine and regions farther east, reaching perhaps Uzbekistan and Kazakhstan. A three-channel multiplex at 11·046GHz V (29,812, 3/4) transmits programmes from that area but I can't identify the specific states. There's a music channel, Muztv-Unost, plus channels CTC+0 and CTC+2 that provide normal programming. An encrypted 'Skystream' in the same multiplex remains secret. A further two-channel multiplex is transmitted at 11·102GHz V (6.000, 3/4). Peregon seems to consist of the colour-bar test pattern with a one-third screen overlay of another colour-bar selection that flashes every half second or so. UTR is a TV channel uplinked from Kiev, which appears as Knib, with the weather forecast extending from Eastern Europe through to Tashkent, and closes down for the night at about 2300 hours Ukraine time. These signals are very strong with a 1·2m dish, and should be easily received using an 80-90cm dish. Readers in the trade with Ukrainian-speaking customers might be interested.

Broadcast news

India: DTT transmissions have been available in the main cities for two years, but the public has shown little interest. So digital TV broadcasting has been put on the back-burner. Lack of consumer interest has been put down to the high cost of digital receivers. In addition radio broadcaster AIR has shelved plans to start MW and SW digital radio services (DRM). Broadcaster Doordarshan intends to expand DTV satellite services however, with plans to offer forty channels via four transponders aboard the Insat craft. These services will initially be directed at eight states including Gujarat and the North Eastern region.

Telecongo appeared via Intelsat 901 (18°W) for a few days in late July.

South Africa: It is hoped that the government will support private-sector partnerships to promote growth of regional TV, with the emphasis on local languages. Plans are expected to be in place by next summer. The new services will be independent of the SABC.

An Athens Olympics feeder for Enex, Luxembourg.

*An Olympics Athens Broadcast Services feed via Europe*Star (45°E).*

Malaysia: The government is to toughen requirements for the issue of TV broadcasting licences and enforce an improvement in current standards because of broadcasters' failure to provide quality services.

Oman: The sultanate is to allow private companies to run radio and TV services. Each licence/franchise will last for ten years.

Fiji: The Chinese are preparing an initial technical specification for Fu Shun Television, which will provide up to twelve channels, starting in the capital Labusa.

Vintage TV sets

Brian Renforth (Jarrow) is an enthusiastic preserver of vintage 405-line and dual-standard 405/625-line sets. He continues to restore and use several elderly TV sets and generates his own 405-line signals from a VCR. Brian tells me that the vintage TV collection of another restorer of old TV sets, Gary Platten, has been subjected to vandalism, with at least four sets damaged beyond repair. Those lost were a very rare Bush Model TV22 and sets fitted with the ITT CVC5, Philips G8 and Thorn 3000 chassis. If any readers, trade or otherwise, have unwanted sets of these types I'm sure that Gary would be delighted to hear from them. His address is 22 Fourth Street, Quaking Houses, Stanley, Co. Durham, DE9 6HB. A 9in. Bush TV22 in the classic brown Bakelite cabinet would probably be asking rather a lot – these sets are now highly sought after and command collectors' prices.

The more recent classic Bush TV62 with Telpic tuner was the son of TV22. For many years I DXed with three or four of these wonderful sets.

Satellite news

New Zealand programme provider TelstraClear is to pull out of TV and sell its half transponder aboard the Optus B1 satellite.

There is some uncertainty about the Sky Pacific (Fiji TV) service which was due to come into operation in September via Intelsat 701 (180°E). It was originally to have used the NSS 5 satellite but is in dispute with the Dutch-based NSS. 701 provides greater coverage, extending into eastern Australia.

Jewish Television (JTV), a 24-hour commercial satellite/cable service, is to start next spring, operating at first in the US. For further information check at http://www.jtelevision.com

Eurosat is promoting the Plaza ST range of Manhattan satellite receivers that feature blind search, an essential tool when hunting for new channels and feeds.

In-line sat TV amplifiers

I am indebted to Bob Cooper of the New Zealand satellite trade magazine *SatFACTS* for permission to use information in the August issue of the magazine in this section of the column. The in-line amplifiers referred to are the small units, usually diecast-metal cased with F in/out connectors, intended for insertion in a long cable run between the dish/LNB head and the satellite receiver to compensate for cable losses. They are usually blister packed with a flat gain of 10-20dB and cost about £10-£25. Power is obtained from the supply via the cable to the LNB. 15V at 50mA being a typical requirement.

Various factors need to be considered when the use of an in-line amplifier is thought to be necessary. The LNB at the dish establishes the overall quality of the receiving system in terms of noise. It amplifies, with minimum addition of noise, the weak incoming Ku-band signals (at about 12GHz), downconverts them to L band (900-2,300MHz), further amplifies the L-band signals and sends them on their way down the coaxial feeder to the receiver. The LNB provides a signal voltage gain of about 55-60dB. The average satellite receiver will contribute a similar gain, providing an overall system gain of 120dB or so.

The feeder should be a good-quality, double-screened cable such as the CT100 or CT125 type. But all coaxial cable has an inherent loss which is related to frequency – the higher the frequency, the greater the loss. Table 1 shows the loss per 100m at specific frequencies for CT100 and CT125 cable. It will be seen that there is a considerable difference between 1GHz and 2GHz.

Very little information is provided by the manufacturers of in-line amplifiers, which are all made in Taiwan, Korea or China. They are supplied pre-packaged with just an operating voltage/current and a gain figure, either 10, 15 or 20dB, stated. The one I have says 10dB gain, 15V/50mA required, 950-2.050MHz bandwidth. It is badged CHY and has the type no. SA-910LA. F-type input/output sockets are fitted of course. Such units can, with some difficulty, be prised apart. You will then see a stripline PCB with perhaps a single active device and a voltage stabiliser. The units are very cheap to mass-produce, may well overload if supplied with too much signal, and are likely to have a high noise figure.

The SA-910LA type has a flat gain while the LA9215 type has a rising (equalised) gain with frequency, from 10dB at the low end of the band to 14dB at the top end over 950-2.050MHz. Thus the LA type is far better suited to compensate

for cable loss over a long run. A check in *What Satellite and Digital TV* magazine shows that Myers Satellite, London E17 (phone no. 020 8520 7277) stocks in-line amplifiers with both flat- and equalised-gain characteristics.

A good-quality LNB may have a noise figure of 0·5dB or even less, while an in-line amplifier could have a noise figure of 8, 10 or even 12dB – it's not usually quoted. Connecting a noisy in-line amplifier in a long cable run between the LNB and the receiver, which could have a tuner noise figure of 12-15dB, will clearly degrade the quality threshold. Nowadays we are concerned with digital rather than analogue reception, and a digital receiver will probably provide a signal level and quality graph or other representation. With Coship receivers this is easily accessed by pressing the info button, which brings up an overlay panel that provides many features of the signal tuned in. Bob Cooper suggests checking the signal quality with the in-line amplifier in circuit then out of circuit. If there is no improvement in quality, the in-line amplifier may not be needed. A problem with this is that it means cutting the cable and inserting F plugs/sockets. The resulting mismatch can introduce a signal loss of perhaps 2dB.

With these unknown variables it's difficult for the enthusiast to assess the improvement that might be obtained by adding an in-line amplifier. Experienced aerial engineers will probably have little problem in deciding whether an in-line amplifier is required and where to fit it. One golden rule is not to fit it at the LNB output, since the higher signal level at this point may well overload the amplifier. Once the signal has been degraded you can't subsequently restore it. The best location for an amplifier is at a point along the cable where the signal attenuation is equal to the gain of the amplifier. For example there will be a loss of 10dB at 2GHz along 33m (100ft) of CT100 cable (see Table 1). The loss can be made good by adding a 10dB gain amplifier at this point, but bear in mind that the two F plugs will contribute an additional loss. Bob Cooper further comments that where a signal splitter is used to feed more than one receiver the throughput splitter loss may take away more than you are making up with a line amplifier, so the amplifier should be fitted ahead of the splitter. An in-line amplifier is used to make up for cable loss, not to provide extra signal gain. If a satellite receiver's front end is driven too hard it may well overload.

Table 1: Satellite cable loss per 100m

Type	*400MHz*	*860MHz*	*1GHz*	*2GHz*
CT100	13dB	19·7dB	21dB	29·3dB
CT125	10·7dB	16·1dB	17·4dB	24·9dB

A final point. Good-quality CT100 cable has a copper screen and an adequate copper braid. Often in modern coaxial cables the copper 'braid' resembles a few strands of cheap Christmas-tree tinsel. Remember: cheap CT100 is low price but high loss!

The August 2004 issue of *SatFACTS* (Vol. 9, No. 10), from which the above information was derived, contains much more detail, also an article on digital meters where BER/MER is discussed. A single copy of the magazine costs US$8/Euro 8 plus air-mail postage. For further information email Skyking@clear.net.nz

HELP WANTED

Wanted: Digital sub-board A (part no. 171 158 81 7) for the Sony Model KV28WS2U (BE3D chassis). Please phone/fax Eastern TV Services (Lowestoft) on 01502 565 427.

Wanted: 27MHz crystal for the Pace ONdigital receiver type DTR735. Cash waiting for an otherwise useless box or just the crystal, or alternatively if somebody knows of a supplier a call would be appreciated. Why would I want such a reliable part? If you want a good laugh, get in touch! A.R. Brown, 3 Moorview Court, New Road, Saltash, Cornwall, PL12 6HQ. Phone 01752 292 009.

Wanted: Working video PCB for the Sanyo Model CBP2876. Please phone Alan Topping on 01905 775 680 (Droitwich) or email alan.tv@bushinternet.com

Wanted: Operating instructions and service manual for the Hameg digital storage scope Model HM205-2. David Ingrey, 87 The Avenue, Hornchurch, Essex, RM12 4JQ. Phone 01708 449 031 or email david.ingrey@tesco.net

Wanted: A tuner panel (part no. 20256340SA) for the Toshiba VCR Model V804B; a tube base (part no. TMP107238) for the Panasonic Model TX2172 (Alpha 1 chassis); and an instruction manual for the Sony HVC3000P camera. Expenses paid. Please phone R.A.B. on 01708 558 792.

Wanted: Old half-inch diameter ferrite rods. Must be six inches or more long. Will pay very good money for them. Peter Tankard, 16A Birkendale Road, Sheffield, S6 3NL. Phone 0114 231 6321.

