## THE LEADING UK CONSUMER ELECTRONICS TECHNOLOGY MAGAZINE



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## CONIHNTIS

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## Consumer Confusion

## Letters

The end is nigh? Will digital TV make a noticeable difference picture quality?

## Teletopics

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## LNBs for Digital Systems

The LNB characteristics that are important for successful reception of digital transmissions.

## Codes for Passive SMDs

## Satellite Notebook

Solutions to problems with satellite TV equipment and installations.

## What a Life!

Donald Bullock devises a Very Nasty Device to deter Greeneyes' dogs, and gets his comeuppance. Some servicing problems as well!

## More Power

Things that go bang in the night - and during the daytime too. Pete Roberts on what causes problems with the mains supply and some ways of minimising their effects.

## The Panasonic K Deck

Adrian Williams provides a guide to dealing with the faults you can get with this VCR deck.

## Satellite Workshop

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## Next Month in Television

## Panasonic Young Technician of the Year -

All you young technicians, make that extra bit of effort for those all-important final examinations this year. You could be Panasonic Young Technician of 1998. See page 669 for details.

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## Consumer <br> Confusion

Retail price maintenance was abolished many years ago. The government has now decided that even quoting manufacturers' recommended prices is, from September 1st, to be illegal in our industry. Whatever for? There is no way of enforcing recommended retail prices, which have become something of a joke - a quite harmless one. No one takes much notice of them. But they have served a purpose. They provide an indication of the value a manufacturer sees in a particular product and its market position. That, surely, is of some help, if not a very great one, to the customer. At least he is given an idea as to whether he is being offered a quality product, an average workaday one or a rock-bottom cut-price item. We are no longer to be allowed this bit of guidance.

Was it useful? Well, the customer can hardly take a piece of equipment to pieces before he buys it. And, nowadays, most TV sets, VCRs, PCs and whatever look much of a muchness - tube size and features apart in the case of a TV set. In this situation, to be given an indication of perceived value is surely better than nothing at all.

It is one thing to encourage free, competitive trading, quite another to leave consumers in the dark with little idea of the value of what they are being offered. They can of course carry out detailed market research, but who has the time - or inclination? They can also wade through one of those interminable Which? reports that state the obvious at great length and come to totally anodyne conclusions.

The fact is that doctrinaire free-marke-
teers have had it all their own way for rather too long. It is of course possible to go too far in the opposite direction, towards control and restrictions. But we need laws to enforce decent behaviour, and have had trade regulations to ensure fair practice. The move to regulation started in the Victorian era, when it was common practice to sell adulterated goods. Surely we don't want to go back to that sort of thing?

Going too far in the direction of uncontrolled trading has very real dangers. An obvious example was the misselling of personal pension schemes a few years back. When it comes to what are nowadays known as "financial products" rather than insurance, banking, pensions and so on, total confusion can reign, making it easy for the less than scrupulous to operate. Insurance, mortgages and so on have been fertile ground for those interested in only a quick, profitable deal. It's all too easy to muddly the water, get the punter confused then come up with what looks like a brilliant offer.

It's strange that governments of both colours have advocated this totally unrestricted approach to business. Right now, as Mike Peters put it recently in $E R T$, the only thing that seems to be regarded as important is different prices! It is not helpful to remove all guidelines such as suggested/recommended prices etc., which do provide a rough if very imperfect yardstick.

Right now things are getting worse and worse. Telephone salespeople are offering all sorts of confusing deals and special offers. And the rot is spreading to
such simple things as the supply of gas and electricity. There have already been complaints about reduced-price offers that turn out to be something different in practice. The free-for-all is in danger of becoming a heaven-sent opportunity for the unscrupulous. You would have thought that we had learnt the lesson about unsupervised marketing.

A great deal of effort is being put into concocting various special services, deals and so on. The public is confused and, by and large, benefits little. Suggested prices represented a little bit of much-needed help. You can blame a lot of this on the Monopolies and Mergers Commission, whose remit has been extended far beyond that originally envisaged. The Commission seems to think it malevolent that anyone should set a value on anything and provide clear terms of trade.

One day the pendulum will swing back - not too far, one hopes. One also hopes that not too much damage will have been done while we were in the anything-goes era. But it will be of little help to those who have been sold a pup because of a lack of standards and guidelines. And it will have been of no help at all to honest traders who have seen their businesses ruined by slick operators.

We need some degree of regulation, in the same way that we need laws. And those recommended prices did provide a little bit of help in an otherwise very confusing marketplace. The president of the Board of Trade has not done the consumer a favour in deciding on this unnecessarily draconian prohibition.

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| 0.64 | TMP47C434N | 3537 |
| 1.32 |  | 15.22 |
| 4.70 | TMP47C434N | 3555 |
| 2.05 |  | 16.63 |
| 14.21 | TPU2732 | 10.05 |
| 2.40 | U2829B | 3.40 |
| 6.13 | UC3842 | 1.46 |
| 3.85 | UC3844 | 1.20 |
| 4.62 | UC3844N | 1.91 |
| 2.74 | UPC1318AV | 3.85 |
| .6.41 | UPC1365C | 1.70 |
| 10.31 | UPC1378H | 1.71 |
| 4.60 | UPC1394C | 1.92 |
| 5.98 | UPC 1488H | 2.99 |
| 11.04 | UPC1498H | 2.31 |
| 1.54 | UPC574J | 0.86 |
| 2.82 | X2402P | 5.78 |
| 2.57 | ZTK33B | 0.28 |
| 1.44 | 2TX650 | 0.51 | 2.82

4.66
9.57
4.00

Al19
$\begin{array}{ll}0.36 & \text { BC557 } \\ 0.71 & \end{array}$ $\begin{array}{lll} & 0.31 & \text { BC557B }\end{array}$

## AN5265 AN5512

$\qquad$
$\qquad$




## $\begin{array}{ll}\text { \& BT151500R } & \mathbf{1 . 1 2} \\ \text { BT151800R } & \mathbf{1 . 1}\end{array}$

TA7281P
TA7698AP

32 Temple Street, Wolverhampton, WV2 4AN, UK Tele ++ 44 (0)1902 773122 Fax ++ 44 (0)1902 29052


Letters
anyone need a van driver, sweeperup or suchlike? I don't mind, anything considered!
Mike Haywood, MHTV,
Falmouth, Cornwall.

## The Neutral Screw

David Smith (Letters, May) observes that the "negative". screw in a UK 13A plug tends to come loose. He means the neutral screw of course, but let's not get sidetracked. Here are two possible explanations.

First; some manufacturers dip the stranded wire ends of the mains cable in solder. This contains lead, which 'creeps' under pressure. The lead exhibits the phenomenon of 'cold flow' until the pressure is relieved. Hence a loose wire. The live wire is less likely to have solder on it because most people trim it back to fit inside the plug.

Secondly, the neutral retaining screw goes into the pin directly, while the live screw goes into the fuseholder. The neutral screw is therefore subjected to shock and vibration each time the plug is inserted or removed from a socket. The effect is exacerbated by the lack of a locking washer for the screw.
Martin T. Pickering, B.Eng., Sandbach, Cheshire.

With reference to David Smith's letter (May, page 482), I would like tooffer the following suggestion as to why a loose neutral mains plug screw can cause a destructive fault when a loose live side screw won't.

When the neutral side of the mains supply goes open-circuit, a current flows from the chassis circuitry to earth. For example, if the live side is at 350 V with respect to earth and the neutral side is opencircuit, in 100 nsec a current of 35 mA flows to earth via the stray capacitance (say 10 pF ). This could turn on power devices unexpectedly. Inductive effects and arcing could alter this simple analysis of course.

If the foregoing is valid, failures may occur in wrongly-wired houses that have single-pole neutral switches at ring-main outlets. Is there any evidence to suggest that this is a cause of destructive failures?
Ray Porter, M.Sc., C.Eng., M.1.E.E., Stourbridge, W. Midlands.

## Daewoo Spares

The phone number given in the Television TV/VCR Spares Guide 1998 for ordering spares from Daewoo is the old main switchboard number. The correct phone number, for account holders only, is
01189252606.

The address details are correct.
Non-account holders can order spares through our distributor

## SEME:

Manoj Aggarwal, National Service Manager,
Daewoo Electronics Sales UK Ltd., Wokingham, Berks.

## Try Zambia

In the May issue (page 483) you printed my letter on being able to supply semiconductor devices and VCR drive components that are difficult to obtain. Readers can now use our e-mail address, which is

## kalibu@zamnet.zm

Our fax number is 002602
221055, telephone number 00260 2 226871. As much information as possible should be provided to help us identify the required item. M.P. Nalletambly, Box 23186,

Kitwe, Zambia.

## Mel's Mod

I've been carrying out a similar modification to that described by Mel Davies (letters, April, page 427) for some time. The current demand seems to be rather close to the limit for a 7812 regulator however. I therefore use two in parallel, with an $0.47 \Omega$ resistor in series with each
output for current sharing (instead of a single resistor on the input side) this is necessary to allow for manufacturing tolerances that affect the exact output voltage of each individual regulator.

If you examine the manufacturers' data sheets for the 78XX family of three-terminal regulators you will find that decoupling capacitors are required at the input and output to ensure stability. The values should be between $0.47 \mu \mathrm{~F}$ and $2 \cdot 2 \mu \mathrm{~F}$. These capacitors should be mounted as close to the regulator as physically possible.
I. Field,

Letchworth, Herts.

## Through-PCB Rivets

A few years ago manufacturers started to use through-PCB rivets for some connections in TV sets, particularly the line output transformer and transistor and high-wattage resistors. As a result, a fault that is potentially dangerous can occur in some sets: the solder between the rivet and the print land becomes dry-jointed, followed by arcing and eventually a burn up on the board.

Within the space of a week I had a number of JVC sets and three Philips Gl 10 chassis that had this fault. In each case the joint was at the line output transformer connection to the collector of the line output transistor. There was a large hole in the board in one of the Philips sets.

My advice is to resolder these joints whenever a set comes in for service.
David Belmont,
Wembley, Middx.

## What's Cooking?

My thanks to those who, in the June issue, commented on my article on microwave oven servicing (April, page 404). Sorry for my mistake about ionising radiation. It was a genuine slip, after I'd been looking into the possibility of X-ray radiation from some types of magnetron. I abandoned this search as it led nowhere. It is my practice to check for leakage before and after servicing an oven, which is a wise precaution. There's a lot of RF power in that little box, fed by lots of volts with a deadly current-provision capability.

The design of a meter for voltage checks in the magnetron circuit was going to be done with safety in mind. Several checkers are available in the USA, but I suspect that they are made for profit rather than to perform any really useful func-
tion in magnetron circuit fault diagnosis. I favour the probe idea, and have been experimenting along these lines, so far without any danger to life and limb!

Finally, I would like to stress again the need for extreme caution when dealing with microwave ovens. There must be an intact earth wire from chassis to the mains plug's earth pin, and the oven must be earthed when installed in its operating position. Follow the manufacturer's instructions for measuring leakage and power output. Get your leakage tester checked regularly, and observe all the safety precautions. If you worked in a service department in the days of valves, or on high-power valved equipment as I did, you will know the folly of taking chances or becoming careless. A $2 \cdot 1 \mathrm{kV}$ AC supply at up to 500 mA is definitely a killer - it's the voltage used for the electric chair. $J$ LeJeune,
Ravenshead, Notts.

## Digital Picture Quality

I am intrigued by the idea that digital television will bring the viewer improved picture quality (as if the viewer could tell the difference anyway!). I wonder where this idea came from?

The system may be capable of providing a better image, but that's a very different thing from what it will be asked to do. It's a long time since even the existing PAL system was strained by anything outside the vertical interval, and I can't see that changing.

When I worked in ITV, many of us thought that the ITN news studio was the standard for picture quality, with BBC news close behind and nearly all other programme content being much inferior. This is how it should be of course: if a company cannot produce a decent quality fixed studio shot, what can it do?

But ITN's standards fell years ago. For a long time now its pictures have been all nasty edges with no real sharpness - rather like a somewhat upmarket VHS picture in fact.

It is only recently that the BBC has started to slip - but, oddly enough, not so much with its studio pictures as with the inserts, which have become very noticeably noisy.

Most of the rest aren't worth a mention, and images via satellites are a joke (except for QVC). I would like to see a good-quality
picture via a digital service - or even an analogue one come to that - but I think I will be waiting for a long time.
A. Jaques, Stretford, Manchester

## Health

I'm a 38 -year old TV engineer who joined the trade after leaving school at sixteen. When I was 27 I was struck down by leukaemia. Thanks to good treatment, followed by a bone-marrow transplant from my sister, I recovered from the illness.

I know two TV engineers in my area, of roughly my age, who have had cancer. Several older engineers have, sadly, died of the disease. This leads me to think that our type of work could involve a health risk.

I would like to hear from any other trade readers who have had leukaemia or some other form of cancer, or who know/knew anyone in the trade who developed this illness.
Brian Milne,
3 Chapelhall Cottages, Undy, Ellon, Aberdeen.


# TELETOPICS 

## Digital TV Update

BDB claims to be "on track" to launch its digital terrestrial TV services in the last quarter of the year. A basic package of "at least twelve channels" will be available to subscribers at under $£ 10$ a month. At its first city presentation the company claimed that it would break even with just under two million subscribers: with three million it would make an annual profit of over $£ 100 \mathrm{~m}$, rising to more that $£ 250 \mathrm{~m}$ with five million subscribers.

BDB is to use the Mediahighway interactive system developed by the French pay-TV giant Canal Plus: in February BDB announced that it would use the MediaGuard conditional access system developed by Seca, which is jointly owned by Canal Plus and Bertelsmann. BDB has appointed BT to set up its customer management centre, which will be staffed by BDB employees but run by BT. The contract is for the whole of BDB's twelve-year licence period. More than a hundred people will be employed at the centre initially, rising to over 1,000 by the end of the licence period.

A new digital TV group, S4C


A PIP display with a set that uses Acorn Group's new acTiVe advanced digital TV system. This software-based technology enables many features to be built into a set and, since the software can be updated remotely, the set is made 'future-proof'. Interactive services such as web surfing, e-mail, home shopping and on-line games are some of the possibilities.

Digital Network, is likely to be awarded the remaining DTT multiplex by the ITC. It will include S4C and Channel 5 programming. Members of the group include United News and Media, S4C and NTL.

British Interactive Broadcasting (BIB), which is owned by BT, BSkyB, Matsushita and HSBC, looks set to get the go ahead from the European Commission's competition authorities following BT's announcement that it will dispose of its cable TV operations in Westminster and Milton Keynes. BIB plans to offer interactive TV services, such as home shopping and banking, via BSkyB's digital satellite TV services.

Research carried out by NOP found that 27 per cent of adults are aware of digital TV: the figure rose to 41 per cent in homes with a PC and/or internet access. A smaller survey carried out by Radio Rentals found that 28 per cent of the population had not heard of digital TV and nearly 60 per cent didn't know what a set-top box was.
Eutelsat, BT Broadcast Services and internet service provider Easynet
are piloting a system called Convergence-1. It's a high-speed DVB internet and TV service and could be launched by the end of the year. More on this in our report next month on the Cable and Satellite '98 Show.

Danish company ITE has developed WebChoice TV, which provides a TV set-PC link. Connection is via an audio lead, a series of audio cues being used to trigger special software stored on the PC's hard disc. This software turns on the PC's modem, giving access to a web site with content related to the TV programme.

The European Commission has blocked a proposed German digital pay-TV venture between media groups Kirch and Bertelsmann. It would have involved merging DF-1, Kirch's loss-making digital pay-TV service, with Premiere, an analogue subscription TV service controlled by Kirch and CLT-Ufa, which is partowned by Bertelsmann. DF-1 is now to be closed. The EC's decision could delay the introduction of multi-channel, interactive digital subscription TV in Germany.

## VHS-ET

JVC has developed a new VHS format called VHS-ET (the ET stands for Extended or Enhanced Technology). As with S-VHS, there is considerably improved resolution: VHS-ET is understood to be capable of close to 500 lines. The format uses standard VHS tape, relying on improved heads and signal amplifiers to provide the higher performance.

Unfortunately ET recordings cannot be played back via a standard VHS machine unless it has 'quasi S-VHS playback', which is rare. They can be played back with an S-VHS machine. The format is to be launched in Japan this summer and in the USA this autumn. There are no plans for a European launch to date.

## Sega's Dreamcast

Sega has announced its next-generation games machine, called Dreamcast. It uses 128 -bit technology, is internet-ready, and will run a version of Microsoft's Windows CE operating system. Dreamcast will be Sega's flagship product and is expected to help restore the company's position in the highly-competitive global video games market.

## Business News

Matsushita Electric Europe recorded a double-digit increase in sales last year and plans to increase the proportion of goods made in Europe. This will reduce transport costs and increase its ability to meet local consumer requirements. Europe accounts for about ten per cent of Matsushita's total turnover.

Lite-On Technology, the Taiwanese electronics company, is to reduce output of computer monitors sharply at its Mossend plant in Lanarkshire. Two of the three production lines will be closed down and two thirds of the 350 strong workforce made redundant. Intense competition from Asian companies following recent devaluations is blamed. The company expects an upturn in the global market within the next twelve months. The plant is close to that of Chung Hwa Picture Tubes, whose current output is for TV sets only.

The South Korean LG group has taken full control of Zenith, the last indigenous US TV setmaker. LG acquired a majority shareholding in 1995. There is to be a debt-for-equity swap and new capital under a bankruptcy reorganisation plan. In future LG will supply the TV sets and other products sold under the Zenith brand name.

## The Betamax Website

The Betamax website is now a year old, providing plenty of evidence that these sophisticated VCRs are still in wide use on both sides of the Atlantic. But spare parts are becoming more difficult to obtain and most service personnel no longer have the expertise to be able to carry out repairs. To help with this, the website includes a list of suppliers and engineers in the UK and USA. There are in fact over 240 pages at the website, which is essential surfing for anyone interested in these machines. The address is
www.elektratec.co.uk
The site was started by enthusiasts Alan Barnett and Martin Evans in London. It's known as the PALsite because it concentrates on European models. For further details you can contact the PALsite on 07050612 290, Alan Barnett on 01812411140 or Martin Evans on 07050612063.


Polar Instruments has launched a unique flying probe PCB test system which has been designed for manufacturers and for service organisations that deal with particular equipment in quantity. The FT100 test system provides completely automated PCB probing and is particularly helpful with fine-pitch boards. It operates with any Polar PFL series PCB fault locator for component-level fault diagnosis. Five tests per second can be carried out, employing Polar's analogue signature analysis (ASA) technique: the board being tested does not need to be powered. For further information contact Polar Instruments Ltd., Garenne Park, St. Sampson, Guernsey, Channel Islands GY2 4AF. 0148153 081,
fax 0148152476.

## Digital TV Technology

Computer company Acom has demonstrated a set-top box technology based on software rather than dedicated hardware. The advantage of using software in conjunction with a powerful processor, in this case an Intel StrongArm 1500, is a considerable increase in operating flexibility, overcoming many interoperability problems. Signals from different sources and using different interactive standards can be handled. As new requirements arise, extra software can be downloaded. The StrongArm 1500 runs at 300 MHz , enabling the system to decode two MPEG-2 data streams simultaneously: thus one channel can be watched while another is being recorded.

Matsushita believes that the next leap forward is likely to occur in 2003, when processors that operate at 10 bn operations $/ \mathrm{sec}$ become available at a reasonable price. They will be sufficiently powerful to enable multimedia tasks to be performed using software, bringing about a dramatic reduction in cost.

Matsushita is already working along these lines. It has developed a media core processor (MCP) that uses $0.35 \mu \mathrm{~m}$ silicon and operates at 3.3 bn operations $/ \mathrm{sec}$ with a clock speed of 54 MHz . The MCP is a powerful, programmable device capable of performing a number of multimedia tasks such as DVD and TV set-top box decoding. It combines a
signal processor with a very long instruction word core. The processor handles sequential tasks such as MPEG stream analysis or the calculation of graphics coefficients while the core unit carries out more intensive tasks such as MPEG video decompression. The microcode routines required for processing are downloaded.

Matsushita is now working on an $0.25 \mu \mathrm{~m}$ MCP rated at 5 bn operations/sec with a clock speed of 81 MHz .

Microsoft is working on voice-controlled set-top boxes for digital TV, using techniques developed by the Belgian linguistics software company Lernout and Hauspie and Creator. The chip set under development will enable the user to select channels, call up web pages and download information and video from the internet by talking into a microphone. Spoken commands are converted into a digital signal that's sent to the settop box in RF form. The Windows CE operating system will be used - it can already handle the speech technology. The system could be ready for production before the year 2000.

VLSI Technology has announced new chips for digital set-top boxes and full receivers. The latest introduction is the VES9600, which demodulates digital terrestrial TV transmissions using the DVB-T
standard. It provides a three-chip receiver in conjunction with the VES2700 for MPEG-2 transport control and the VES6100 for MPEG-2 decoding. VLSI has the VES1893 for satellite digital TV demodulation and the VES1820/VES 1900 for cable digital TV receivers. Another new chip, the VESI848, is a return-channel modem for interactive TV with cable systems.

VLSI subsidiary Comatlas has developed the CAS2043 plug-in board to enable a PC to receive digital satellite TV and data transmissions. The board is intended primarily for professional use, but similar products at consumer prices are expected to be available "before too long".

Texas Instruments and Philips Semiconductors have entered an interoperability agreement on physical layer IEEE 1394 (FireWire) chips running at $400 \mathrm{Mbits} / \mathrm{sec}$. An article on the FireWire digital interconnection system appears on a later page. As part of the agreement, TI and Philips will share specification information for their next generation of two-, three-, fourand six-port $400 \mathrm{Mbits} / \mathrm{sec}$ physical layer devices. The individual companies can provide product differentiation by incorporating additional features and capabilities while conforming to a common pin-out, packaging and signalling specification.


Factors that determine the performance of an LNB with digital satellite transmissions

## LNBs for Digital Systems

When a satellite uses digital transmission it can deliver more information in the same bandwidth than with analogue transmission. In addition, there's an improvement in the quality of the signal. To take full advantage of this, the receiving LNB must suit the digital signal characteristics.
Technically, there are over fifty factors that should be considered, including RF leakage, in-band spurious performance, out-of-band spurious performance, long-term ageing effects, vibration effects, corrosion resistance, intermodulation performance, dynamic range, reliability, tolerance of electrostatic discharge and many others. There are however a few key specifications that we will consider here - noise figure, gain, LO frequency stability, phase-noise performance, susceptability to microphonics and input VSWR.

## Noise Figure

This is a measure of how much noise the LNB adds to the received signal. The lower the noise figure the better the reception, of weak signals in particular. With Cband ( $3 \cdot 4-4 \cdot 2 \mathrm{GHz}$ ) LNBs the noise figure is usually expressed in Kelvin, a unit that relates to absolute zero or the level of molecular activity. It is technically incorrect to refer to degrees Kelvin. Zero Kelvin represents no noise. A very good figure for a C-band LNB is 15 Kelvin : 30 Kelvin is more typical.
With a Ku -band $(10.7-12.7 \mathrm{GHz}$ ) LNB the figure is expressed in dB . A very good noise figure for a Ku -band LNB is $0.6 \mathrm{~dB}: 0.8 \mathrm{~dB}$ is more tyical. As a point of reference, $35 \mathrm{Kelvin}=0.5 \mathrm{~dB}$.

## Gain

Gain is also expressed in dB . With a digital system it is important that the LNB's gain does not vary significantly with temperature over the received bandwidth - digital systems are much more sensitive in this respect than analogue ones. With a digital system a gain of $55-65 \mathrm{~dB}$ under all conditions is typically required. Gain flatness
across a $500-800 \mathrm{MHz}$ band should be better than $\pm 5 \mathrm{~dB}$, and less than $\pm 1 \mathrm{~dB}$ over 27 MHz . Greater variations can introduce gain distortion with reduced receiver performance as a result.

## LO Stability

Three main types of local oscillator are used in LNBs.
(1) The dielectric resonant oscillator (DRO). Frequency conversion is determined by a free-running oscillator whose operation is stabilised by a piece of ferroceramic material.
(2) The phase-locked loop (PLL) type. An internal tem-perature-compensated crystal oscillator is incorporated within a digital phase-locking circuit.
(3) The PLL type with external reference. A reference oscillator outside the LNB, usually in the receiver, is used to control the frequency of the internal LO. In most cases the reference frequency is 10 MHz . Connection is via the coaxial downlead.

Different digital signal types and bandwidths call for different degrees of frequency stability for optimum receiver performance. With a wideband signal such as MPEG-2 TV, frequency stability is not so important as the receiver tuning can be wider. With an SCPC radio broadcast the bandwidth is very narrow, calling for a high-stability PLL system to enable the receiver to track the signal.
The frequency stability with a DRO oscillator is $\pm 250 \mathrm{kHz}-1 \mathrm{MHz}$. This type is suitable for TV and wideband data broadcasts. With an internal reference PLL the frequency stability is $\pm 5-100 \mathrm{kHz}$, making it suitable for SCPC audio, news gathering and VSAT. The frequency stability with an external reference PLL is 0 $\pm 1 \mathrm{kHz}$ : applications include satellite paging and nar-row-band data.

## Phase-noise Performance

The phase-noise specification indicates the level of noise introduced at various frequencies away from the converted carrier frequency. This noise is generated by the LO and is an indication of the oscillator's quality. In the specification, the frequency separations from the carrier are $100 \mathrm{~Hz}, 1 \mathrm{kHz}, 10 \mathrm{kHz}, 100 \mathrm{kHz}$ and $1 \mathrm{MHz}-$ Table 1 shows typical Ku-band LNB phase-noise specifications.
With a digital system the bit error rate (BER) at the receiver is affected by the phase noise in the signal fed to it: the higher the noise level, the greater the number of errors.