Wanted: TYB44007P (MC44007P) luminance/chroma IC and ST6365 microcontroller IC for the Grundig 1000 chassis, or possibly a scrapped chassis with at least one of these items in good order. Please email with price required or phone David Beckett on 01782 514 692 (Stoke-on-Trent) davidarthurbeckett@lineone.net

Wanted: An aerial socket for the ITT Model TX2613 (twist fitting with short lead and socket at end). Also a pinch roller for the Akai reel-to-reel tape deck Model GX260D. Please phone 01268 414 654.

Wanted: Circuit diagram (photocopy OK) for the Samsung Voyager 10in. colour portable Model CI210R. Also a scrap Ferguson midi hi-fi Model HFD06 – one with broken cassette decks/turntable would be fine as I need just the PCBs. This unit dates back to 1988. E. James, 8 Bryn-y-Derwydd, Trefin, Haverfordwest, Pembrokeshire, SA62 5AY, phone 0781 417 6641.

Wanted: Quad 34 or 44 preamplifiers, 405 power amplifiers and FM3 tuners for spares, also boards and modules for these. Contact Mike on 0175 861 3790.

Wanted: An AV interface board for the Tatung 170 series chassis to enable a Model TU8711 dating from 1987 to be used with a DVD player. The board has a scart socket and TEA2014 and CD4053B ICs fitted. Also require the IR receiver 'light guide'. Parts from a scrap chassis would be perfect. Will pay postage etc. Nicholas Arnold, 30 Mere Road, Upper Wolvercote, Oxford, OX2 8AN. Phone 07960 646 061 or email nicholas_arnold@hotmail.com

Wanted: I am having difficulty with a Philips VCR Model VR447/05 that doesn't seem to be listed anywhere. What I need is a diagram showing the mechanics of the deck loading system. Can anyone supply this or identify the deck or indicate an equivalent model? Please email paul.gibson@btdigitaltv.com

For sale or swap: Because of a house move I have the following for sale or swap: Sharp Model VZ3510, both sides play MC; B&O Model 3600 music centre, black; B&O tuner Model NR1001; Ferguson piano-key VCR Model 3V00; fifty assorted Betamax tapes, three still wrapped; eight vintage radio receivers, various models. Offers to E. Williams please on 01686 630 637 (Montgomery, Powys).

AUDIO FAULTS

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Sharp CD-DP2400

The reported fault with this unit was "all controls except volume lock when playing a CD or a tape: power has to be removed to restore". This was in fact an almost perfect description of a very odd fault. But there was another factor, which the engineer who brought the unit in had missed. It made the problem even more bizarre.

If 'play' was pressed in say the CD mode, the disc would spin up and play as requested. All other functions worked correctly. You could skip forwards or backwards, stop the disc, open the drawer, change function, anything – until the volume was altered. The display would then change correctly to read 'volume', plus a dB level as the control was rotated. When the control was left at the new setting the display reverted to track information after a couple of seconds, as it should – but no controls other than volume worked! I discovered, by accident, that if the volume control was rotated rapidly normal operation of the other controls would sometimes be restored.

This suggested a software problem so, as a first move, I decided to reinitialise the system. You might think that this happens to a hi-fi unit when mains power is first applied, but in fact all that happens is a system master reset. If the system control was reinitialised, all stored radio stations would be lost together with timer information, clock information, last set function, last set volume etc. So sleep power to the microcontroller's core/memory is usually maintained, by means of a large-value 'goldcap'.

As I didn't have the service manual I was unable to locate such a capacitor with any certainty. So, with the unit completely disconnected, I clipped a crocodile lead to chassis at one end and to a 10Ω resistor at the other end. I then stroked the other end of the resistor around all the microcontroller IC's pins several times, to ensure that any capacitors connected to the pins would be thoroughly discharged.

When the system was repowered the problems had all been cleared. An extended soak test, with several overnight depowerings, proved that the cure was permanent. **G.D.**

Aiwa FD-LM88K

A very long time ago, when I was an apprentice, many parts would be repaired, made or modified daily. Poor mechanical design or construction could often be improved or corrected by a judiciously positioned screw or washer. Sometimes a new spring would need to be made, or reworked from an existing one in the junkbox. These skills were passed down by our workshop mentors, and learning them was an important part of our training.

Nowadays such practices are frowned upon, and often regarded as bodging by the university graduates in power. Doubtless many of the things we did back then were bodging, and would thus not be acceptable today. But the lateral thinking and mechanical skills we learnt all those years ago can still be pressed into service sometimes, in particular to rescue something that would otherwise be dead in the water.

In this case the job ticket said 'CD lid jammed'. It's a motor-driven lid that opens, clam-shell style, in the top of one of the two system units. The motor made an initial grunt, but nothing further happened. When the case had been dismantled and the gear train block had been removed it was clear that two gear teeth had broken off the quadrant-shaped rack, which is part of the lid itself. Once they had been found, jammed in the teeth of one of the drive gears, and removed the motor drive operated freely. This left me with the problem of the missing teeth on the rack. They are the two that engage with the final drive gear when the lid is fully closed and at rest. Thus when the open button was pressed the lid just bounced as the drive gear caught and slipped on the remnants of the broken teeth.

As many of you will know, obtaining parts for Aiwa products has become nigh on impossible since the brand was taken under the Sony umbrella, particularly small or obscure ones for cheaper products such as this one. So it was that I brought some of the old skills and lateral thinking to bear on the problem of the damaged lid.

Clearly any replacement teeth would need to be strong and reliable. Thus any kind of gluing, or profile rebuilding with epoxy resin, was out of the question. The rack is about 3mm thick, so I took a scalpel and planed down the remnants of the broken teeth to leave a flat surface. I then used an 0·7mm PCB drill bit to make two holes, side by side, at each of the missing tooth sites. Next I took some 0·9mm lacquered copper wire and made a sharp hairpin bend at the end. This was cut off, at a length of about 5mm, and the two ends were pushed into the previously drilled holes.

A soldering iron was used to heat the wire loop until it pushed down into the tight pilot holes in the rack. I continued until the top of the loop was level with the adjacent tooth. The whole process was then repeated for the other missing tooth. A small amount of epoxy resin was next mixed and teased in around the bottoms of and between the new teeth. This was to ensure that no movement could take place

between the copper wire and the remaining, original teeth.

After leaving this overnight to harden really solidly, I finally touched up the profile of the newly created teeth with a rat-tail file. When all had been reassembled, I was rewarded with a lid that operated as smoothly and faultlessly as the day it came out of the factory.

This may seem to have been a long-winded procedure that was not worthwhile in view of the value of the equipment, but in fact it took no longer than a 'normal' repair. There was the added bonus that a piece of otherwise working equipment had been saved from becoming just another piece of landfill. **G.D.**

Sony HCD-ED1

There was no power on though the record and DBFB lamps were lit. When I carried out some voltage checks I found that the master control chip IC201 was faulty. A replacement restored normal power-on operation. **C.B.**

Sony STR-KSL60

There was no fluorescent display – only the function-indicator LEDs lit up. Multimeter checks on the display board proved that the supplies to the FL/LED driver IC were present and correct, so a closer look was taken at the connections to FL101's pins. Inspection with an eyeglass revealed a hairline crack across the track that leads to the pad of pin 64. I soldered a small wire link between the pin and a test pad on the track just before the break. This restored the display.**C.B.**

Sony HCD-ED1

There was an intermittent CD playback problem with this unit. The cause was on the volume/power board, where R516 (470Ω, 5%, 0·25W fusible) was defective. A replacement restored correct operation. **C.B.**

Revox B226

There were a few faults with this CD player. The display wasn't visible, the operation of the CD tray was erratic because the guides on one side had come loose and one of the O rings on which it rests had split, the BD136 transistor in the power supply was short-circuit collector-to-emitter because of the excessive current drawn by the display driver circuit, and a 220μF capacitor had blown its top!

The BD136 transistor was replaced with a BD140, the tray loading rings were replaced and a new 220μF capacitor was fitted. These were the easy things. The display in this model has a special illumination circuit – normal models use standard bulbs. A ferrite toroid drives an illuminated back plane that needs 110V AC and costs about £140 to replace – a dim display is a sign of impending outlay. In this case the transformer also needed replacement. The owner didn't want to replace it because of the cost and the fact that he used the display in a pair of Meridian digital speakers, through the digital output.

My thanks to a Revox service engineer in Cheadle, Cheshire for information and help with this one. **P.R.**

Nakamichi BX2

This cassette deck dates from 1983. After repairing the usual idler (between the reels) problem, which causes no fast forward/rewind or play, I found that with some cassettes the output from one channel (left) was lower than that from the other. After tweaking the record/playback levels I discovered that the metal plate behind the cassette, the one that covers the cassette workings, wasn't located in the guide pin slots. So everything had to be reset to the correct levels. **P.R.**

Test Case 503

These chilly autumn days play havoc with Television Ted's chest, and the Test Case workshop's climate-control system is not the most sophisticated in the world. Thus it was that our Ted was off sick, sitting in front of his fire at home instead of in front of this Tatung TV set in the workshop. In fact the set, Model V25NEFO (E chassis), was in the tender care of Real Technician, along with all the tellies here, and for the present he was stuck with it. The symptom was simple enough: no picture, no raster. Sound was present and correct, and the power supply was working properly, with 150V at the line output stage. Ready for more?

The line timebase was actually running, but only at half-cock so to speak. It couldn't muster enough energy to light up the picture tube. RT soon discovered that the waveform at the collector of the line output transistor was wrong. It peaked at only about 600V and the duration of the flyback period, normally about 12μs, was 22μs. A quick bone-up on the theory of line output stage operation reminded RT that the flyback consists of one half-cycle of oscillation of the resonant circuit formed by the line output transformer and its tuning capacitor. In this chassis the line output transformer is T402 and the tuning capacitor is actually a combination of three components, C419 (3·3nF), C420 (6·8nF) and C421 (22nF). RT unsoldered one end of each of them, then checked them all with a digital capacitance meter. Each one measured correctly, within about five per cent, and they all looked OK physically. So they were soldered back into circuit and attention was turned to relevant components nearby.

The EW modulator diodes D404 and D405 proved to be OK when tested, likewise the line output transistor TR401. Maybe the line scan coils were somehow loading down the output stage? They were easily disconnected by pulling out plug 402, but this action had no effect on the voltage waveform at the output transistor. Could there be something wrong with the line drive waveform? The oscilloscope showed that it was perfectly OK, with the correct amplitude and timing, and the line output transistor was certainly being turned off by it at the correct point with respect to the video waveform. So the cause of the problem had to be the output transformer, RT reasoned. He had a perfectly good one on a cracked PCB in the scrap pile. It was transplanted to the patient on the bench – with no effect at all on the fault!

At this point some desperation set in. The tuning capacitors and EW diodes were checked by substitution, the EHT cap was removed from the CRT (it then jumped slightly each time the set was brought on), and another deflection yoke was tried. As none of these measures provided either a cure or a clue, Sage was consulted. After a while the set was brought to his bench, and the full sorry story of the symptoms, the searches and the substitutions was poured out to him.

Having ensured that everything, component- and connection-wise, was present and correct, Sage got the fault up and sat there dabbing his oscilloscope probe around the line-scan circuit. Within a few minutes he had the culprit in his hand, and the set worked correctly once a replacement had been fitted. So which scan component had been faulty? For the answer, turn to page 59.

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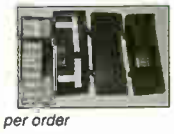

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- Professional, low heat magnifying lamp with extra large lens.
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- High light output enhances clarity and low heat increases comfort.
- Fully adjustable internal spring arm can hold the head in any position.
- Ideal for professionals, hobbyist, craftsmen, needleworkers and beauticians.

SPECIFICATION:

	TL-3000	TL-3005
Lens Material	Glass	Glass
Lens size	7" x 5.2"	5"
Dioptre	3 / 5 dioptre	3 / 5 / 8 dioptre
Light source	110V-120V / 220V-240V 2 x 7W fluorescent lamp	110V-120V / 220V-240V 22W circular fluorescent lamp
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FRONT VIEW

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- Selectable recording qualities (best/high/medium/low).
- Recording can operate manually or gets activated automatically when alarm is triggered.

SPECIFICATION:

		NTSC	PAL
Image system			
Resolution	Display	720 x 480	720 x 576
	Record	640 x 224	640 x 272
Video input		BNC x 4	
Video looping output		BNC x 4	
Video ouput		BNC x 1	
Display frame		4 x 30 FPS	4 x 25 FPS (field per second)
Recording frame rate (QUAD)		Max 30 FPS	Max x 25 FPS
Recording frame rate (MUX)		Max 30 / 4 FPS	Max x 25 / 4 FPS
Storage media		Max 2 IDE Hard Disk	
Image format		M-JPEG	
Compress rate		Low: 8k bytes/field	Medium: 10k bytes/field
		High: 15k bytes/field	best: 20k bytes/field
Recording Mode		Manual / Alarm / Schedule	
Playback speed		Fat forward x2 x4 x6 Fast reverse x6 Frame by frame forward playback	
On screen display & setup		Time/date/setup menu	
Alarm input		x4	
Relay output		NO or NC programmable contact x1	
Password control		one for HDD format	
Motion detection		Yes	
Buzzer		Yes	
Video loss		Yes	
Key lock		Yes	
Power input		AC 90-260 V input (60/50Hz)	
Dimensions (H x W x D)		55 x 432 x 321 mm	
Weight		4.5Kg	

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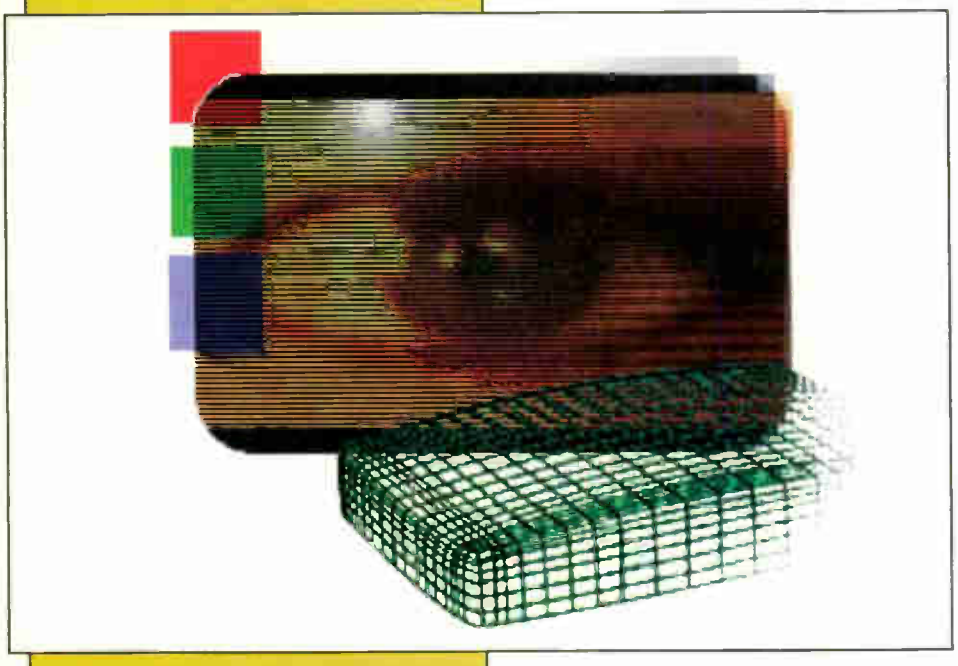

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Azalea Drive, Swanley,
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Sharp 28JW73H

The customer had complained about a black dot on the face of the tube – the set was apparently OK in all other respects. When it was brought in I noticed that there was a phosphor dot burn mark. As the set was still in warranty, I ordered a new tube. When this arrived I fitted it and returned the set to the customer.

Four months later the set came back with the same fault. The first time the set had come in I had checked with the Sharp website to see if it was a known fault. On this second occasion there was a bulletin on the problem. The cure is to change zener diode D1307 from a 5·6V to a 6·2V type (part no. RH-EX0584BMZZ). D1307 is mounted on the print side of the panel, beneath the line output transformer. Unfortunately the CRT had to be replaced again. **P.S.**

Philips 32PW6515/05 (A10E chassis)

There was no sound or picture, just a ticking noise. Some quick checks showed that the BU4508AX line output transistor Tr7410 was short-circuit. I couldn't find any cause for its failure, so I fitted a replacement. The set then came on and a long soak test proved that it was OK. The part no. for the transistor is 55089127. **P.S.**

Samsung WS24V53N

The symptoms with this in-warranty set were sound and a bright raster. I carried out a quick check to establish whether the 220V supply was present at the tube base panel. It was present at one side of R519 (47Ω, 0·5W) but at the other side there was a short-circuit reading. The culprit was the STV5109 RGB output chip IC501. I've had similar trouble with the Vestel 11AK19 chassis. **P.S.**

Sony KV24LS35U (FE2 chassis)

Replacement of a faulty line output transformer, which blows the line output transistor, is a well-known and straightforward fault with these sets. After replacing these items this set sprang to life, but I noticed that the picture regulation altered with changes in scene brightness. I decided to check with Sony, and was pleased to find that it's a known fault. The components to check are the following resistors: R516, R517, R518, R510, R528 and R529. In this case R518 (1·5kΩ) was open-circuit. It's a surface-mounted component. **P.S.**

Bush WS7673SIL (11AK19 chassis)

The customer complained of loss of output from the AV2 connector. Sound was present, but there was no video. AV1 was OK. As a first step I replaced the scart socket, in case the customer had damaged it, but this made no difference. So a fax to Bush technical seemed a good idea. I was told to check the surface-mounted resistors R083 (75Ω) and R084 (47Ω) and, failing that, to check for a hairline crack at the AV2 socket edge. The latter turned out to be the cause of the trouble. **P.S.**

Hitachi C28W430N-311 (A7 chassis)

We've had three of these sets in recently, all with the same problem – popping or crackling from the right-hand speaker. Needless to say they were all lined up on the soak test bench for days with no sign of the fault. I decided to check with Hitachi technical, who were aware of the problem. I was told to resolder R4005 at the top and bottom of the PCB. Since doing this the three sets have been returned with no further complaints. **P.S.**

Hitachi 28W440N (11AK33 chassis)

This set was dead with the 2SD2579 (BU2508AF) line output transistor Q602 short-circuit. The part no. is VS30016869. Once a replacement had been fitted the set powered up with an under-scanned picture and EW distortion. The culprit was C611 (3·9nF, 2kV), part no. VS30014943. According to Hitachi failure of Q602 can be caused by spurious spikes. A modification is recommended to avoid this possi-

bility: wire a BA159 diode directly across the base and emitter of Q602, with its cathode connected to the base.

In another of these sets the line output transformer, part no. VS30001441, had failed in addition to the above components.

By way of interest the service mode is entered by pressing the remote-control unit's blue key followed by 4725. It wasn't necessary to do so with these faults. **M.S.D.**

Thomson 28WT25US (ICC17 chassis)

The fault symptom with this set was vertical lines at the left-hand side of the screen. This is line ringing, which occurs when RL26 (1kW, 0·5Ω carbon) in the feed to the line scan coils goes open-circuit. The part no. is 10393870. Replacing this resistor usually cures the fault. If there is still a small amount of ringing, replace the line linearity coil LL26 (part no. 10526140) and if necessary the line output transformer. **M.S.D.**

Toshiba 32W8DB

We've had several of these large widescreen sets in with faulty tubes. This set was dead however, because the STRS6709 chopper IC Q801 was short-circuit between pins 1, 2 and 3. The 3Ω, 15W surge-limiter resistor R810 had also failed. A careful check on all the diodes associated with Q801 showed that they were OK, so replacement of R801 and Q801 completed the repair. **M.S.D.**

Thomson 52RW87E (RPC21-ICC21 chassis)

This monster set kept switching off to standby then coming straight back on again. The fault was intermittent, and there didn't seem to be any pattern to it. The mains lead, mains plug and wall socket in the house had been replaced in case there was an intermittent mains connection. All this was to no avail, so the set was brought into the workshop. Fortunately the innards can be removed in one block and then powered up on the bench. It was then immediately apparent that one of the tube bases was arcing over within the socket assembly. A replacement cured the fault and a soak test confirmed that all was now OK. **M.S.D.**

Sanyo CE32WN5B (EB6A chassis)

We've had several of these sets with intermittent or no sound. In every case resoldering IC801's pins has cured the fault. It's a reasonably-sized surface-mounted IC that's on the underside of the main board. A standard iron, lamp and magnifier are all that's needed. **M.S.D.**