## Microphony

An installed LNB is subject to the elements - wind, rain etc. Rain or hail hitting it will produce small disturbances in the LNB's electrical performance. Wind will move or vibrate the dish with similar effect. These disturbances are superimposed on the incoming modulation. It's possible for the distortion introduced by such disturbances to be so great that the incoming signal cannot be resolved. The LO is the circuit most likely to be affected. Great care with the mechanical and electrical design of an LNB is required to minimise microphony.
There are no standards or units of measurement for LNB microphony. Simulated rain drops or other means are used for evaluation.

## Input VSWR

The voltage standing-wave ratio at the input is sometimes referred to as the return loss. It's the ratio of the incident voltage/primary voltage wave present in a transmission line or waveguide to any reflected voltage present as a result of mismatching. Under optimum conditions, where there is a perfect match between the feed and its load (the LNB), the VSWR is $1: 1$. In practice, because of electrical and physical variations this is not possible. The reflected energy is lost and, in addition, interferes with the incoming wave, producing further loss.
A good match between the feed and the LNB is most important for maximum signal transfer to the LNB. Table 2 shows the approximate effect of VSWR on the noise performance of a Ku-band LNB with a noise figure of 0.8 dB . It highlights the considerable effect that the input SVWR can have on an LNB's noise figure.

## In Conclusion

With some applications selection of the correct LNB makes the difference between a system operating at full potential or one that gives far less than satisfactory performance. A high-stability or even an external reference PLL LO is required with a satellite digital paging system. Examples in the Norsat range are the 1000 and 3000 series. With an MPEG-2 digital TV signal a highstability DRO LNB is suitable, such as the Norsat 4000 series. SNG trucks use PLL LNBs such as the Norsat 1000 series for the most reliable performance in the worst conditions.
Most operators appreciate the importance of an LNB's noise figure, gain and LO stability, but other factors such as microphony, input VSWR and phase noise also require attention. It is important to check all these parameters in a manufacturer's specification.

## Aknowledgement

The above paper by Don Filmer, V.P. Engineering of Norsat, was presented during a seminar at Cable and Satellite '98, which was held at Earls Court 2 in May.

Table 1: Typical Ku-band phase:noise specifications.

| Offset | Analoge <br> $D R O$ | Digital <br> $D R O$ | Int. ref. <br> $P L L$ | Ext. ref. <br> $P L L$ |
| :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |
| 100 Hz | NS | NS | $-70 \mathrm{dBc} / \mathrm{Hz}$ | $-65 \mathrm{dBc} / \mathrm{Hz}$ |
| 1 kHz | $-55 \mathrm{dBc} / \mathrm{Hz}$ | $-65 \mathrm{dBc} / \mathrm{Hz}$ | $-75 \mathrm{dBc} / \mathrm{Hz}$ | $-75 \mathrm{dBc} / \mathrm{Hz}$ |
| 10 kHz | $-70 \mathrm{dBc} / \mathrm{Hz}$ | $-80 \mathrm{dBc} / \mathrm{Hz}$ | $-80 \mathrm{dBc} / \mathrm{Hz}$ | $-85 \mathrm{dBc} / \mathrm{Hz}$ |
| 100 kHz | $-85 \mathrm{dBc} / \mathrm{Hz}$ | $-100 \mathrm{dBc} / \mathrm{Hz}$ | $-85 \mathrm{dBc} / \mathrm{Hz}$ | $-95 \mathrm{dBc} / \mathrm{Hz}$ |
| 1 MHz | $-95 \mathrm{dBc} / \mathrm{Hz}$ | $-100 \mathrm{dBc} / \mathrm{Hz}$ | $-95 \mathrm{dBc} / \mathrm{Hz}$ | $-105 \mathrm{dBc} / \mathrm{Hz}$ |

NS = Not specified.

Table 2: Effect of input VSWR on the noise performance of a Ku-band LNB.

| LNB | Feed <br> VSWR | VSWR <br> loss | Effective <br> LNB NF |
| :--- | :--- | :--- | :--- |
|  |  |  |  |
| $3.5: 1$ | $1: 1$ | 1.6 dB | $0.8+1.6=2.4 \mathrm{~dB}$ |
| $3: 1$ | $1: 1$ | 1.2 dB | $0.8+1.2=2 \mathrm{~dB}$ |
| $2.5: 1$ | $1: 1$ | 0.8 dB | $0.8+0.8=1.6 \mathrm{~dB}$ |
| $2: 1$ | $1: 1$ | 0.5 dB | $0.8+0.5=1.3 \mathrm{~dB}$ |

## Codes for Passive SMDs

The following code marking systems are widely used for surface-mounted resistors and capacitors. They give the resistor value in ohms and the capacitor value in picofarads.
With the three-symbol code the first two digits are the base figures and the third the multiplier (number of zeros to add). Thus $270=27 \Omega$ or $27 \mathrm{pF}, 331$ $=330 \Omega$ or $330 \mathrm{pF}, 472=4 \cdot 7 \mathrm{k} \Omega$ or $4 \cdot 7 \mathrm{nF}$ etc. $2 \mathrm{R} 2=2 \cdot 2 \Omega$ and $2 \mathrm{P} 2=2 \cdot 2 \mathrm{pF}$. This code is also used for some wire-ended components, e.g. small disc ceramic capacitors.
The two-symbol code uses a letter to indicate the base figure, again in $\Omega$ or pF , followed by a multiplier number. The code is as follows:

| $\mathrm{A}=1$ | $\mathrm{M}=3$ | $\mathrm{Y}=8.2$ | $0=\times 1$ |
| :--- | :--- | :--- | :--- |
| $\mathrm{~B}=1.1$ | $\mathrm{~N}=3.3$ | $\mathrm{Z}=9.1$ | $1=\times 10$ |
| $\mathrm{C}=1.2$ | $\mathrm{P}=3.6$ | $\mathrm{a}=2.5$ | $2=\times 100$ |
| $\mathrm{D}=1.3$ | $\mathrm{Q}=3.9$ | $\mathrm{~b}=3.5$ | $3=\times 10^{3}$ |
| $\mathrm{E}=1.5$ | $\mathrm{R}=4.3$ | $\mathrm{~d}=4$ | $4=\times 10^{4}$ |
| $\mathrm{~F}=1.6$ | $\mathrm{~S}=4.7$ | $\mathrm{e}=4.5$ | $5=\times 10^{5}$ |
| $\mathrm{G}=1.8$ | $\mathrm{~T}=5.1$ | $\mathrm{f}=5$ | $6=\times 10^{6}$ |
| $\mathrm{H}=2$ | $\mathrm{U}=5.6$ | $\mathrm{~m}=6$ | $7=\times 10^{7}$ |
| $\mathrm{~J}=2.2$ | $\mathrm{~V}=6.2$ | $\mathrm{n}=7$ | $8=\times 10^{8}$ |
| $\mathrm{~K}=2.4$ | $\mathrm{~W}=6.8$ | $\mathrm{t}=8$ | $9=\div 10$ |
| $\mathrm{~L}=2.7$ | $\mathrm{X}=7.5$ | $\mathrm{Y}=9$ |  |

Aluminium electrolytics may have a three-symbol code with numbers to indicate capacitance in $\mu \mathrm{F}$ and a letter to indicate the voltage rating. The letter code is as follows:

$$
\mathrm{C}=6.3 \mathrm{~V}, \mathrm{D}=10 \mathrm{~V}, \mathrm{E}=16 \mathrm{~V}, \mathrm{~F}=25 \mathrm{~V}, \mathrm{G}=40 \mathrm{~V}, \mathrm{H}=63 \mathrm{~V}
$$

The position of the letter indicates the decimal point position in the capacitance value. Thus $\mathrm{F} 47=0.47 \mu \mathrm{~F} 25 \mathrm{~V}, 3 \mathrm{E} 3=3.3 \mu \mathrm{~F}, 16 \mathrm{~V}$ and $22 \mathrm{C}=22 \mu \mathrm{~F}$ 6.3 V .

This information is intended to supplement the surface-mounted device (transistors/diodes) listing contained in the supplement to our May 1998 issue.


Reports from
Graham Richards Michael Dranfield Nick Beer and Hugh Cocks

## BT SV5300

We've had several power supply faults with these receivers. If the power supply is dead, check R802 ( $100 \mathrm{k} \Omega$ ). It's best to úse two $47 \mathrm{k} \Omega$, IW high-stability resistors as the replacement. Also check C805 ( $220 \mu \mathrm{~F}, 25 \mathrm{~V}$ ).

If the power supply is trying to start up or takes five minutes to do so, replace C810 and/or C825 (both $1 \mu \mathrm{~F}, 63 \mathrm{~V}$ ). The resistance across R811/814 should read $1.5 \Omega$. If it's higher the power supply may begin to trip.

Here's a point to note. If you remove the VideoCrypt decoder PCB, beware of the rear support pillars. They are not secured to the cabinet, and can crack the bottom PCB if too much pressure is exerted! G.R.

## Pace MSS100

If the power supply is dead, check D9 (RGP10K) on the secondary side. You will usually find that it's short-circuit. M.Dr.

## Pace MSS1000

This receiver wouldn't decode VideoCrypt transmissions and there were no on-screen displays. The contrast level had been set to maximum on the menu - the field engineer had tried this as a setting below three will cause the problem. It was noticeable that with clear channels the contrast, i.e. video level, was low.

Scope checks showed that there was the normal 2 V peak-to-peak output from the Nicky chip, and that the signal level remained OK through stages Q53 and Q57. It dropped to a maximum of 800 mV p-p at the output from Q58 (BC856B). This surface-mounted pnp transistor had gone high-resis-
tance. A replacement restored normal operation. N.B.

## A Cable Problem

The problem with a six-year old installation (Pace SS9200 receiver) was sparklies on the higher-frequency channels such as UK Gold, Sky Sports 3 and CNN. Lower-frequency signals continued to produce good results.

The dish was checked and found to be correctly aligned. A new LNB produced a marginal improvement, no doubt because it had a lower noise figure and produced a few more dBs of IF output than the original one, but reception of the higher-frequency channels still wasn't as it should be. Time to investigate the cable run.

A temporary substitute cable from the LNB to the receiver in the living room produced good signals on all channels, even with the old LNB. The original cable disappeared into the loft, where a length of it was found attached to a hotwater pipe with some cable ties - a practice not to be recommended! When I removed the cable I found that the section which had run alongside the pipe was very rigid in comparison with the rest of it. The new cable was installed well away from the offending pipe! H.C.

## Eclipsed . . .

Reg is retired and looks after some houses for friends who are often away for several weeks. He rang one Monday morning recently to say that the satellite picture at one of the houses in his care was full of snow. Could we call to have a look, as the owner was expected home the following thursday?
When I called later that day I
found that a large spider had made a home in the scalar feed tube at the 1.2 m dish. After removing the spider and fitting a small piece of polystyrene at the entrance to the tube to prevent a repeat performance, I carried out a slight dish alignment peaking to wrap up the job. Spring is always the worst time for insects making themselves at home in prime-focus dish feeds. Some of them get right down the end of the tube. Don't use your finger as a test probe you can never be quite sure what's there!
On Thursday Reg rang on our mobile phone in great panic. "It's the same as before, all snow, and they've arrived!" This seemed rather strange, unless the polystyrene had worked loose and the spider had returned. It doesn't usually come out however, and I always ensure that it's a tight fit. Visions of polystyrene eating spiders came to me!
Reg was waiting when I arrived He switched the TV set on and a perfect picture appeared. The polystyrene was firmly in place, and the dish was firmly locked in position.
Then it dawned on me. Reg had checked the signal at about 10.20 in the morning and it was early March, right at the time when the sun has an eclipsing effect on Astra. The sun is a much stronger source of radio energy than Astra: while it is within the dish's beam width there will be picture degradation or disappearance. Exactly the same symptoms produced by a large spider! Had Reg left the TV set switched on, he would have seen the pictures start to reappear fairly quickly. The moral could be: don't watch TV in the morning! H.C.

## The Chinese Digital Channel

I was recently asked to install a digital receiver for the Chinese channel via Astra. This is now available as a vertical transmission (we're outside the horizontal digital Astra footprint here) at 11.778 GHz , as part of the Canal Plus package. The receiver was a Canal Plus digital type with built-in MediaGuard conditional access - fortunately the menus are in English. It's actually the Philips Model DRD-DSI175B/05G. The Canal Plus version is referred to as the Philips 96514D.

The photocopied instruction manual is also in English, and is well-written by someone with experience of digital installations and the causes of any problems that might arise. It gives the symptoms, for example the picture breaking up into squares when the signal is weak.

There's no UHF modulator, but the receiver comes with a good-quality scart lead and has video and TV scart sockets. Nor does this version have an internal modem - there is provision for an external one to be connected. There are two card slots, one for the subscription card and the other for a smart bank card to enable payments to be made for pay-per-view programmes. The instruction book said that the latter slot has no function with this version of the receiver. In operation the box runs quite cool, which was a pleasant surprise.