Hitachi C2842 (11AK19 chassis)

There was a standard EW fault with this older set. The circuit diagram can be found on Hitachi's excellent Esta D2 disc. This showed traditional EW drive and diode modulator circuits. The driver FET Q603 feeds the diode modulator via C620, L604 and R629. A quick cold check revealed that R629 had died. It's a 2·7Ω safety resistor in this model. A replacement from a scrap set cleared the fault. **M.S.D.**

Wharfedale CTV850

This set was dead with the mains fuse VA603 open-circuit. A check on the BUZ90A chopper FET T602 showed that it was short-circuit. I also replaced the TDA4605-2 chopper control chip, as a precaution. Once satisfied that there was nothing else amiss I powered up and was rewarded with a working set. **D.G.**

Portland P14F5

The customer said that this combi unit would work only when it felt like it. I could get it to come on only momentarily, after repeated pressing on the front-mounted standby button. The unit had to be stripped down. Once I had the main board on the bench, under the inspection glass, the cause of the problem was obvious: the PCB-mounted, tactile-type standby switch SW08 was badly dry-jointed. Once it had been resoldered and the unit had been rebuilt it worked faultlessly. **D.G.**

Toshiba 218D9H

This set had field collapse of the type that's quite common with Toshiba sets: there was the usual band of thinly-spaced lines above the collapsed frame line. As always capacitors are suspect, and I found that C303 (2·2μF, 50V) was leaking. A replacement restored the field scanning. **D.G.**

Schneider STV2502T

All this Asda TV set produced was a glowing LED and a ticking/pulsing sound. After some visual checks I connected my meter to the S2055N line output transistor, which was short-circuit at all terminals. Checks on the line output transformer with my LOPT tester then confirmed that this was also faulty. All was well once a new transistor and transform had been fitted. **D.G.**

B&O L2502

The symptoms with this set were sound but no raster – the screen was black. I suspected that someone else had looked at it, as the cabinet screws were loose. I decided to turn up the setting of the A1 control to see what this would produce. The result was a thin horizontal line across the screen. Checks at the TDA2170 field output chip IC2 confirmed that it was the cause of the trouble. It's not cheap, but a replacement restored normal operation. **D.G.**

Amstrad CTV2880

This set was stuck in standby. I was unable to obtain a service manual, so I had to spend some time looking around on the chassis. I discovered that the standby transistors Q903 (2SA1013) and Q905 (2SD1543) weren't operating, though Q903's base voltage rose to what seemed to be the correct level with the remote 'on' command. The two transistors had already been replaced. Looking closer, I found R924 (100kΩ) which is the base-bias resistor for Q903. It had risen in value to over 250kΩ. A more substantial metal-film resistor was fitted, curing the problem. **G.R.**

NEI NE3743

This 14in. portable was dead with a short-circuit reading across the source and drain connections of the chopper FET Q801. The FET was blameless however, the chopper transformer TR802 reading short-circuit across all its primary connections. All that was required was to replace TR802 and R809 (0·47Ω, 0·5W). **G.R.**

Tatung E chassis

This B-grade set had no model number on it. The problem was intermittent video, and I noticed that the video switch chip IC202 had been overheating. A replacement also started to get hot. This was because the 8V regulator transistor TR806 was producing 11V at its output. Closer examination showed that the associated 8V zener diode ZD821 had been clumsily fitted next to the regulator's heatsink, with the cathode end not properly soldered and its leg touching the heatsink. All that was required was to reposition and resolder ZD821. **G.R.**

Sharp 51AT15H (5BSA chassis)

There was no line drive because Q603 (BC547) had failed. As there's no transformer in the line driver stage, Q604 (BC636) and Q602 (BC635-16) should also be replaced. The line output transistor Q601 is type BU508DFI: only this type should be fitted, as 'equivalents' may well overheat. Note that the HT (cathode of D708) is 114V, not 105V as shown in the manual we had. **G.R.**

Grundig M95-410/9

This set is the size of a small bungalow. The complaint was very poor focus. As the set uses a separate EHT multiplier with an integral focus control I obtained a replacement and fitted it, all to no avail. The cause of the fault lay on the dynamic focus PCB, where the series-connected capacitors C64001 and C64002 (both 1·5nF, 6kV) were faulty. While waiting for replacements I found that the set functioned without them, with little deterioration in picture quality. The part no. is 8502-200-066, Willow Vale 81066A. **G.D.**

Sharp 28JF73H

The complaints with this ultra-flat screen set were no picture, a funny noise and a smell. The CRT base socket was arcing merrily. A new one didn't help, and it turned out that the line output transformer was being rather generous with its A1 and focus supplies. Amazingly for a Sharp set, a new (expensive!) transformer restored normal operation with no further problems. The Willow Vale code for the transformer is 27983LT. **G.D.**

Bush WS7671 (11AK19 chassis)

This 32in. monster is fitted with a modified 11AK19 chassis. As it was tripping I went straight to the line output stage, but there was no short here – and the tripping was much more rapid than usual. Unloading its various outputs pointed to a power supply fault, especially as the chopper FET was running warmer than usual. I replaced the 1·5MΩ resistor (R816) that causes odd faults, also various diodes with upgraded parts, all to no avail. The FET and IC were blameless too. There was only one thing left, the chopper transformer TR802. This turned out to be the culprit, though I could find nothing obviously wrong with the open-construction original. Fortunately it's cheap! **G.D.**

Thomson 28WR23UG (ICC17 chassis)

This set had failed three days out of guarantee. Currys had diagnosed a faulty line output transformer, but was unwilling to bend the rules. So the customer approached us. The LED flashes, two followed by seven, confirmed Currys' diagnosis. Internal burning was revealed when the EHT lead was released, providing further confirmation. But the symptoms were the same when a replacement transformer had been fitted. Then, remembering the TX92 chassis, I checked the trip associated with the beam limiter. Sure enough TL59 (BC857B) and TL02 (BF422) were both short-circuit. Replacements restored normal operation.

It's worth noting that the faulty transformer was the newer black type. **G.D.**

Sharp 28JW73 (GA20 chassis)

This set was dead with the TEA1507 chopper control chip IC701 blown apart. No other fault could be found on the primary side of the power supply so, as these sets are usually very reliable, we decided to check with Sharp technical. We were told that a few such failures have been caused by the HT rectifier D755 going short-circuit. It's thought to fail in some unusual manner, as a typical short across the HT rail does no damage. In this case IC701 and D755 were the only faulty components. **A.J.**

Hitachi C32WD2TN

This huge set was dead. When we got it to a serviceable position and carried out some tests we found that HT was reaching the chopper transistor but no drive was present. Checks around the UC3844 chopper control chip IC900 showed that there was no supply at pin 7. There was a very low resistance reading between this pin and chassis. As the leak remained when pin 7 was disconnected, it was clear that ZD902 (BZV85C18) was the culprit. This was the only faulty component. **A.J.**

JVC AV29SX1EK (JA chassis)

These 29in. sets produce excellent sound and picture quality with good reliability. One problem however is total or partial field collapse caused by failure of the TDA8350Q output chip IC401. Replacement of this IC alone provides only a short-term cure. For a permanent cure fit JVC's field modification kit, part no. TPCE-0051. This kit is also available from SEME under part no. RK204G. **A.J.**

Philips 29PT6773/05 (MD1.2E chassis)

This set worked all right with scart inputs, but no channels could be tuned in. Checks showed that the tuning voltage was missing at the 33V regulator. Tracing back to source, R3568 (100kΩ 0·5W in this model) was found to be open-circuit. It's in the power supply area of the main PCB and is connected to the 140V HT rail.

This model has a beautiful piano-finish cabinet and an excellent-quality tube. I doubt whether more recent sets could match the picture quality. **A.J.**

Samsung CI683CNG (S51A chassis)

The job ticket said "dead", but checks showed that the power supply was tripping. A lot of time was spent eliminating items on the primary and secondary sides of the circuit, but nothing obvious was found. The voltages on the secondary side all rose to about ten per cent of the correct value. The cause of the trouble was eventually found to be C814 (850pF, 1kV) which had an 8kΩ leak. It's in parallel with the HT (B+) rectifier D805. **A.J.**

Sharp 28/32 JW73 and JF73 (GA20 chassis)

These widescreen sets have proved to be very reliable, but you can get the dead or intermittently dead (with a fizzing sound) symptom because of a poor-fitting plug/socket connection where the incoming mains lead is attached to the PCB. **A.J.**

Black Diamond BD21T (11AK19 chassis)

The BU2506DF line output transistor Q605 was short-circuit because the HT was excessive. When I replaced Q605 and the CQY80NG optocoupler IC801 the HT returned to its correct value, 115V, but there was field collapse. Replacing IC701 (TDA8356) cured that, but the result was a bright raster with flyback lines. This fault was cured by replacing IC901 (TDA6107Q) and R914 (47Ω) on the CRT base panel. **C.R.**

Grundig P37-731 (CUC7303 chassis)

Tuning drift was the problem with this set. Before doing anything about it I decided to resolder the connections to the snubber capacitor C669 (1nF, 1·6kV) and check the ESR of the mains rectifier's reservoir capacitor C626 (47μF, 385V), as these items are well known for causing power supply blow-ups.