An on-screen menu assists with dish installation. The receiver already knew what signal to head for ( 11.778 GHz vertical), though a different one can be entered manually. A signal-strength bar display, reading $1-5$, helpfully turns green at 3 - anything above this level is acceptable. The receiver is then left to scan the band. It lists the names of all channels found, whether scrambled or not. Prior to the scan you can ask the receiver to place the Chinese Channel (TVB Superchannel) as first on the list of channels found, or it can be picked from the scanned list (in this case it's channel 247) and placed in the favourite list.

The free-to-air digital channels via Astra are available, including CNN, TNT, Fashion TV, RAI-1, TV5, Moroccan TV, Egyptian TV and a mass of German stations. Scrambled ones produce an identification, after which the screen remains solidly blank. The scanning process takes up to twenty minutes, during which an on-screen bar display indicates how many stations have been found and the percentage of the scan completed. The symbol rates and forward error correction values don't have to be entered, but signals with a symbol rate of less than 15,000 are not catered for

Amongst other oddities after the scan, Pace receiver information was listed just as a 'station name' - I suspect that this is for the Dutch receiver software upgrade. One prob-
lem is that although the receiver remembers the main scanned channel list, in the event of even a brief power cut the favourite channel list is immediately forgotten.

The favourite channels are picked from the main list: then, in the 'favourite mode', you can skip the unwanted ones. If you force the receiver to place TVB Superchannel on 1 during the initial scan, after a power cut all you have to do is to enter 1 via the remote control unit - otherwise 247 has to be entered, then the entire favourite procedure has to be repeated. I briefed the customer on the procedure and haven't had a call for help so far.

The receiver reinserts conventional teletext data on a normal PAL signal, so that the TV set's text decoder functions in the usual way. With the digital receivers I've come across previously, teletext is at best available via the set's own remote control or there are no teletext facilities at all.

I feel that, certainly as far as the digital receiver enthusiast market is concerned, a tuner should be linked to a PC for band scans and channel organising. The data can then be uploaded to a digital receiver - a sort of digital PaceLink system. I hope that the Sky digital receiver box will have userfriendly favourite menu structures.
For those with internet access, more information on the Chinese Channel can be found at http://www.chinese-channel.co.uk H.C.


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# What a Life! 

## Donald Bullock makes a Very Cruel Device that produces shocks and gets his comeuppance. Then there are sets and customers. And a puzzle about where the voices come from

Poor Daddy B does his scribbling all by himself in his wooden shack in the garden, away from everybody's noises and distractions. Greeneyes' dogs recently discovered it, and have on occasion done their business there.

This annoyed Daddy B very much. He doesn't particularly like dogs, especially pampered ones that do unspeakable things in his shack. So he decided to adopt a Very Wicked Wheeze: he sorted out some odds and ends from his junkbox and built himself a Very Cruel Device - a pulsing shock machine. He connected this to a pair sprung wires which he strung across the shack's doorway, just above floor level.

Then he pretended to go out. But, instead, he sat behind a bush with a whiskey and watched. Presently Greeneyes' dogs trotted up to the door and touched their noses against the wires. Then they made lots of yelping noises and did double somersaults all over the garden. Daddy B laughed happily and rubbed his hands together. But Greeneys said he was wicked, cruel, drunk and she didn't love him any more.

Daddy B didn't care. He connected an extra capacitor across the output of his Very Cruel Device to make it even Crueller, and made sure it was switched on all the time Though he left his shack door wide open, the dogs never darkened its doorstep again.

The time came for Daddy B to write his column. He stepped over the Very Cruel Wires carefully and started to clear his desk. This dis-
turbed some nasty mosquitoes, which Daddy B sprayed with his Cruel Mosquito Spray. They coughed and fell down dead. Except one, which flew about laughing. This made Daddy B Very Vicious. He spun around, spraying it. When it flew out of the door, Daddy B went after it.

Unfortunately he forgot about his Very Cruel Wires, and tangled his legs in them. They gave him lots of Very Cruel Shocks that made him shout and jump about Very Much. He hoped that no one had seen him dancing or heard him shouting some Very Naughty Words.

Greeneyes had of course. She said it served him right for perpetrating Cruel Things on innocent little dogs, and that he was to tell everyone in his column how Cruel and Wicked he really was.

But Daddy B mocked and told her she was getting like her mother. He hobbled off to his shack to write about his Nastiness - and to mend and refit his Cruel Wires ...

## Sins

Some days later I was back in the shop when this cove with bright eyes and a shiny red face came in. He was carrying a sign on a small pole. "Be sure your sins will find you out" it read.
"I don't suppose I can help you?' I asked.
"It's my Mitsubishi" he said. "It has faded and died - Matthew 16, verse 6 (or something)."

I eyed him up and down.
"It's in my old pram outside" he continued, "there's a picture but
there isn't a picture."
"Right, I'll get it" I said.
When he'd pushed off, with his sign, I put his set on the bench. It was a CT2553STX (Euro 4Z chassis). There was sound, and the screen displayed some dull chunks of colour. Nothing else. When I increased the brightness I saw a faint raster as well.
"Strange fault" said Paul.
"No luminance" I replied. "You're looking at a raster plus the transmission's colour content but not its monochrome content, which provides the detail. They do it that way to save bandwidth."

When I opened the set up I saw that there were three upright panels at the rear of the chassis, secured by a plastic bracket. The one on the right is the chroma/luminance panel. I waggled it and the luminance flashed on and off.

When I examined the panel I found that during manufacture a dab of securing adhesive had been put between its print side and the bracket. This had dried and corroded the print beneath it. So I cleaned it off and bridged the gap. When I switched on again a good, complete colour picture appeared.

## Mrs Tubbs' VCR

Meanwhile Mrs Tubbs had brought in a Samsung VI710 VCR. It was virtually dead, with just bits of the display visible. "One for you" I said, "I'm off to make the tea."

When I returned Paul was replacing the STK5333 regulator chip IC101. "I checked the outputs from the power panel, at the 12-pin plug CN101" he said. "Instead of

15 V at pin 1 there was only 1.3 V . At pin 4 there was 0.2 V instead of 5 V . These two supplies are both decoupled by $47 \mu \mathrm{~F}$ electrolytics, which are OK. So I think a new chip will cure the problem."

He finished fitting it and checked the voltages. This time they were right. The VCR had a full display and worked well.

## The End

Later the shiny-faced cove returned with his sign.
"Your Mitsubishi's ready" I said. "Twenty quid to you."

He pulled out his wallet and smiled. "Ah, safely delivered from its woes" he said, "Mark 22, verse 4 (or something)."

I carried the set out to his pram for him. As he pushed it away I noticed that the sign was doublesided. "The End of the World is Nigh" it announced on the other side.

## Egbert Craddock

Our next customer was Egbert
Craddock, who always looks as though he's riding a bike against the wind. He struggled in with a B\&O 7180.
"I switches him on, right?" he bawled.
"If you say so" I replied.
"He clicks four times then goes off, right? That's no good to anyone, right?"
"You've cracked it man" I said, "give it here."

He left the set and made off. Steven took the back off and found the cause of the trouble immediately. This sort of thing narks me.
"It's just the blue focus unit" he said, "hand me a new one will you?"

I did and it did the job. "Too clever by half' I muttered.

## Flighty's Visit

Mr Flighty came in, frowned at me, bought a flylead and winked at Greeneyes.
"What's worse than a giraffe with a sore throat dear?" he asked.
"Dunno" said Greeneyes, brightening up.
"A centipede with corns of course" he blurted out. "Har, har, har!!" Then off he minced, leaving Greeneyes laughing happily.

She caught my eye. "Coppades, arnohyeh, da?" she said as she laughed.
"Just a minute" I said, "you're not gibbering with Flighty now. Let's have it in English."

She looked at me coldly.
"Merely asked whether you'd like a cup of tea, or not yet. You really will have to do something about your increasing deafness."

Later she came in with the tea. "Careful, it's hot" she said.
"Cartful of what?" I asked, frowing and looking about as though puzzled.
"Don't be funny" she replied.
"Toast and honey?" I asked.

## A Philips K40

Major Haggerty, the bristling military no-nonsense blimp, brought in a Philips Model 22CS5751 - the old K40 chassis.
"It needs a spell in the guardhouse" he barked. "Only works in the sunshine. Otherwise whines instead. Had a coolie like that once, in the Himalayas. Yanked his head of in the finish and kicked him to the tigers . . ."

He was right. About the set I mean. At switch on it whined loudly and refused to start up until we heated the power supply with our hairdryer. Then it was OK. So we cooled the power supply down and then directed the hairdryer's heat via a funnel at various components in this section. The culprit turned out to be C2128. A replacement put an end to the nonsense.

We've had this fault before. Be careful about identifying the capacitor: there's another C2128, in the EW modulator circuit.

## Little Men

When I was a small boy I was fascinated by the voices and music that came from our wind-up HMV cabinet gramophone and our huge Ekco wireless set. I knew that Henry Hall's orchestra consisted of dozens of dinner-suited musicians and their instruments, because I'd seen a picture of them. How could they get into our wireless? Obviously they would have to be shrunk. Assuming this to be possible - the early Thirties was a time of mechanical and electrical miracles - how, I wondered, did they sneak in and out?

Whilst they were in there, what did they do about eating and sleeping and other things. The answers evaded me.

And our gramophone. When father played an Al Bowlley record Al sang immediately. When the tone arm was moved across the record he would cut in with different bits of the song. How did he know which bits to sing? Did he slip along the tone arm and look through the hole beside the needle?


## Unfortunately Daddy B forgot about his Very Cruel Wires.

## Then there were Bix

Beiderbecke's magic cornet sounds. He had died before I was born, yet he played for us from inside our gramophone. In the Thirties nobody scoffed much at the idea of ghosts. Had Bix slipped to some secret graveyard in the bowels of our gramophone?

My confusion increased when the wireless set when wrong and had to be opened. There were no little men or orchestras. Only a row. of rosy-coloured valves, bits of wire and Bakelite.

Then the spring in our gramophone broke. Inside there was just a dowdy box full of greasy metal cogs. Nobody could live in there, especially in their nice clean clothes!
"Where do the voices come
from, Dad?" I asked.
"Out of the air" he replied.
"Who put them in the air?"
"Never mind about that" he said brusquely. "Here's tuppence ha'penny. Slip over to Thomas's and get me a packet of Woodbines."


We have what is arguably the most reliable electricity generation and distribution network in the world, with both the voltage and the frequency accurately controlled. But with thousands of miles of wire and thousands of transformers, along with numerous circuit breakers and other control gear, most of which are exposed to whatever the elements care to throw at them, breakdowns are inevitable.
Most supply faults are trivial, causing only local inconvenience. But there is always the possibility of a real humdinger of a fault, such as a Grid transformer exploding, the result being total mayhem over a wide area. In addition to complete power failures, which don't usually constitute a risk to domestic electronic equipment, there can be spikes and surges, dropouts (loss of a few cycles) and brownouts (low voltage). These can all cause problems - especially with those nasty little chopper power supplies that crop up everywhere nowadays.

## Thunderstorms

Spikes and surges probably cause most damage, and are the most common types of disturbance. Thunderstorms are a common cause. These can occur when unusually large cumulo-nimbus shower clouds form in unstable air, typically found in the cold sector of a depression, often along or just behind the cold front. You can get this type of storm at any time of the year. Summer thunderstorms are frequently produced by sudden convective updraughts of hot, moist air during a heatwave. Cumulo-nimbus clouds can build to a height of several miles, sometimes extending into the lower stratosphere, topped by the distinctive anvil formation that's a trade-
mark of a mature thundercell. Thunderstorms can sometimes hide amongst other innocuous clouds, waiting to pounce without warning.
The exact mechanism that produces the cloud's electrostatic charge is not known. It's thought to be the result of water drops and ice crystals breaking up in fierce upand down-draughts in the heart of the cloud. These fragments carry a static charge, and their motion inside the cloud is analogous to the way in which charges are carried on the belt in a Van de Graff generator.
The end result is a huge, delinquent electrostatic machine that rumbles around, looking for something to lob multi-gigavolts at. This something is all too often part of the electricity distribution system. An enormous amount of energy is stored in a mature thundercell. Fortunately most of it is dissipated by inter-cloud strokes. Earth to cloud strokes start with corona discharge from the ground, forming an ionised conductive channel to the cloud. The initial pilot stroke travels up this channel. The main stroke returns from cloud to earth, and may involve several discharges.
Because of the expense of running high-voltage cables underground, the National Grid is mostly carried overhead by pylons - frequently across some of the most exposed, inhospitable country that graces the OS maps. The pylons are often the highest things around, and have lovely pointed tops. What better target for a thunderstorm? Most strikes are to the pylons themselves, or to the neutral/earth conductor that joins their tops.
Sometimes the strike is to one or more conductors, and this is where the fun starts. Grid sections can be tens of miles long, and the transmission lines behave as, well, transmission lines. The pulse induced by a strike can
bounce back and forth between Grid substations until its energy has been dissipated. A lot of the energy flashes over the arcing horns fitted across the insulator stacks that support the cables, and the similar horns that adorn switchgear and transformers (see the accompanying photos). Electrical engineers also have at their disposal suppression devices that are more familiar to us - varistors, capacitors and chokes. They are just somewhat larger.
Despite all these measures, it's possible for a lightning strike to put a section out of action. The Grid network has a fair amount of built-in redundancy to ensure network integrity should individual sections suffer sufficient damage to prevent normal working. When a Grid line is struck, the section concerned is disconnected by high-speed, airblast-quenched breakers. Once the excess energy has been dissipated, the affected circuit is reconnected. The effect on local electricity supplies is those half-second or so blackouts that can crash a computer and make a fluorescent light restrike.
Lightning strikes become more dangerous the lower down the distribution hierarchy they occur. While the Grid and your local electrical supplier's primary highvoltage system can dissipate most of the energy in a strike, this may not be the case with a local $33 \mathrm{kV} / 11 \mathrm{kV}$ network. Rural distribution networks with their cables and pole transformers in the open are at particular risk. Urban systems with their underground cables aren't very much better off. A ground strike can produce a massive instantaneous current pulse with a potential drop of several kV per metre, easily able to induce similar potentials in nearby burried cables. A local distribution network may not have any built-in redundancy, so lightning damage can black out a large area until repairs are carried out.

## Magnetic Storms

At least there's one form of electromagnetic mayhem from which we don't generally suffer in the UK: magnetic storms. Our planet is continually bombarded by the solar wind, a stream of charged particles that are emitted by the Sun. The terrestrial magnetic field (the magnetosphere) traps most of these particles in the Van Allen belts. Thus all but a tiny percentage is prevented from reaching the Earth's surface. What little does get through forms a large proportion of terrestrial cosmic radiation. Strictly speaking, particles from the Sun and other extra-terrestrial sources, known as primary cosmic radiation, don't reach the surface: collision between primary radiation and the atoms of gas in the upper ionosphere generates showers of lower-energy particles, the so-called secondary cosmic radiation, which is what we are exposed to on the ground.
Every so often, especially during sunspot maxima, the Sun's surface becomes even more disturbed than usual and the solar wind can turn into a gale. When the vastly increased number of high-energy particles strike the Earth's upper atmosphere they often produce an intense auroral display, visible even at our latitude, seriously disturbing the ionosphere and disrupting long-distance radiocommunications.
By distorting the magnetosphere, solar storms also cause disturbances in the terrestrial magnetic field, which is strongest near the magnetic poles. While the South magnetic pole is safely out of the way in the Southern Ocean, the North magnetic pole lurks in Northern Canada. In both Canada and the USA there are large power grids with sections hundreds or even thousands of miles long. Substantial changes in the terrestrial field can induce heavy fault currents. A magnetic
storm was responsible for the city-wide blackout of New York City.

## Ice Storms

Ice storms are the only meteorological phenomenon that pose a major threat to both the Grid and local networks in the UK. Water doesn't necessarily freeze at $0^{\circ} \mathrm{C}$. Under certain conditions it can remain liquid at temperatures considerably below the normal freezing point. Water in this state is described as being supercooled. Ice storms occur when supercooled rain hits a stationary object then flash freezes.
Ice storms occur in unusually cold conditions and are relatively rare in the UK. Severe ice storms attacked the USA's eastern seaboard last winter, causing extensive damage to electricity distribution systems.
With an ice storm you get a build-up of solid ice on conductors, which are brought down by sheer weight. System redundancy is rapidly used up, large parts of the network becoming isolated. Loss of power because of ice damage can have serious consequences, as the weather that gives rise to the problem prevents repairs. My own recollections of notable ice storms in the UK are of those that occurred during the winters of '62-63 and '81-82.

## Wind

High winds can bring trees down on to 11 kV and 240/415V local networks, causing extensive blackouts. Grid cables and electricity companies' primary highvoltage circuits are carried well above tree height, and those flimsy-looking pylons are designed to withstand winds that are considerably stronger than anything ever experienced in the UK.
Interesting factoid one. High winds in 1984 brought down one of the eight cooling towers at Fiddlers Ferry power station, Widnes. At the time my home overlooked the power station, and it took a few minutes to realise that something was different. It was a freak incident: a strong gust from a particular direction, deflected just so by the other towers, did the trick. Bear in mind that cooling towers are hollow: the concrete shell surrounds a structure of wooden lathes, down which the cooling water from the station's steam condensers trickles, its heat being removed by natural convection. The trend now is to use a large number of very small cooling 'towers', relying on forced draught rather than natural convection.

## Heavy Industry

Lightning isn't the only cause of spikes and surges. In urban areas a regular supply of lower-grade but still potentially damaging spikes and glitches is produced by heavy industry. Prime suspects are high-power, vari-able-speed drives, as chopping up 415 V at perhaps 1 kA or more can cause serious EMC (ElectroMagnetic Compatibility, i.e. interference etc.) problems.
I remember seeing 2 kV spikes on the mains supply in Chester city centre some twenty five years ago. At the time I built light dimmers for a small company there. We first noticed the spikes when using a scope to watch the mains waveform to see what effect our dimmers had on it. As the spikes occurred on only a couple of days each week, it was a dead cert that the culprit was the local paper's printing press. If I remember correctly, it was driven by three 75 hp DC motors: the thyristor-drive system that controlled them was considered to be state-of-the-art at the time.
Nowadays large thyristor drives are fitted with line reactors, a sort of three-phase version of the suppression
chokes found in the input to a chopper power supply. A line reactor's main job is di/dt limiting, i.e. to slow down the initial current build-up when the thryistors are fired. It also helps to reduce the amount of hash that finds its way back into the supply. There's nowadays a tendency to feed each large drive directly from a dedicated 11 kV transformer to reduce pollution of the local $415 / 230 \mathrm{~V}$ supplies.

## Inverfers

The availability of cheap, reliable, high-voltage MOSFETs has brought down the cost of variable-speed drives, which are becoming increasingly popular. Known as inverters, these devices first rectify the incoming mains supply, usually 415 V three-phase, producing 630 V DC. A six-transistor bridge arrangement then converts this DC back to a three-phase AC supply. The point of this is that the voltage and the frequency of the output are both variable.
Bear in mind that the almost universal squirrel-cage induction motor is semi-synchronous: thus the ability to run at a frequency higher (usually up to 75 Hz or so) than the standard mains frequency enables the motor to run faster than normal without overload. Unlike a DC motor, an AC induction motor can be fully sealed. This makes AC drives suitable for use in wet, dusty, dirty or otherwise inhospitable environments.
Rectification of the incoming supply is the main source of noise with an AC drive, because the current that flows consists of high-amplitude pulses at the tips of the mains waveform. We are talking about full-wave rectification of a three-phase supply, so the fundamental frequency of any resultant noise is 300 Hz . High-frequency PWM drive techniques are used to control the transistor bridge to produce the output waveform. Conventional armoured cable is, or should be, used to connect the inverter to the motor, with the armouring earthed to prevent radiation of the HF components of the switching waveform. Any HF components reflected back to the inverter's internal DC supply will be absorbed by the reservoir capacitors which, in a large inverter, may add up to $10,000 \mu \mathrm{~F}$ or more. If, because of a fault, the drive signal did become impressed on the incoming supply, it would sound like a slightly wavering, fairly high-pitched raucous whine.
You have to be careful when working on these beasts: the reservoir capacitors are charged to 630 V . The consequences of accidentally dropping a screwdriver across the capacitor bank's terminals would be, shall we say, interesting.
Single-phase induction motors are large, difficult to start and relatively inefficient. Up to now however they have been the only option for small business or domestic premises that have a single-phase 230 V supply. Small inverters that can produce a 220 V three-phase supply from a standard domestic 13A socket, with speed control as a bonus, are now available, enabling tools or light machinery with a three-phase motor to be used.

## Electric Induction Furnaces

It's not just variable-speed drives that play havoc with the mains supply. Many metalworks use electric induction furnaces. Rated at hundreds of kilowatts or even several megawatts, these have what could be called a stator winding that consists of a few tens of turns of very thick copper tubing, through which cooling water flows, wrapped around a refractory pot that holds the melt. It generates heat by inducing eddy currents in the metal by transformer action. The system is particularly popular for alloying, as the eddy currents also churn the molten
metal, mixing the melt better than any mechanical method would.
The power of an induction furnace that operates at the supply frequency is usually controlled by employing a saturable reactor to regulate the current. The saturable reactor is connected in series with the supply from the transformer to the furnace. Some furnaces are driven at high frequency by a kind of inverter and can, unlike most supply-frequency units, melt metal from cold.
This manipulation of thousands of amps at several hundred volts can have serious effects on the local supply. An aluminium plant in my locality can draw up to 4 MWh . In return for power at a very cheap rate, it's contracted to shut down during a power emergency.
The power factor (this is the multiplication factor for true power with an inductive/capacitive load) of an induction furnace isn't constant: it varies with melt volume, melt temperature, melt composition and the applied power. Parallel-connected capacitors are used for power-factor correction, by switching more or less microfarads into circuit as required. The current that flows via the PF-correction capacitors is pretty hefty their circuit breakers have to be able to switch and carry hundreds of amps. There's plenty of potential here for some serious spikes. Interesting factoid two: as far as induction furnace power factor is concerned, charging and pouring are the most critical phases of a melt cycle.
Furnace operators used to control the power factor of their furnaces by manually switching, via their control panels, capacitors in and out of circuit in accordance with a cos-phi meter reading. Nowadays PF control is usually handled by a computer. Over correction is extremely dangerous, as an induction furnace with too much capacitance connected, i.e. a leading phase characteristic, becomes unstable. In one incident I was told about, a furnace with a particularly bad case of indigestion vomited a couple of tons of molten aluminium at $1,500^{\circ} \mathrm{C}$ (that's about yellow hot). The glob of molten metal was ejected with sufficient force to hit the foundry roof. Miraculously no one was hurt.
From our point of view, heavy inductive loads such as induction furnaces and their associated switching and control gear are potential sources of serious mainsborne interference.

## Rectification

The electricity supply industry is getting rather concerned about the distortion of the mains waveform caused by millions of small power supplies in TV sets and VCRs. Once a reservoir capacitor has been charged, current is drawn from the supply as short, comparatively narrow pulses. The resulting mains waveform distortion lowers the power factor. The result is additional heating in the supply cables and transformers, effectively derating them. A poor power factor represents wasted energy that still has to be generated, but nobody pays for it.
The electricity supply industry is, understandably, not particularly pleased about this state of affairs. Industrial users are encouraged to keep their power factors as near unity as possible by having kVAR (kilovolt/amps reactive) meters fitted, with swingeing charges of several pounds per $\mathrm{kW} / \mathrm{h}$. I wonder how they would cope if everything still used half-wave rectification, as we did in the good old days?!
I wouldn't be surprised to see EMC requirements slowly tightened, with capacitor-only filtering eventually outlawed. You never know, we might see the return of choke-input filters. Interesting factoid three: did you know that if all the TV sets in the country were switched
off rather than being left in standby, one large power station's worth of electricity would be saved?

## Tap Changing

A very common cause of surges and dropouts is tap changing. Rapid changes of load on the network cause voltage fluctuations that are compensated for by changing transformer taps. The tap-changing switches are located in the transformer tank and, to avoid shorting sections of winding, are break-before-make. Although tap changing is usually very rapid, it's still possible for several cycles to be lost.

## Disconnectors

11 kV rural networks suffer from dropouts caused by the method used to clear faults on the overhead lines. Shortcircuits are often caused by bits of tree (or, if you are particularly unfortunate, a whole tree), wet grass or large birds landing on the cables. When such a short occurs, automatic circuit-breakers (known as disconnectors) disconnect the section of line for a fraction of a second before reconnection and checking for a fault. If the by now parboiled bird or whatever is still there, another disconnection occurs.
These systems must have been designed by someone of the Bill Clinton school of thought, as they operate on a "three strikes and you're out" policy. Three attempts are made to clear the fault: if the short is still present, the section of line is permanently disconnected and it's up to the electricity company's engineers to remove the burnt offering. This repeated switching off and on again is not generally appreciated by the average chopper power supply.