Back to the tuning drift problem. A replacement tuner didn't make any difference, and the 33V tuning supply across D683 (ZTK33B) was rock steady. A point I noticed was that tuning didn't stop when a station was found. Slight adjustment of the vision demodulator coil F130 cured the fault. **C.R.**

Black Diamond BD14T (11AK20S chassis)

This set produced a very dim picture. When checked, all three cathode voltages were high. The fault gave the impression that the tube's G2/A1 voltage was low, but it turned out to be correct. The picture was restored to normal brightness by replacing diodes D901 and D902 (both type 1N4148) in the beam-current information (BCI) circuit. These diodes are on the CRT base panel. **C.R.**

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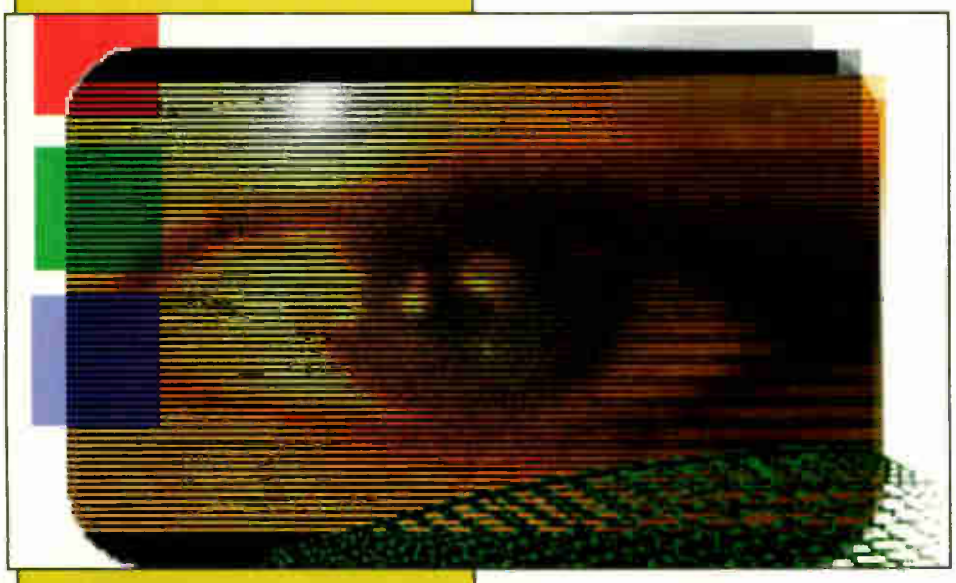

Extended Reports

Reports on complex or tricky TV fault conditions are sometimes too long for inclusion in our basic fault-finding section. We've put a few of them together in this extended fault report feature

Reports from
Michael Dranfield
Charles Ritchie
Arthur Jackson and
John Coombes

We welcome fault reports from readers – payment for each fault is made after publication.

Reports can be sent by post to:

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Fault

Sharp 66FW53H (DA100 chassis)

This set powered up at switch on, with EHT, but went back to standby before a picture appeared. I kept switching it on and off, in the hope that the CRT's heaters would get warm enough to produce some sort of picture and a clue to the cause of the fault. But what happened was that the set came on and stayed on! All I could do was to resolder a number of dry-joints. After that the set would sometimes come on and sometimes it wouldn't. At least some scope checks could be made however.

I found that the field drive disappeared when the set tripped. A clue at last! But it was a very misleading one, and more time was wasted. As the set had been brought in from some distance away, when it came on there was just a snowy raster. I connected a pattern generator to the scart socket and found that there was colour displacement on the verticals. The penny then dropped: the EEPROM was corrupt.

On to the next problem then. As EEPROMs usually become corrupt rather than faulty, Sharp supplies a blanking chip that empties the EEPROM in the set (IC1003). It's used with a jig, in the EPROM position (IC1002). Once the EEPROM has been blanked, default data will be loaded into it via the microcontroller chip at switch on. But the blanking chip is quite expensive and, in addition, there are different versions depending on whether the microcontroller chip is a 3·3V or a 5V type. Guess what? I had the wrong (3·3V) one for this set!

I looked through the Farnell catalogue and found a blank 4MB ROM at a third of the price of the Sharp blanking chip. So I obtained one and copied the contents of the 3·3V chip into this 5V chip. Use of my new blanking chip cured the fault, but quite a bit of setting up for picture geometry is still required. **M.D.**

Matsui 1420T

A screeching sound came from the power supply in this set and I found that the line output transistor was short-circuit. A replacement transistor blew at switch on, but I couldn't find any other faulty components in the line output stage. As a last resort I connected my digital inductance meter across the line scan coils. The reading obtained was in the μH range instead of the usual 4mH.

Clearly the cause of the fault was shorted turns in the line scan coils. This surprised me a bit, as the usual cause of scan-coil failure is hardened moisture-absorbent convergence rubber wedges and these were still soft. All became clear when I removed the yoke. Glue that holds the coils together had become conductive and, as a result, there had been a burn up. So the set was scrap.

All was not lost however. A few weeks earlier a customer had given me a 14in. Matsui TV/VCR combi set that had fallen off its wall bracket, saying that he couldn't be bothered to claim off his insurance. As the tube was the same type, I put the two sets back to back and powered the tube in the smashed cabinet. It came on with purity errors, so a tube swap was out. But at least the scan coils were OK.

After fitting them in the 1420T and converging it, the set worked fine. In the end I had spent more time than I could charge for on the repair – or than the set was worth. But by the time I had found the cause of the fault I was passed the point of no return. The customer went away happy. **M.D.**

Bush 2035T (11AK19 chassis)

The owner said that a mineral drink had been poured down the back of this set, which was now dead. When I examined it I found that the liquid had dripped down the back of the CRT and landed on the primary side of the power supply. The damage wasn't too bad. The surge limiter resistor R817 (2·2Ω, 5W) was open-circuit, two of the 1N4007 bridge rectifier diodes, D802 and D804, and the FET chopper transistor Q802 (03N60S5) were short-circuit.

To gain access for cleaning, I removed the chassis from the set. Then I removed the faulty components and some of the larger ones, i.e. the chopper transformer, chopper control IC etc., and gave the PCB a good scrub, using a half-inch paintbrush and a solution of distilled water and washing-up liquid. After rinsing it I gave it a blast from a hairdryer then placed it on top

of the workshop storage heater to dry overnight.

The next morning I replaced the faulty components (a BUZ90A is a suitable replacement for the 03N60S5), refitted the others I had removed, then refitted the chassis in its cabinet. With some trepidation, I switched on. The LED lit up red and, on pressing a channel button, the LED changed to green and the set came out of standby. To my great relief, sound and a picture came up a few seconds later. A long soak test confirmed that all was now well. **C.R.**

Sharp 51AT-15H (5BSA chassis)

When this set had been on for half an hour the red picture content would flash on and off. According to my notes, I had had a similar problem with the blue channel in this chassis. Replacing Q872 (BF422) and Q877 (BF421) on the CRT base panel had cured the fault on that occasion. So this time I decided to replace the BF422 and BF421 transistors in the red channel, but this didn't make any difference.

When I connected the scope to the CRT's red cathode there was no variation when the fault occurred, which was odd. Moving over to the green cathode, I found variation here and realised that the red and green channels were transposed. The transistors I had replaced were in the green channel. The manual clearly shows that pin 7 of the CRT base socket is the red cathode, pin 9 the green cathode and pin 3 the blue cathode (correct). I also noticed that the pins of connector K were transposed.

The parts list gives two numbers for the CRT base PCB (PWB-B). In this set the number on the PCB didn't correspond to either of those listed. This is probably the explanation why the green and red channels were transposed.

Replacing the correct transistors cured the fault. **C.R.**

Grundig T55-731 FT GB (CUC7301 chassis)

Audio OK but no picture was the complaint with this set. When I switched it on I could see the CRT's heaters glowing and heard a healthy buzz from the field scan coils. So at least the field and line timebases were working. I turned up the setting of the A1/G2 control on the line output transformer, expecting to see a blank white raster with flyback lines, but there was still no display.

A check on the A1/G2 voltage at the CRT base PCB produced a reading of only 95V, even at the highest setting of the control. The voltage didn't increase when I disconnected the wire from the CRT base PCB and checked at the wire end. So it seemed that the line output transformer (TR550) was faulty. Before condemning it I decided to measure the focus voltage. This was when I noticed the green corrosion at the focus connection on the CRT base socket. I assumed that the leakage here was loading the focus and in turn the A1/G2 voltage.

When I replaced the CRT's base socket and switched on, a noise came from the neck of the CRT. I switched off quickly. The next step was to disconnect the A1/G2 and focus wires from the CRT base PCB and switch on again. There was now a reading of over 1kV at the A1/G2 wire even with the control at its lowest setting. Obviously the earthy end of the A1/G2 and focus controls was open-circuit. A replacement line output transformer restored the picture and, fortunately, there was no damage to the CRT.

The part no. for the line output transformer is 29221-031-56A. **C.R.**

Black Diamond BD28S (11AK19 chassis)

This set was dead though 320V was present across the mains bridge rectifier's reservoir capacitor C804 (150μF, 400V). There were no outputs from the secondary side of the power supply. While working on the primary side I noticed a dry-joint on a coil, which is not shown in the circuit diagram, between pin 7 of the chopper transformer and the drain of the chopper FET Q802. Resoldering this coil cured the dead-set symptom.

When the set was taken out of standby however I saw a slight discharge between the CRT's Aquadag coating and the degaussing coils. The set then reverted to standby with the green LED flashing. This was a man-made fault. While I was moving the chassis to service it, the wire from the Aquadag to the CRT base PCB had broken from a coil (again not shown in the circuit diagram) at the CRT base PCB end. Reconnecting the wire to the coil restored the set to normal working order. **C.R.**

Thomson 21MS73CT (type 109/TX91 chassis)

This 21in. set was dead, though degaussing was heard at switch on. Checks in the power supply showed that there was voltage at the collector of the chopper transistor TP20 but no oscillation. When I consulted my TX91 service manual I found that two very different power supply arrangements are used in this chassis, one with a TEA2261 controller IC and the other a discrete component design that uses several transistors. This set used the discrete-component version.

The cause of the fault was simply loss of the kick-start supply, which comes via three series-connected 270kΩ, 0·5W resistors, RP05, RP06 and RP07. RP05 was open-circuit. In view of the age of the set I decided to replace all three resistors.

Be careful, as the mains bridge rectifier's reservoir capacitor CP10 holds a healthy charge with a fault of this type. **A.J.**

Philips 25MN1550 (GR2.1 chassis)

The owner of this 25in. mono sound TV set said that it had given no trouble until now, at twelve years old, there were two faults. First, the set would run for up to an hour after which the picture and sound were lost and the green LED changed to flashing red. The second complaint was that there were three fine horizontal coloured lines approximately an inch down from the top of the screen.

The cause of the first problem was simply a dry-joint at pin 1 of the line output transformer (the primary winding). The cause of the second problem was in the discrete-component field output stage, where the 22μF, 50V bootstrap capacitor C2502 was open-circuit. **A.J.**

Vestel 11AK19 chassis

We've had a number of sets in recently, mainly Bush/Alba models, fitted with this chassis. The faults have been as follows:

Dead with the mains fuse intact and 320V at the drain of the chopper FET Q802: A couple of components connected to the chopper control chip IC802 can cause this fault. We've had C807 (1μF, 50V) leaky and R811 (22kΩ) open-circuit.

EW faults: Check R629 which goes open-circuit and C630 for dry-joints. The value of R629 can vary: replace with the same value.

Bright raster with flyback lines: R914 (47Ω) in the supply to the RGB output chip IC901 (TDA6107/8) could be open-circuit and/or IC901 faulty. R914 is by the side of the IC.

Stuck in standby: Many components in the power supply can cause this symptom. In this case the HT rectifier D816 was open-circuit.

Set in trip mode with red LED flashing: D807 (BA159) in the snubber network was short-circuit. **J.C.**

WHAT a LIFE!

The boys take a late holiday, so it's back to guard the fort. A wet day at the shop brings a mixture of different types of faults and customers. Emails welcome. Donald Bullock's servicing commentary

The boys had wanted to take a few days' late holiday. So Greeneyes and I were driving towards Alicante airport to return and guard the fort.

"Did you lock the front door?" said Greeneyes. "I hope Rebecca remembers to feed the dogs . . . Hope Flashie won't miss us too much . . . Look at the row of windmill ruins along the top of that mountain ridge. How did they get the grain up there? Did you check the car for oil? And water? I hope Flashie will be all right . . . Why can't we get the BBC on Sky any more? Did you bring some beer for yourself and some juice for me? I wonder what Flashie thinks when we go away?" You know how they go on.

I pondered. "Because the powers that be decided to aim the transmissions well towards the north of Spain" I said. "We could pick up enough of the scant signal if we really wanted to. Dealers are offering to install eight-nine foot dishes for £1,000 or so."

Travellers

We arrived at the airport a few beers later and took our place in the queue, behind a scruffy, overweight, sunburnt pair of holiday Brits. Hearing us speaking English, they turned round.

"What joo do fer a livin' mate?" beer-gut asked.

"Nothing" I replied.

"He's a very good TV engineer" said Greeneyes, "but he's retired now, really."

His wife studied me as if I was a smear on a slide. "He don't look old enough" she declared. Only then did I realise how very intelligent she was.

Meanwhile beer-gut was also looking me up and down. "Had our set so-say mended before we came over" he said. "Kept 'im a week and charged us thirty quid. Lasted two days. Reported 'im I did."

"You thinks it's the valve, don't you dear?" she said to him. "But our daughter's chap says it's the condenser."

"Can't be the tube, cos 'e's only four year old" he said. "But these telly people says anythin', don't they? What was on when 'e went wrong, Flor?"

Back at the ranch

We landed in England to a terrible patch of weather, rough and rain-drenched. It was even worse when we reached the shop the following morning. But it didn't stop Greeneyes from going shopping. What would? As she left I saw that there was a 21in. Toshiba set on the bench, with a note from the boys asking me to do it first. It was a Model 2173DB (C7S chassis). "No pix, no function, no on-screen display, no audio" it said on the card.

I dismantled the set and let my eyes dawdle on the power supply, which was under a carpet of bird seed. It seemed a good idea to check the fuses and fusible links. When I did so I found that Z830 (1A) was open-circuit. A replacement restored normal operation, and the results were very good.

I had barely got the set back together again when its owner blundered in, ready for battle.

"I'm Mr Belcher, mate" he growled. "Ah, I see me Toshiba's done. At last. You new 'ere?"

"More or less" I replied.

"They said it 'ud be ready Sat'dee night" he continued. "'Ad 'im all weekend, you 'av. No telly all weekend. Didn't know what to do with meself. Made me bloody mad it did. I was comin' in to wipe the floor with that smiley young chap, Paul innit? But that was before my tragedy." His lip started to tremble.

"Tragedy?" I echoed.

"Caruthers 'ad a convulsion and died. Just afore opening time yest'y. Had to 'av nine pints. 'E was my best friend, the prettiest budgie there ever was. 'Bugger off, bugger off Cyril' 'e'd shout. Then he died. Just like that."

I adopted my best undertaker's expression as I worked out his bill.

A turntable fault

Shortly after he left a lovely young lady came in with a Technics record deck, Model SL-QX200. I gave her all my attention.

"The pick-up doesn't lift" she said.

At that the phone rang, just as I wanted a bit of peace. "Hello" I bellowed.

"Donald!" a voice said, "nice to hear you again." It was the Reverend Goode. "Could you pop along and have a look at our lady organist's set? Her name's Miss Hewitt. It's a Beko or something. Not like the days when they were all Pyes and Ekcos, what? She lives in one of those little places in The Mews. Everyone there knows her! She'll be back in ten minutes or so and will wait for you."

I booked the call, then put a record on the turntable and started it. Sure enough the arm didn't lift. I knew why, because I'd come across the problem before. The rising lever on its underside had slipped out of the slot. It took only a moment to fix, and I showed her that it now worked.

As she reached for her purse I said "no charge for a little thing like that".

"Oh, my husband will be pleased" she replied. "He knew it wouldn't be much. He's so clever you see."

Clever enough to send you here I thought as she left. I'd have charged him plenty.

At that Greeneyes returned with her shopping. Most of it was in big, slim expensive-looking bags with Next, New Look and Stead and Simpsons all over them.

"I found a lovely pair of shoes to match my new lipstick" she announced, "only forty five pounds. I wanted another pair to match my green skirt but . . .

"Just park yourself behind the counter, dear" I said as I strode out, "only I have to go look for a woman."

The Beko TV

I found Miss Hewitt's place and saw the set, a Beko Model 2842NDS. It didn't produce a picture but there was a band of flyback lines on the raster, the top ones being red, green and blue.

"I do hope it isn't the tube" she said.

I gave her a reassuring smile, while being a bit worried about the possible cause. I suspected field timebase trouble, but it took me a while to find the culprit. This was a short-circuit electrolytic capacitor, C126 (100μF, 100V).

"Does it seem to be the tube?" Miss Hewitt asked.

I managed to produce another reassuring smile and, while putting the back on the set, I straddled the coaxial flylead across the top.

Miss Hewitt was looking at it. "Is that the tube?" she asked.

A DVD/VCR combi unit

When I returned to the shop I found Mr Flighty chatting up Greeneyes. She was lapping it up.

"At it again Flighty!" I declared as I strode in, "what's your trouble this time, apart from the usual?"

"Oh, er, hello Don" he spluttered, "actually it's your lucky day. I've brought you my new Sanyo DVD/VCR combi unit to look at. It's dead."

"You're kindness itself" I replied

It was a Model HVDX1E. Once he'd departed I opened the unit up and carried out a few checks in the power supply. It struck me that I'd had trouble of this sort before, with a Philips model. The cause of the fault turned out to be a 1N5822 diode, D111.

"Would you do a bill for Flighty, dear?" I asked Greeneyes as I boxed the unit up. "You can fill the total in first if that makes it easier. Comes to fifty five pounds fifty."

She shot me a look. "What? For one diode and a few minutes time?"

"Sure thing" I replied, "remember it's for Flighty. Oh, and you're getting to sound like the customers!"

"Itemise it" she challenged.

"Right!" I said brightly. "One diode, fifty pence. Time, labour and expertise, twenty five pounds. Aggravation and pratness factor, thirty pounds."

I noticed that the rain had become heavier. At least he would get wet.

A camcorder

Our next customer, Mrs Crabbe, was soaked when she came in. She was carrying a camcorder wrapped in a plastic bag. The weather and her appearance reminded me of an item I'd seen in an early *Two Ronnies* programme, in the days when some BBC programmes were worth watching . . .

"I didn't want to get this thing wet" she said as she handed me the package, "there's a note inside".

I smiled and drew up a job card. "Tickle your bum with a feather" I mumbled.

She stiffened and glared at me. "What?" she said sharply.

I carried on smiling calmly. "Particularly nasty bit o' weather" I commented.

She relaxed and looked a bit happier. "Oh, er, yes, I suppose it is" she said.

The camcorder was a JVC GRDVX707EA. When she'd gone back out into the rain I put it on the bench. It didn't seem to work. The accompanying note mentioned two faults.

First, the unit continuously displayed the message 'operation paused due to condensation'. As expected the cause was the dew sensor. It's connected via a flat ribbon cable that plugs into connector CN201, which is on a small PCB below the lens assembly. The cable also connects the loading motor. As the securing clip hadn't been pushed home, the cable had worked loose enough to disconnect the dew sensor. Hence the message displayed.

The other fault was very intermittent camera-lens drop-out, leaving the unit with no image when recording. This was also caused by an unsecured plug-and-socket connection that had allowed the ribbon to work loose. It was still in the socket, but had partially pulled out and was at an angle.

Pushing these two connectors home and securing them properly put the camcorder to rights. Lucky I didn't have to delve any deeper!