## Brownouts

An odd fault is the so-called brownout, or severe voltage reduction. The supply line voltage can drop as low as 100 V , the result being dim lights and motor burnouts. The usual cause is loss of a phase somewhere in the 11 kV system. Three-phase transformers have a threelimbed core: each limb carries one primary and one secondary winding. The three circuits are magnetically coupled, so loss of one phase at the input to the transformer will result in reduced output from all three secondary windings.
Brownouts put fridge and freezer motors at risk, because of the means used to start them. Unlike their three-phase cousins, single-phase induction motors are finicky creatures. To start, they usually require some sort of arrangement that involves phase shifting to create a rotating magnetic field, for example shaded poles (as in old-fashioned gramophone motors) or capacitorfed auxiliary windings. In a fridge or freezer motor the relatively high-impedance run winding has many turns of wire and is rated for continuous operation. Compressors need a lot of torque to get them moving, so the starting arrangement includes a low-impedance starter winding with relatively few turns of thick wire. As the starter winding has a much lower inductance than the run winding, the current in it leads with respect to the current in the run winding, thus producing that allimportant rotating field.
The low-impedance starter winding produces much higher torque than that needed for running, and is meant to be energised for only a second or so. Low voltage can mean that the starting relay malfunctions, leaving the starter winding connected. Although the applied voltage may be less than half of what it should be, it's still capable of driving a heavy current through the winding, which rapidly overheats and burns out. The main stator


Arcing horns on a 33kV isolator.
winding can also pass excessive current, as the motor remains stalled.
I can't see any reason, apart from cost or a desire to maintain a profitable market for replacement motors, why fridge and freezer manufacturers can't fit no-volt trips, which are nothing more complicated than a selflatching contactor. Should the supply voltage drop below a defined level, the contactor releases and has to be manually reset when the normal supply has been restored. All right you might end up with a freezerful of ruined food. But without a no-volt trip you could end up with a freezerful of ruined food and a burnt-out compresssor.
By the way, fridges and freezers that use the ingenious heat-driven ammonia absoption system are powered by a small heater cartridge and are not at risk from brownouts, though underrunning for an extended period may result in the interior temperature rising above a safe level. Caravans, motorhomes and boats are often fitted with absorption fridges, as they can come not only with both 12 V DC and 230 V AC heaters but can also be powered by gas!

## Excessive Voltage

Things can go the other way of course. I remember, back in the Sixties, reading in the paper that a nice new substation had put more than a little sparkle into the lives of some villagers. In the previous article I described how a substation transformer is connected to provide a three-phase supply of 415 V between phases and 230 V between any phase and neutral. The transformer's secondary windings are connected in a star configuration, with the centre of the star forming the neutral connection which is securely earthed at the substation. The villagers got a bit of a surprise when they


A classic study of insulators and their arcing horns.
switched on their appliances one bright morning: light bulbs exploded, cooker rings glowed white hot, radio receivers went up in smoke and fridges burnt out. Someone, when wiring the substation, had made the classical error, uprating the domestic supply to 415 V . Has anyone heard of this happening since?

## Protection

There are ways in which customers can protect their equipment from the effects of power supply problems. Some could represent useful additional business. The best way to protect TV and video equipment from lightning damage is the simplest: pull the plug out and disconnect the aerial cable - even in an urban environment.
For dealing with mains-borne hash, a suppressor plug helps a lot. It has varistors connected between all three pins to divert to earth the energy of a spike that arrives via the live and/or neutral line. Varistors can be destroyed by really high energy surges, and more sophisticated (i.e. expensive) suppressor plugs have some kind of indicator to warn of varistor failure. Suppressor plugs also help in preventing interference generated elsewhere in the home from affecting sensitive equipment like hi-fi systems.

## The UPS

Because of the possibility of hardware damage and data corruption, mains-borne spikes present a considerable hazard to computer systems. If someone has forked out
over a grand for the latest Pentium II job and lives out in the sticks, it shouldn't be too difficult to persuade him to invest a couple of hundred quid in an uninterruptable power supply (UPS) - especially if the customer depends on the computer for his living. As well as providing power filtering, these units incorporate a batterydriven 240 V inverter which, in the event of power failure or a particularly long dropout, will maintain a 230 V supply to the computer long enough for the user to save his work and then shut down correctly.
The type of UPS intended for domestic or small business use incorporates maintenance-free, sealed leadacid batteries that are continually trickle-charged when mains power is present. On page 436 of the current CPC cataloge for example you will find listed a 250 VA UPS that's capable of maintaining power for seven minutes. It incorporates EMI/RFI filtering and lightning/surge protection, all for $£ 140.28$ plus VAT. There are plenty of opportunities for extra sales here, particularly with the forecast increase in teleworking in rural communities.

## Other Measures

There are other ways of cleaning up the mains supply, but they start to get expensive. One that I've not seen for years is the constant-voltage transformer. Made by Advance, it was a specially-designed transformer with a saturable core and two secondary windings, one of which was tuned by a parallel capacitor.
Other measures include filtering the mains where the supply enters the building. Prices in the current Farnell Electronic Components catalogue (EMC, Filter and Suppression, Installation Filters section) start at $£ 92.13$ for a $240 \mathrm{~V}, 16 \mathrm{~A}$ single-phase filter to $£ 579.41$ for a $220 \mathrm{~A}, 415 \mathrm{~V}$ three-phase unit, all prices plus VAT. These filters have open terminals, so they would need a suitable enclosure. Installation would probably be best carried out by an electrical contractor.

## Danger

Finally I'd like to mention the very real dangers presented by the various parts of the electrical distribution system. My photographs of substation equipment were all taken from outside the railings: the only part of my body inside the fence was the hand holding the camera. High-voltage sites (high voltage being deemed to be in excess of 1 kV ) are exceptionally dangerous. The supply impedance is extremely low, and exposure to high voltage either by direct contact or flashover means instant death. With Grid voltages of 275 kV or 400 kV , any remains would probably be cremated for good measure.
Never enter any electricity company or National Grid site unless authorised to do so and accompanied by another, qualified persion. Overhead cables can also pose a threat to the unwary. You wouldn't normally regard fishing as a particularly dangerous pastime, but an angler in my vicinity was fried only recently when his carbon rod touched an 11 kV cable - and I mean fried. So the same caveats that apply to the erection of aerials, or carrying long metal objects, apply to anglers using carbon rods: keep them well away from overhead power lines, including the 25 kV cables that run along electrified rail routes. Remember: kilovolts mean killervolts.

## Acknowledgements

I'd like to thank Manweb plc for allowing me to use some of its educational material in the preparation of these articles, and the numerous maintainers of the internet sites used for my research.

## more on the

Panasonic K Deck

## Adrian Williams describes some common faults experienced with this widely used VCR mechanism

The K deck has been around for several years now. It's used in a large number of Panasonic VCRs, ranging from basic mono sound models to S-VHS editing machines with hi-fi stereo and Nicam sound. There are a number of common problems. The following list of symptoms and cures may be helpful to those not familiar with the deck.

Refusal to load a tape or lace up: The loading motor, part no. VEM0427, is faulty. The shaft has a plastic collar on it: this spits, the result being loss of drive to the mechanism. Also check worm wheel gear part no. VDG0868 - remove the gear and inspect it for loose or missing teeth.

Refusal to eject tape or load (tape gets stuck in housing): Replace shaft assembly part no. VXP1339. It tends to bend outwards, away from the side plate. As a result, the housing gets stuck. You will also notice that the top plate of the carriage assembly is bent on the right-hand side.

Tape is pulled very tight in the play mode. As a result there is damage to the tape and the guide bases: Replace the take-up brake lever, part no. VXZ0313. It snaps at the end, where it's in contact with the supply brake arm, part no. VXZ0312, which it holds off during play (in the fault condition the supply brake is on).

Line at top of screen during pause or forward/rewind search: Replace the supply guide assembly, part no. VXA5245 KIT. As mentioned above, the brake lever may be faulty. The take-up guide, part no. VXA5427 KIT, may also be damaged.

Lower edge of tape is damaged, or pinch roller assembly doesn't go down fully: The P5 arm unit is distorted, part no. VXL2306. Also check the pinch roller, part no. VXL2246.

Ticking noise from the mechanism during play: There are three possible cures for this one, as follows.
(1) Strip out the capstan rotor unit and regrease it (not too much).
(2) It may be necessary to replace the flywheel, part no. VXP1519. You will find that the new one has a more solid base where the rotor and capstan shaft meet.
(3) The tension roller unit, part no. VXA4799, may be worn, rubbing on its bracket.

VCR goes to standby when a tape is pushed in (no forward operation of the loading motor) or ejected (no reverse operation of the loading motor): Replace the loading motor drive chip. It's usually a BA6887, part no. BA6887-V3. Check the loading motor which may have a dead spot or a broken shaft (see above).

Capstan speed problems: The capstan drive chip is probably faulty.

## Service Notes

All new Panasonic VCRs have a service mode. No. 7 drives the loading motor forward when the play key is held on, and reverses the loading motor when the stop key is held on (the capstan is also reversed to prevent a loop of tape being formed). This is very useful, enabling most of these mechanical problems to be diagnosed very quickly without dismantling the VCR - the top must of course be removed. As far as I know older machines such as the NVHD100/NVSD44 don't have this feature.
The timing doesn't usually need to be altered.
For further information refer to John Coombe's article in the November 1996 issue.


## Amstrad/Fidelity <br> SRD950/SRD700

In previous articles I've mentioned tuner problems with these models because of failure of one or more of the $10 \mu \mathrm{~F}$ capacitors inside. This fault is becoming commonplace. I'm also getting receivers with faulty EEPROMs. In this case the symptom will be either stuck in standby with the LNB voltage tripping, or autotuning works but no channels are stored.

It seems that these EEPROMs can be damaged by voltages applied to the TV scart socket by certain TV receivers. To prevent a recurrence, disconnect R95 and R96 (both 270ת).

Some customers have asked whether a decoder scart socket can be fitted to these models. It can, but might require an extra twenty or so components as well. A few of these receivers had these components fitted at the factory, but most didn't. A list is available.

## Amstrad SRD600

I don't do many D2-MAC receiver repairs. Most get sent to the experts at Satfix in Swansea (01792 781

WORKSHOP
673). The SRD600 is an exception. It's faults are often quite simple to deal with, so I'm prepared to tackle them myself. But one particular receiver had been back to me three times, each time from a different dealer. Clearly the owner was unhappy with my diagnosis, but I had written the same report on the label each time. Without repeating the exact wording, it said that reliability couldn't be guaranteed because of something to do with the owner's cat! This time it was Wossname up Church Street who brought the receiver to me.
"Stinks" he commented. "Think the dog did something. You do it for me. I know nowt about these DeeMacTwo things."

Having pointed my dish at $1^{\circ} \mathrm{W}$, I put the receiver on test. The picture would occasionally appear to lock, but most of the time I could see only a mess of black and white lines.

I repeated the procedure I'd undertaken before, but this time I scrubbed the MAC board with a toothbrush while pouring generous amounts of isopropanol across it. I dried the board with my hairdryer, and had to open the windows because the alcohol made me feel quite dizzy. Fortunately I wasn't driving that day! To chase off any remaining moisture, I finally sprayed WD40 across the board.

The unit now produced perfect PAL pictures, but there was no MAC sound and strange messages appeared when the card was inserted. Audio problems are usually caused by the AMU2481 demodulator or the DMA2281 chip. Neither of these was likely to lead to card problems however, so I guessed that the trouble was being caused by a fault in the DMA2286 chip. These square chips are mounted in sockets. There are two ways to remove them without damaging the socket:
(1) Use epoxy resin to glue a paperclip to the chip, then hook a screwdriver through the paperclip and lever it upwards, using the side panel as a fulcrum.
(2) Use of the proper tool. I've seen this item in a catalogue at $£ 27$ plus VAT. Mine came from SatCure (01270 753 311) and cost $£ 6.95$. It
was worth every penny, because a new DMA2286 cured the fault.

Unfortunately this IC is rather expensive, so the repair wasn't cheap. And I still couldn't guarantee its reliability.

## Pace PRD700

"What do you know about Mister Bishey?"
"Err, sorry??"
"What? I'm a bit mutton-jeff like. Age you know."
"I'm sorry, I don't understand" I shouted at the old fellow.
"No thanks. I had one afore I came out. Can you have a look at my Mister Bishey decoder?"

With that he placed a Mitsubishi ST-PB10 on the counter and hobbled out. It's actually the Pace PRD700, but was never sold under the Pace name. It was left to the likes of Mitsubishi and Granada to explain why there was no channel number display.

The fact that two screws were missing worried me. Someone had already been inside. The first thing I saw was a huge, white ceramic resistor where R1 should have been, and another in the R8 position. These are safety resistors: they are designed to go open-circuit in the event of a fault. Some prize chump had decided to prevent them doing so. Fortunately the damage had been minimised by a very black-looking 6A fuse! I fitted the correct resistors and IAF fuse, then noticed that the chopper transistor was an underrated plastic BUT11AF which had been stood on tip-toes instead of being pushed firmly down to make a good mechanical joint before soldering. Rather than attempt to fault-find, I decided to fit the replacement kit.
"Zap, zap, zap" the receiver said when I reconnected it to the mains supply. It was the sound of R8, R14 and the fuse going open-circuit in succession. But I didn't give up. I found that the cause of the trouble was a broken track to C8. After repairing it with Teflon-coated wire I tried again.