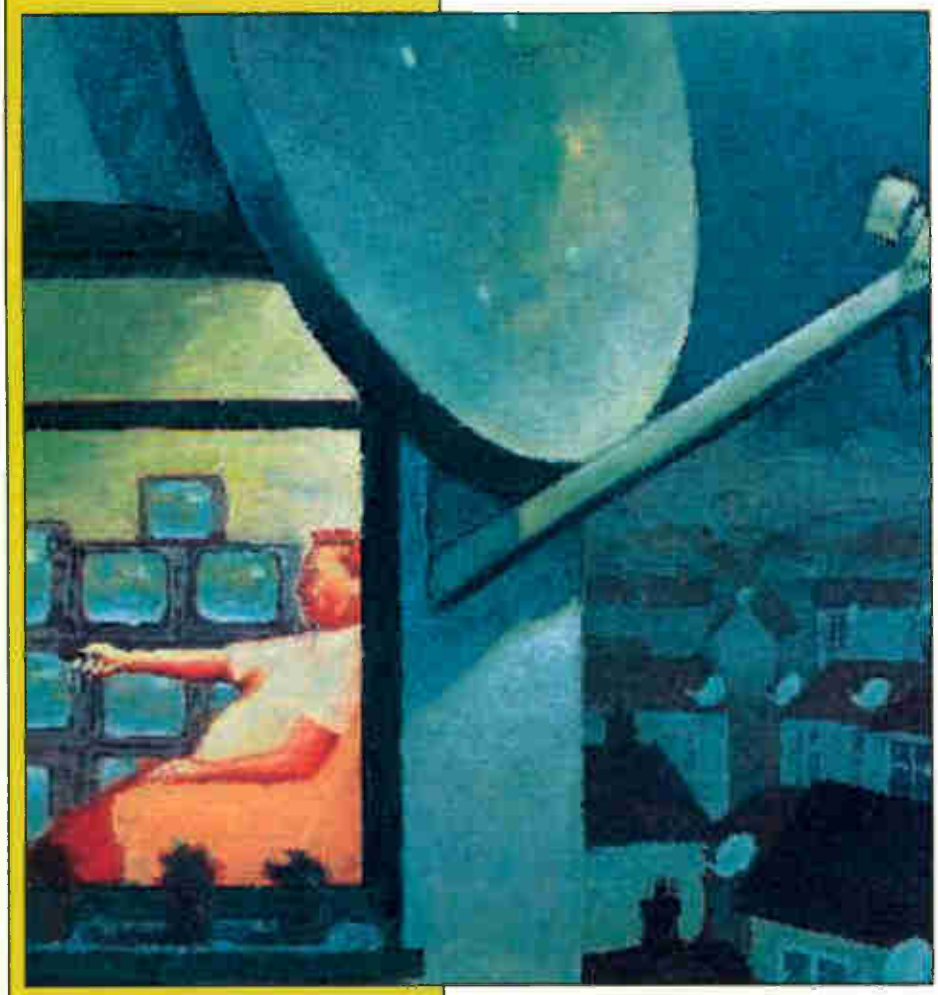
Emails

Later on I had an opportunity to read a print-out of an email I had received from Steve Burgess, who controls a crew of ten technicians at Channel 4. Their job is to keep the whole technical operation going twenty four hours a day, seven days a week. The total staff there, including commissioning, advertising sales, legal, finance and so on amounts to some eight hundred.

I've always felt that Channel 4's programmes can be outstanding, providing proof that commercial television doesn't have to be cheap and nasty. While criticising present British programmes as a whole, he agreed with me on this latter point. Steve, who is clearly a fount of wisdom, points out that television today has become a highly competitive, multichannel, commercial business, with roots going back to Murdoch. The traditional broadcasters feel that they have to respond to this situation. For commercial stations, he reasons, this means chasing the lucrative eighteen to thirty-four year olds, who are the big spenders.

"A new generation's culture and values have to be embraced" he says. "Sponsorship, a commercial by another name, is a big earner and is the biggest blurring factor in the once sacred programmes/adverts divide." Then, mercifully, he added "as long as they don't start messing around with Radio 4!"

Don't forget, emails are welcome. Send them to donald@wheatleypress.com ■



SATELLITE NOTEBOOK

Reports from Christopher Holland Michael Dranfield and Pete Haylor

Adding ITV channels

We often get asked about adding out-of-area ITV channels. Unlike the BBC channels, the ITV ones are encrypted, requiring the use of a Sky viewing card. This can be a defunct current-issue card (dark blue) where the subscription has ended, or a free-to-view card – either the type currently being promoted by Sky or the earlier Solus type that was discontinued. These cards look the same as a standard Sky card but normally have the 08702 438 000 call-centre phone number included instead of the Sky 08702 404 040 number. But only ITV1 reception is possible with these cards: unlike Freeview, ITV2 requires a subscription. The forthcoming ITV3, which is due to start on November 1, may however be available with these cards – all in all it's a confusing situation!

Again unlike the BBC, out-of-area ITV channels are not normally available in the EPG. At some registered card addresses where ITV regions overlap more than one ITV service may be available in the EPG. In some parts of South Essex for example Meridian and Anglia are available at around 963/964, with Carlton the main channel at 103. But Meridian and Anglia may no longer be available with these cards, presumably because of a shortage of EPG channel numbers in the area.

Other ITV regions can be added via the digibox's 'add channels' facility, as all UK-based viewing cards allow their reception. This is not the case in Ireland, where ITV is well and truly blocked, though when ITV first appeared via satellite it was possible to tune it in manually.

ITV uses three Astra 2D transponders, 49 (10·831GHz H), 53 (10·891GHz H) and 54 (10·906GHz V). The transmissions have a symbol rate of 22.000 and 5/6 forward error correction. The services carried by the three transponders are as follows:

Transponder 49: ITV1 London, Central,

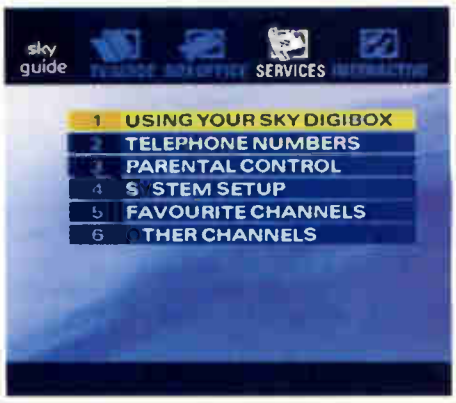


Photo 1: The digibox services menu.

Photo 2: The system setup menu.

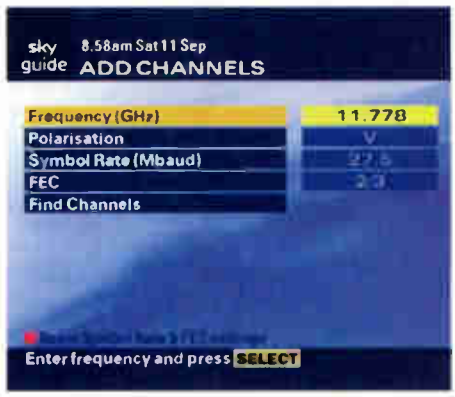


Photo 3: The add channels menu with default frequency.

Photo 4: Adding channels from transponder 49 (10·831GHz H).

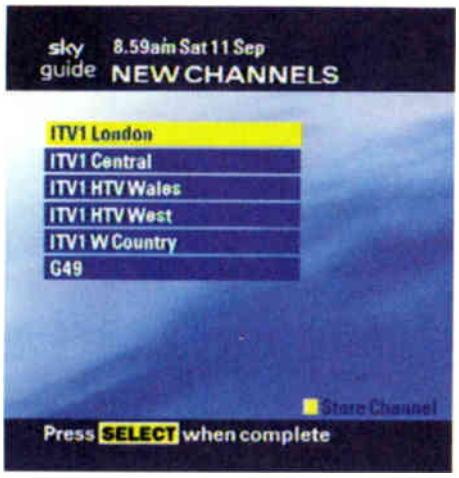


Photo 5: The new channels list.

West Country, HTV Wales and West.

Transponder 53: ITV1 Anglia, Border, Border Scotland, Meridian South, Meridian East, Tyne Tees and Yorkshire.

Transponder 54: ITV1 Channel Islands, Grampian, Scottish, Ulster, Granada and ITV2.

To add channels, press the green 'services' button on the digibox's remote-control unit. The menu shown in Photo 1will appear. Select option 4, 'system setup'. This will bring up the menu shown in Photo 2. Select option 4, 'add channels'. The digibox's default frequency, 11·778GHz V, will then appear, see Photo 3. To add channels from transponder 49, change the frequency to 10·831GHz, the polarisation to H, the symbol rate to 22 and the FEC to 5/6, see Photo 4. To do this use the left/right buttons at either side of the round 'select' button on the remote-control unit, using the adjacent up/down buttons to scroll up and down through the menu. Finally, go down to the 'find channels' option.

The digibox will then search for the channels and should produce a list as shown in Photo 5. Select the channels you want to store by scrolling through the list and pressing the yellow button, which will produce ticks alongside the channels required. Then press the 'select' button and after that the 'Sky' button on the remote-control unit.

The channels will now be found by pressing the 'services' button followed by option 6 in the services menu. Avoid pressing the remote-control unit's yellow button while in this menu, as the channel will be deleted from the list.

I've found that digiboxes can lose their memory of added-in channels from time to time, especially when there has been an over-the-air software upgrade. In this case the above procedure will have to be repeated. **C.H.**

Digital channel update

The latest channel additions at 28·2°E are listed in Table 1, with the EPG number shown in brackets after the channel name. London TV previously shared channel time with Overland TV (EPG no. 166).

GlobeCast Radio (Eurobird transponder D9S), mentioned in the September issue, has been assigned EPG no. 907. **C.H.**

Widescreen captions

With widescreen transmissions becoming more common, it's not surprising that satellite captions and test cards are going widescreen as well.

The BBC CAR (Central Apparatus Room) colour bars are often seen in conventional 4:3 format via Eutelsat 2F3, which is in inclined orbit at 21·5°E. Photo 6 shows the colour bars in 16:9 format, with extensions at each side.

Photo 6: The BBC CAR (Central Apparatus Room) colour bars in 16:9 format, with extensions at each side. Transmission via Eutelsat 2F3.

Photo 7: Caption received via Eutelsat 2F3 prior to a BBC transmission from an independent production facility, showing 4:3, 14:9 and 16:9 screen borders.

Photo 8: Cubavision International via PanAmSat 9.

Photo 9: Feed from Edgbaston via PanAmSat 9.

The 16:9 caption shown in Photo 7 was also received via Eutelsat 2F3. It appeared prior to transmission of a BBC programme from an independent production facility and shows 4:3, 14:9 and 16:9 screen borders. The 14:9 format is a compromise between the main 4:3 and 16:9 formats: it is now used by the BBC for the Corporation's good old-fashioned analogue UHF transmissions!

Both transmissions were in MPEG 4:2:2 form, requiring the use of a PC-based receiver. As Eutelsat 2F3 is in inclined orbit, some dish elevation tracking is required to receive its transmissions. This has been mentioned in recent Satellite Notebook and DX and Satellite Reception columns. **C.H.**

PanAmSat 9 (58°W)

Cubavision International, see Photo 8, is an exotic signal that can be received from PanAmSat at 58°W. In the UK the satellite is fairly low to the south west, but it provides a strong signal in western Europe. The frequency to check for Cubavision International is 11·612GHz H (symbol rate 3,670, FEC 3/4).

There's not a lot else of interest from this satellite. I've found occasional news feeds at 11·530GHz H (SR 6,630, FEC 3/4) in the morning. There are also occasional feeds at 11·477GHz H, with SR

26,460 and FEC 3/4. The satellite's footprint covers the western Atlantic, and I've seen a cricket feed from Edgbaston, presumably intended for the West Indies – see Photo 9. **C.H.**

Pace 2200

This digibox was stuck in standby. The basic cause was simple: no resets were being generated by the NEC micro chip U600. I found that the 10MHz clock signal was missing at pins 40 and 41 of U600, though the 10MHz crystal was oscillating. Tracing back, I discovered that the 10MHz output at pin 12 of the inverter chip U203 was missing. But so was the input at pin 13. The only component that could have been the cause was a 100Ω surface-mounted resistor, which turned out to be OK. So a print break had to be the cause.