This time the power supply ticked in time with the flashing of the standby LED. I hastily pulled the plug. Something else had been missed. I won't bore you with
details of the tests carried out and the number of cups of tea it took to find the cause of the fault. Suffice it to say that C 4 , a $1 \cdot 2 \mathrm{nF}$ surfacemounted capacitor, was cracked in half. But the crack was invisible until I touched the capacitor with my iron. Since C4 is the timing capacitor for the chopper control chip, it's not surprising that the circuit was ticking!

Once I'd fitted a replacement all I had to do was to find two Pace screws - black-japanned 3 mm crosshead taptite sems - and reassemble the receiver before the old boy's return.

## Pace PRD800

A reader has taken me to task. "My PRD800 receiver's LNB voltage is too high, so I can't get the vertical channels. In addition the picture is dreadful - and you haven't written about this fault!"

I have to confess that these symptoms have not been mentioned. The reason is that I always replace $\mathrm{C} 5, \mathrm{C} 7$ and C 8 before applying mains power to a PRD receiver, and I assumed that all other repairers did the same. The reason is quite simple: when the value of C5 falls, all the power supply output voltages go high. The LNB voltage rises, and the 5 V supply increases to about 6 V
and starts to destroy ICs fairly rapidly. C7 and C8 simply make the power supply go bang!

My advice to the reader was to disconnect the power supply immediately and fit all the capacitors supplied in Relkit-1 before reconnecting it. You can order this and other Relkits from SatCure (e-mail satcure@ netcentral.co.uk). I think I've mentioned this before!

## Pace MSS200

This receiver produced on-screen channel names and clear (not bluescreen) menus that drifted from right to left. The obvious cause of the trouble was the PTV110 chip. A replacement cured the fault, but when I inserted the Sky card I got a "card invalid" message. I checked and found that there were no clock pulses at the card, so the card's supply voltage wouldn't stay high. Since the clock pulses are supposed to come from the PTV110 chip, I fitted another one.

This time the card worked and I got pictures, but there were large black sparklies on all card channels - not Sky News, the German channels or QVC. The sparklies danced around on the left three-quarters of the picture: the right quarter was free of the dots. Yes, it was the PTV110 chip again! Since this IC is

Jack Armstrong is willing to try to sort out readers' satellite TV receiver problems via e-mail. You can reach him via the internet at:

## jack@netcentral.co.uk

One model per message - state make/model and fault symptoms. If you have no e-mail facilities you can write to him c/o Television, Room L302, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Please enclose two first-class stamps.
not available officially as a spare, I was taking used ones from 'unrepairable' receivers. I finally found one that resolved all the problems.

## Grundig GRD300

This twin-input version of the GRD150 has a fluorescent display. The customer reported that it was "dead". But, as is often the case, it was the customer's brain that was dead. The receiver worked perfectly but its display didn't light up.

Thanks to a tip from Nigel Goodwin (www.lpilsley.demon. co.uk) I was able to fix the problem in just ten minutes by replacing the $10 \mu \mathrm{~F}$ electrolytics on the display board.

## Test Case 427

"This must be the Daewoo TV" muttered Techocrat as he carried a 21 in . set to his bench. It was in fact a Daewoo Model T512, which is fitted with the CP330 chassis. The fault seemed to be simple enough - according to field technician Colin Doc's label there was no vertical scanning. A doddle, done by coffee-time, thought Technocrat. The power supply and line scan circuits were working, with EHT present and correct. But nothing was happening in the field scan department.

Technocrat's first check was on the 25 V supply to the TDA3653B field output chip I301. It's derived from the line output transformer and was OK - in fact there was almost 27 V at pin 9 of I301. He then carried out an oscilloscope check at output pin 5 . If there was a drive waveform here, the scan path was open-circuit. There was no output from the chip however. Did it have an input? No, there was no waveform at input pins 1 and 3.

The drive should come, via an $R C$ network, from the fieldscan generator within the TDA8362 jungle chip I701. It should be present at pin 43 of this chip, but wasn't. Neither was there a field ramp waveform at pin 42 . So attention was concentrated on this chip and its peripheral components.

Since the chip was producing a line drive output, its supply was obviously present. So far as Technocrat could determine, its other outputs were all OK. Only three of the chip's pins are devoted to field scanning: the feedback pin 41, the ramp generator pin 42, and the output pin 43 . Technocrat checked the components (R301 and C301) in the ramp-generating circuit, also its

33V supply and the associated resistors. Everything was in order. So he ordered a new TDA8362 chip and headed for the coffee department.

When the new chip had arrived and he had fitted it Technocrat was mortified to find that there was no change: the symptoms were exactly as before. He looked again at the circuit diagram. There's a capacitor (C303) between the field drive output from 1701 and chassis. But it seemed to be OK, and a replacement made no difference. Nor was there a fault with any of the components connected to the TDA3653B chip's input pins. Maybe this chip was loading the drive from I701 in some way? In view of the series resistors present (R304 and R305) this was hard to believe. But as Technocrat was getting short of theories he decided to replace I301 - this one was in stock. Once again the replacement made no difference: there was still no field scan.

What next? Both chips involved with the field scanning had been replaced, and all relevant passive components seemed to have been either checked or changed. The situation was deteriorating rapidly! It was difficult to establish a chicken-and-egg prognosis, and the supplies were all OK. But the set was finally repaired and sent on its way - with the two new chips it didn't need, and with one other new component whose price was a matter of pence. As a clue, do you remember the AN5521 field driver/output chip that was so popular with Panasonic some years ago? For the solution, turn to page 671.


> The FireWire interconnection system, or IEEE 1394, is a high-speed serial data bus that's likely to become the standard way of linking digital domestic electronic equipment. Geoff Lewis, B.A., M.Sc., MIEEE, describes the system and its operation

TThe name FireWire belongs to Apple Computers Inc. which devised the basis of this easy-to-use, very fast, low-cost network system as long ago as 1988. Since then it has become an established IEEE standard supported by a world-wide Trade Association with over ninety members.
IEEE 1394, as FireWire is generally known, is a cross between a network and a bus extension system. It was originally intended for the distribution of digital sound via Apple Computers. Over the years however it has expanded into many other areas. In the very near future it's likely to become the main method of interconnecting digital signals between domestic communications and entertainment equipment. A clear account of its development is contained in reference (1).
Fig. 1 gives an indication of the wide range of devices that can be connected via IEEE 1394 links. Any device that incorporates the appropriate interface can be coupled to others via a simple cable. Currently available services that can be linked in this way include home video editing, photo-CD handling and image enhancement: at a later date video- and tele-conferencing will be added. Such is the adaptability of FireWire that it is also likely to find industrial applications.
Samsung has recently announced what it claims to be the first TV chassis to incorporate an IEEE 1394 interface. It enables the Web browser-equipped TV sets to communicate with digital audio/video equipment and PCs.

## Interconnections

IEEE 1394 devices are fitted with one- or three-port interfaces that can be coupled together via special cables. An extra device can be added to a network simply by plugging it into a spare port anywhere. Devices may be linked in daisy-chain fashion or in clusters. The only restrictions are that there should be no more than sixteen hops between any two devices and that no loops should be formed.
The network is usually described in terms of a root,
tree and branch or a parent-and-child configuration, with the root or parent being the nearest to the controlling device. The serial network is currently available with bit rates of 100,200 and $400 \mathrm{Mbits} / \mathrm{sec}$, but this is soon likely to be extended to $800 \mathrm{Mbit} / \mathrm{s}$ or even $1.6 \mathrm{Gbit} / \mathrm{sec}$. FireWire will then be faster than the currently available FibreNet optical-fibre network, which runs at $1 \mathrm{Gbit} / \mathrm{sec}$.
Furthermore since IEEE 1394 is compatible with MPEG-2 video data streams, see reference (2), it will also be compatible with the ATM (Asynchronous Transfer Mode) system used for telecommunications this has a maximum data rate of $622 \mathrm{Mbit} / \mathrm{s}$. Thus FireWire is seen as a possible way of delivering digital TV signals to homes via a cable network.

## Cable and Transmission

Fig. 2 shows the construction of the special IEEE 1394 screened cable. It has three individually shielded cable pairs: two screened and twisted signal pairs (TPA and TPB) plus two power lines that are designated Vg (ground) and Vp (positive supply). There are keyed connectors. The power line pair can supply up to 1.5 A at 8 40 V DC. A cable without the power pair can be used for certain applications. Typical maximum cable length is 4.5 m , but in the near future this could be extended to about 25 m for special applications
An extra device can be plugged into a spare port without the need to switch off the power. The system then automatically reconfigures and reprogrammes itself to the new situation. This plug-and-play arrangement is possible because the signal lines are balanced to earth by the signal format employed. In addition, the driver transceiver in an interface provides further isolation between the signal and power lines.
The high data rates are made possible by using differential non return to zero (NRZ) signalling via each shielded twisted pair (STP). These are biased with respect to earth at 2 V DC maximum.
At these high data rates it is important that an accurate
clock signal is maintained. This is achieved as follows. Twisted pair TPA carries the data signal while pair TPB carries a strobe signal. As Fig. 3 shows, the strobe signal changes state whenever there is no change of state during a data signal bit period. In this way, either the data or the strobe signal changes state at every bit period.
At the transmitter, exclusive-or logic is used to combine the signal data stream and the clock signal to produce the strobe signal. The strobe and data signals are combined at the receiver, again using exclusive-or logic, to generate an accurate clock signal.
The bus data streams are organised as two time-division multiplex (TDM) formats: a one-way, low bit rate asynchronous stream is used for control purposes, while a high bit rate isochronous stream carries the data being distributed (payload data). The data in an asynchronous stream is transmitted in blocks, with start and stop signals: since the data rate is constant, the local clock can be regenerated from the data stream. With an isochronous system the same master clock synchronises everything. In this case the current controlling device acts as the cycle master (CM). Both formats use vari-able-length data packets.
An important advantage of isochronous data transfer is that less first-in-first-out (FIFO) memory is required before and after transmission across the IEEE 1394 bus. This reduces the die size of the interface IC significantly , and thus the IC cost.

## Protocols

The communication protocols used by the FireWire system are based on the International Standards Organisation (ISO) 7-layer model that was developed for open systems interconnection (OSI). Fig. 4 shows the FireWire arrangement. The two lower layers of ISO7 are retained as the physical layer and the link layer. The system control functions are concentrated in layer 3 through to 7.
The physical layer has four main functions: to translate the symbols used by the link layer into appropriate cable signals and vice versa; to define the mechanical and electrical connections for the bus; and to provide arbitration to ensure that only one device transmits at a given time, also ensuring that all devices have fair access to the bus.
Link layer control (LLC) manages data packet assembly and disassembly for both the asynchronous control data and the isochronous payload data. The one-way asynchronous packets, which are sent to a transaction layer, contain delimiting signals whose reception must be acknowledged. The isochronous data stream is sent direct to the receiver. In addition LLC handles address and error control, data framing, and generates packet cycle timing and sync signals.
The resource manager layer acts as the transaction layer for the asynchronous data stream. Write operations send data from the source to the receiver while read operations function in the reverse direction. A lock operation is also possible: this sends data on a round trip through the processing at both ends of the chain, and can act as a test and control function.
The bus management layer is quite complex, operating in the hardware and software of an individual interface. It controls the operation of the physical, link and transaction layers. If the network includes a PC, this will most likely act as the bus manager, running its own applications program, but other arrangements are possible.
A fully-managed system includes a PC or similar smart device that controls all modes of data transfer for


Fig. 1: Example of devices that can be linked via on IEEE 1394 bus.

Fig. 2: Section through the IEEE 1394 interface cable.

Fig. 3: FireWire signal format.

Fig. 4: FireWire bus control arrangement.
up to 64 channels and is capable of power management and bus optimisation. The PC can also create data-rate maps and network topology diagrams.
A non-managed bus has a cycle master and is capable of only asynchronous data transfers for control functions. Examples are direct transfer of data between a scanner and a hard disk or between a hard disc and a printer, without the direct involvement of a computer processor.
A limited bus management system falls between these two extremes: it has a limited power management ability, but can handle both asynchronous and isochronous data transfers for between eight and 64 channels.
A network can include up to 63 devices, each with a 6bit ID number. Multiple networks can be interconnected via bridges, with up to 1,023 separate buses each with a 10 -bit ID. This combination allows for a total system with up to $63 \times 1,023=64,449$ devices. Device addresses have 64 bits: 16 specify the devices and networks, while the remaining 48 bits are for memory addressing.

In this way the network can identify uniquely 280 Tbytes of memory.