With the aid of a microscope I found the exact part of the print where the 10MHz signal went missing. When the green etch-resist had been scraped off, a break so small that it could be seen only under a microscope was found. The cure was to link it over with a single strand of very fine wire, but this wasn't easy. **M.D.**

An 'easy' upgrade to digital

"Do you fit motorised satellites?" came the question over the phone. "My system was fitted ten years ago and needs an upgrade to digital."

The local shop had given him my number. A day was arranged, and questions were asked about his system. This consisted of a Nokia analogue receiver and matching 36V positioner, a Channel Master 1·2m dish and a 9·75GHz LNB, fitted by the customer himself.

On arrival a quick tour showed that the dish was sited above a thorn bush! This would have to be cut back before I could gain access. The customer proceeded to trim his bush and I tried to remove the LNB. But ten years of weather had jammed the fixing pins into the brass inserts and, after a prolonged session with releasing oil, both came out together and couldn't be separated.

Fitting the new LNB was easy. I then went inside the house, where I removed the old equipment. But when I connected the spectrum analyser to the feed from the dish no signal could be found. After a long check it transpired that the customer had just cut the cable in two!

A temporary F-to-F joint produced a weak signal at the receiver end. When I checked at the new joint, about 3m from the LNB, the result was the same. So the LNB was changed as a precaution. This made no difference.

The customer was again quizzed about the dish, and I was assured that it tracked from east to west and had worked faultlessly since it had been installed. On checking the trueness of the wall mount that held the dish I discovered that it was out by quite a bit. "The wind must have moved it" was the customer's comment.

After adjusting the mount and setting the elevation and azimuth I found that the signal was still not very good for this size of dish, so a different type of LNB with a separate feedhorn was fitted. This produced great results at the LNB end, but the same low-level signal was present indoors. The coaxial feed was only about 6m long, so a new cable was installed. On retesting I was at last rewarded with good signal strength.

The receiver was connected to the various cables and the E/W limits were then set. But when the east limit was reached the dish was far from the easterly direction required for the Hellas satellite, the most important of them all here!

When I inspected the jack arm on the dish I found that the back of the motor housing caught the wall if it was adjusted farther back. So a compromise was sorted out. After a few further checks Hellas was located – at the expense of the westerly satellites, which were of no interest to the customer.

The wall mount and 18in. jack arm were made for this make and model of dish, and I can't remember having had this problem before. I told the customer that the other, westerly positions could be obtained if a 12in. jack arm was used, but no interest was shown and, as we all know, the customer is always right.

The overall time spent on this 'easy' upgrade: five hours. **P.H.**

A new one

A Grundig satellite receiver had a new fault for me: the card reader was not attached to the main PCB! Someone had dropped the receiver and the impact had sliced the reader off. A replacement was fitted and, after careful inspection of the main PCB and a power supply upgrade, the receiver worked faultlessly.

A replacement front fascia was also fitted, as the card slots were broken. An old receiver was then ready for resale! **P.H.**

Table 1: Latest digital channel changes at 28·2°E

Channel and EPG no.	*Sat*	*TP*	*Frequency/pol*
London TV (244)	*EB*	*C1*	*11·223GHz/H*
Pulse Unsigned Radio (905)	*EB*	*D7S*	*11·588GHz/H*

TP = transponder. EB = Eurobird.

An ongoing saga

The phone went. "Do you repair motorised?" was the first question. The next was "how much do you charge?" The reply, after mine, was "OK, I'll tell my dad". Then the phone went dead. Two weeks later I heard the same voice. This time it said "can you come?" It was a job that, with forethought, I should have left alone.

The receiver was an EchoStar 3000, about three years old. The first thing was to check that it worked. When I switched it on, a picture from Hotbird appeared. This was useful, as an upgrade was required. I upgraded the software from 400 to 1,000 then, after a factory reset, I tried to move the dish to the east to set the first limit. This is when the fun started!

There were no motor functions and, when I removed the receiver from the cabinet, there were no cable connections to the motor. The cables were found at the back of the cabinet, so a check was carried out to ensure that the colours were correct. When I opened the back door I was confronted with the jungle. There was a tall growth of ramblers, grass and old furniture . . .

After hacking my way to the dish I first noticed that the pole was undersized and not straight. The cables outside were not the same as inside. The joint had to be found and a drawing made of the colours. When all this had been sorted out the reed switch was found to be short-circuit. So a new one was fitted and the pole was bent back to the upright position. It was loose in the ground and just fell back. The dish was not fitted correctly on the mounting stub, and the bolts for elevation adjustment were missing!

A long discussion with the daughter, who spoke good English, revealed that a succession of 'satellite fitters' had been called in. As each of them had left, less of the system had worked.

That's more or less the story to date. The system has been removed, the pole scrapped and a new one has been concreted in. Next week an attempt will be made to fit it all, once and correctly! **P.H.**

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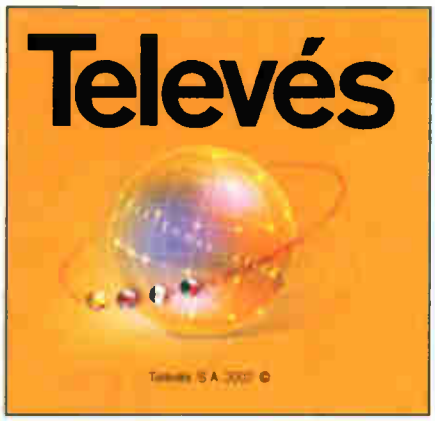

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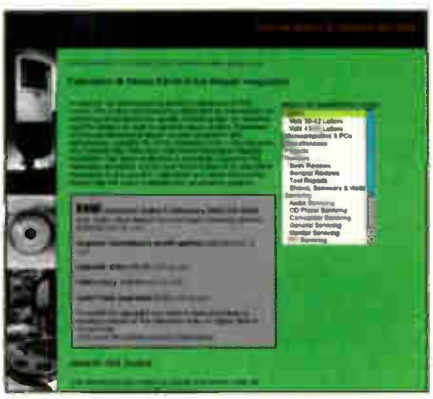

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Solution to Test Case 503

– see page 41 –

Had there been enough energy in the line output transformer in this Tatung Series E set the cause of the no raster fault would doubtless have been found much sooner – and without reference to Sage. In fact a vertical white line would have been displayed, indicating loss of current in the line scan coils. Sage's careful probing with his oscilloscope revealed the same waveform as at the collector of the line output transistor at the 'upstream' side of the line-scan coupling/S-correction capacitor C426. But there was a strange waveform, low in amplitude and with a double peak, at the 'earth return' side of C426 – at the top of the scan coils in fact. C426 was then found to be open-circuit. When it was removed and examined carefully its case was seen to be somewhat bulged. It read precisely 16pF when checked with a capacitance meter.

Why did this have such an effect on the flyback period? In practice the tuned inductance of the *LC* resonant circuit is formed by the output transformer and the scan coils in parallel, linked together by the low impedance (at the scanning frequency) of the coupling/S-correction capacitor C426. With this capacitor open-circuit, the scan coils were in effect no longer in parallel with the output transformer. Thus the higher inductance resonated with the tuning capacitors at a lower than normal frequency, giving rise to the abnormally-long flyback pulse. All basic stuff, which would have been applicable donkey's years ago!

NEXT MONTH IN TELEVISION

Measuring ESR

The equivalent series resistance (ESR) of an electrolytic capacitor is a reliable indication of its condition. Since electrolytic capacitors tend to deteriorate and are such a common cause of problems in consumer electronic equipment, a meter that provides a quick ESR check is a great help as a diagnostic tool.

Alan Willcox's ESR meter design published in these pages some five years was very popular. It's simple to build and easy to use. But there is always room for improvement. Alan presents a Mark 2 version that incorporates several improvements, in particular a simpler oscillator design and single-battery operation.

At the Japan CEATEC Show

The Japan CEATEC (Combined Exhibition of Advanced Technologies) is one of the world's leading consumer electronics shows. This year's show, held in Tokyo, will include the latest developments in flat-screen displays, optical-disc technology, hard-disk recording and the convergence of PC and CE devices. George Cole reports on the show's highlights.

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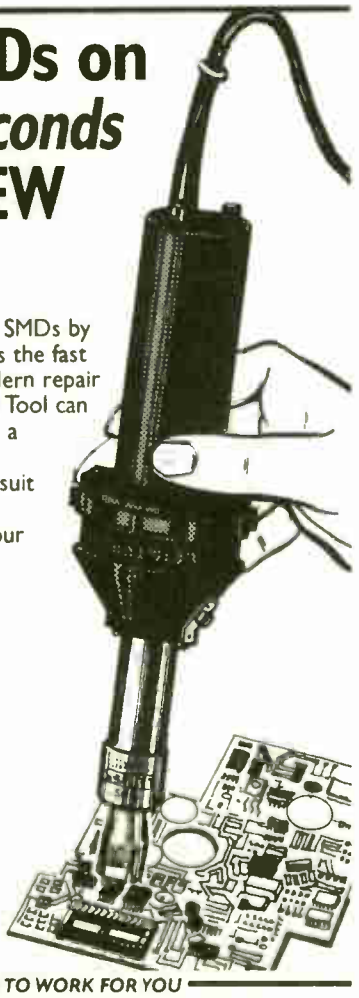

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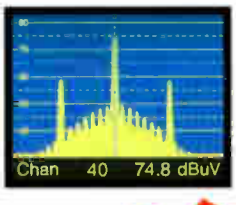

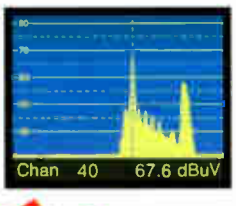

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MC 577

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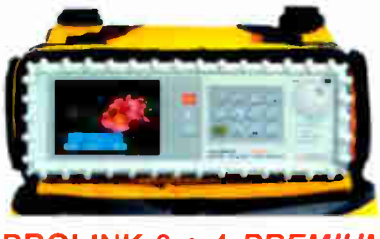

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