## Initialisation

At the end of the FireWire initialisation process the root/parent device will have been established and will remain in control as long as it's connected to the bus. Initialisation occurs at power up and whenever a device is added or removed. At the start of the process, all the information on network topology held in the device registers is cleared. The physical layer at each device first checks the connection status of its ports, each of which signals 1 if it is connected or 0 if disconnected. If more than one port signals 1 , the device may be a branch.
As this process continues, a tree structure begins to form so that the root device can be selected and all the other physical connections referred to it. Generally the last device selected during this process is designated as the root. If one particular PC is to be designated as the root, the process time can be extended to ensure that this is the result. Once the tree has been formed, each device is allocated an ID for asynchronous traffic.
Various management roles will have been allocated during the initialisation process. Most important is that of the cycle master, which is usually the root device and has the highest priority for bus access. The cycle master provides and maintains the clock signal for isochronous data transfers. Some management roles can be allocated to devices other than the root one. The isochronous resource manager allocates time to those devices with isochronous data to transmit.
Whenever hot plugging generates a reset signal, the asynchronous resource and bus manager functions remain with the original device - assuming that it hasn't been removed.
The next stage of initialisation involves allocating channels 0 to 63, and time slots for those devices that need to communicate. Only channels that are free can be allocated: this information is held in the channel-available registers.
After a reset, the allocation of time slots may leave one device short of its previously allotted capacity. The device will then make requests periodically for an increased allocation. This continues until another device relinquishes time slots.
When configuration has been completed, the various devices connected negotiate for access to the bus. In addition, asynchronous and isochronous data compete for access to the bus. This is all controlled by the cycle master which transmits a timing signal known as cycle start, typically once every $125 \mu \mathrm{~s}$.
This very complex protocol, which appears to be so simple to the user, is usually controlled by a collection of single bits that are stored in various registers.

## System Timing and Arbitration

System timing is based on the phase-locked-loop crystal oscillator in each device's interface. These oscillators run at 24.576 MHz ( 98.304 MHz clocks may also be found). The clock in the interface device chosen as the cycle master is the one that is actually used. The 24.576 MHz signal is divided down to create 1 Hz (one second) and 8 kHz timing control signals. These control the time division multiplexing (TDM).
The cycle status and control bits are contained within bits $20-24$ of the third, fourth and fifth quadlets. The basic cycle duration is $125 \mu \mathrm{sec}$, and is repeated at 8 kHz . Of the total cycle period, at least 20 per cent is allocated to asynchronous control data with the remaining 80 per cent used for isochronous payload data.

Devices negotiate for bus access at every cycle. Only one is allowed to transmit at a time. Devices with reserved isochronous channels negotiate first: when a device receives a cycle start signal it sends a request for access to the root device. This accepts the first request it receives, which is always from the device nearest to it. There follows a small isochronous gap, after which arbitration starts again and the next nearest device is granted access. The process continues until all the devices that have isochronous data to transmit have gained access.
A longer gap, called the sub-action gap, follows so that asynchronous arbitration can start. Both gaps are proportional to twice the number of connections in the network. The sub-action gaps provide time for the acknowledgement signals.
To provide fair access, each device is allowed to transmit only once during the asynchronous part of each cycle. The cycle time ends with a longer idle period gap, called the arbitration reset gap, after which the process restarts.

## Data Packets

The serial data is organised as quadlets: each is four bytes long ( 32 bits). A data packet has at least two header bytes and two bytes of data. Quadlets are time aligned for accuracy so that they can be loaded into the FIFO registers, which are 32 bits wide and 64 quadlets deep. So that the quadlets consist of integer multiples of bytes, meaningless bits may be added as padding. Cyclic redundancy checks (CRCs) are included at the end of both the header and the payload data blocks.
These basic elements are common to both asynchronous and isochronous packets, but the headers for the two differ in length and content. Asynchronous headers include at least four quadlets to specify the destination ID, source ID and various control functions such as packet priority. Isochronous packet headers include just the channel number plus control information, and can be as short as two quadlets because the destination and source addresses are included in the channel number. Table 1 summarises the isochronous packet structure.

## Operation of a Typical Interface

A typical interface consists of little more than two VLSI (very large-scale integration) ASIC (application specific IC) chips that act as the physical and link layer controllers. Suitable chips are the Texas Instruments TSB11CO1 (physical layer) and TSB12CO1 (link layer), which use low-power CMOS technology but with the inputs designed to allow for hot plugging.
The TSB11CO1 is a three-port device that includes logic to perform the arbitration and bus initialisation functions. The TSB12CO1 transmits and receives cor-rectly-formatted isochronous data in real time. It includes reconfigurable FIFO memories for the data as well as the configuration registers required to operate the device.

## Physical Layer Control

Fig. 5 shows the basic arrangement of a physical layer control chip with three identical ports. Its crystal-controlled PLL clock provides three outputs via digital dividers, $98.304 \mathrm{MHz}, 49.152 \mathrm{MHz}$ and 24.576 MHz . The 49.152 MHz output is maintained at an accuracy of $\pm 100 \mathrm{ppm}( \pm 4.9152 \mathrm{kHz})$ to control the outbound encoded strobe and data signals. This frequency is also needed by the link layer controller to resynchronise received data.


Fig. 5: Physical layer control chip arrangement (Texas Instruments). R1 is 56, R2 5k 2, R3 6.36k $\Omega \pm 0.5 \%$, C1 250pF and C2 1 $\mu$ F.

Data bits to be transmitted are received from the link layer controller chip via the relevant data lines, in synchronism with the 49.152 MHz clock. After encoding, they are transmitted via the TPA pair. The encoded strobe, at 98.304 MHz , is transmitted via the TPB pair.
During packet reception the transmitter sections of the TPA and TPB transceivers are disabled while the receiver ports are enabled. This is achieved by the use of a simple flip-flop control bit.
The data and strobe signals are both differentially encoded - the signal swings equally about the 1.86 V nominal bias level. These signals are typically restricted to a voltage swing of $172-265 \mathrm{mV}$ (about 220 mV $\pm 40 \mathrm{mV}$ ). The level was chosen to allow interoperability with chip sets that use either 3 V or 5 V CMOS technology. The resistors marked as R1 provide optimum loading ( $112 \Omega$ ) for the line drivers. R2, C 1 act as a filter for the TPB lines. R3 sets the driver stage output current and controls the bias level: Ports 2 and 3 act in an identical way.
The chip's link layer interface directs the data between the receive and transmit modes, determined by a range of control signals. The most important of these are as follows:

Cable power status (CPS): This pin is connected to the cable power line via a $400 \mathrm{k} \Omega$ resistor. It detects the presence of the cable power supply and also feeds this information to the link level control chip.

Link power status (LPS): When this link is not powered the system clock is disabled and the chip performs only the basic repeater functions required for network initialisation and operation.

System clock (SYSCLK): This terminal provides the 49.152 MHz clock signal to which the data, control and link requests are synchronised.

Link request (LREQ): This signal from the link layer
control chip requests a particular service.
Control inputs/outputs (CTLI/CTLO): These bidirectional terminals control the exchange of information between the physical and link layer chips.

Data inputs/outputs (DI/DO): These bidirectional terminals provide the communication paths between the physical and link layer chips.

Reset input (/RESET): When this line goes low, there are bus reset operations at the active cable ports and the internal logic is reset to the start state.

## Link Layer Control

The TI TSB12CO1 high-speed link layer control chip provides easy integration with an input/output subsystem. It transmits and receives correctly-formatted IEEE 1394 data packets and generates the 32 -bit CRC (cyclic redundancy check) - this is used to check the header and payload data blocks. It can operate as a cycle master and can receive two isochronous channels. Fig. 6 shows the basic arrangement of this chip.
The TSB12CO1 integrates directly with physical layer chips such as the TSB11CO1 described above or the TSB21LVO3, which is used for processing an MPEG-2 data stream. It operates at 100,200 and $400 \mathrm{Mbit} / \mathrm{s}$ rates. Its 32 -bit bus is compatible with most other 32-bit proprietary buses available.
The FIFO memories ATF (asynchronous transfer), ITF (isochronous transfer) and GRF (general receive) provide variable-length data transfer and are software adjustable for optimum performance. The physical layer interface I/O signals have already been described:
The transmitter retrieves data from either the ATF or the ITF FIFO and generates correctly-formatted serial data packets for transmission via the physical layer interface. When data is present at the ATF FIFO the transmitter negotiates for bus access then sends the data packet. When data is present at the ITF FIFO the arbitration results in data being transmitted on the next


Fig. 6: Link layer control chip arrangement (Texas Instruments).
isochronous cycle. When the chip acts as cycle master its transmitter automatically sends the cycle start packet.
The receiver accepts data from the physical layer interface and checks the address. If the data is addressed to this piece of equipment and the CRC is correct, the header is confirmed in the GRF. For block and isochronous packets the rest of each one is checked on a quadlet-by-quadlet basis to the end of the packet and then confirmed in the GRF.
The error code for a packet is contained in a status quadlet which is sent as an acknowledgement. With isochronous packets, which need no acknowledgement, the error code tells the transaction layer whether the data CRC is correct or not. If the header is in error, the memory is emptied and the remainder of the packet is ignored. When a cycle start message is received, it is detected and sent to the cycle timer but not placed in the

## Table 1: Isochronous packet structure.

| Field | Bit size | Notes |
| :--- | :---: | :--- |
| Data length | 16 | Indicates number of bytes in <br> current packet |
| TAG 2 Data format (see footnote) <br> Channel no. <br> Indicates channel number   |  |  |
| Transaction code | 4 | with which data is associated <br> Code for current isochronous <br> packet |
| Synchronism code | 4 | Transaction layer specific sync <br> code |
| Header CRC <br> Data block | 32 | All isochronous packets <br> All data block payload packets |
| Data block CRC | 32 | All data block packets |

Footnote: The TAG field is used to define the data format: 00 represents data formatted for normal IEEE 1394 operation while 01 indicates that HyperLynx for MPEG-2 data is in use. The other two codes are at present not allocated.

GRF. If, at the end of an isochronous cycle, the cycle mark enable bit in the control register is set, the receiver inserts a cycle mark packet in the GRF to indicate the end of the cycle.
The transmit and receive FIFOs, both asynchronous and isochronous, are software adjustable to cater for individual applications. The maximum memory capacity is 509 quadlets, which can be shared between the ATF, ITF and GRF sections.
A cycle timer is incorporated in all devices that use isochronous data transfer: it consists of a 32-bit register. The lower twelve bits form a modulo-3072 counter that increments once every 24.576 MHz clock periods $(40.69 \mathrm{nsec})$. The next 13 , higher-order bits are used to count up to $8 \mathrm{kHz}(125 \mu \mathrm{sec})$. The higher seven bits form a seconds count.
A cycle source bit in the configuration register can be set to indicate which device is acting as the cycle master. The cycle-in input starts cycle count incrementing: the cycle-out signal indicates that it's time to send the cycle start packet. The cycle monitor is used only by devices that provide isochronous data transfer. It monitors the chip activity and schedules the operations.
The host interface consists of a 32 -bit parallel data bus and an 8 -bit address bus. The BCLK signal is the bus clock, which is asynchronous to the system clock (SCLK). The CA and CS inputs denote cycle acknowledge and cycle start respectively. The WR input indicates read/write and operates in conjunction with the CS input. When these are both driven high, a read from the chip is signalled - low inputs produce a write operation.
To speed operation, this chip is interrupt driven. When the INT line goes low, this indicates that a particular service function needs to be performed.

## References and Acknowledgement

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I would like to acknowledge the help provided by Colin Davies of Texas Instruments.

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## Ferguson TX92 Chassis

If there is loss of one colour, check the tube's first anode (screen/G2) voltage as laid down in the manual. The cathode voltage for the missing colour should of course be high, and there will probably be no change as the Al voltage is varied. The first checks should be on the tube's base panel. Lift one end of all three $82 \mathrm{k} \Omega$ RGB feedback resistors RB24/44/64. Check their values and replace any that are out of tolerance.

If this doesn't restore the missing colour, switch off and lift one end of RV17 (82 ), RV18 and RV16 (both $120 \Omega$ ) on the main panel. Tune in a monochrome signal and scope IV01's RGB output pins 27, 28 and 29 . With a monochrome signal all three waveforms should be of similar amplitude. If one is low, replace the three 100 nF chip capacitors CV 10/11/12. This has solved the problems I've had so far. P.B.

## Samsung SCTIIB/D Chassis

The following applies to sets, including Models CI3373 and CI5079, that are fitted with this chassis - you will find the chassis number printed on the PCB, just below the line output transformer on the solder side.
If the set is dead with DZ801 or IC801 short-circuit, inspect the

## TV Fault Finding

board in the area of DZ801. If it's blackened, indicating that DZ801 has been getting hot, the power supply has probably been producing excess voltage in standby. In standby the 125 V line should rise to 140 V . In some sets it can rise to 180 V , with the result that DZ801 fails. Replace the following parts with the latest types - this normally solves the problem:

DZ801, replace with part no. 0403000691.

IC801, replace with part no. AA1320004P version C.

HC801, replace with part no. AA13-20004M version C.

If the supply still produces 180 V in standby, replace C852 using part no. 2301-000111. P.B.

## Grundig M70-690/9 (CUC6851 chassis)

If there is no front display, check whether fuse Si 6010 on the mains switch panel is open-circuit. P.B.

## Samsung CI5079T (SCTIID Chassis)

This set produced a blank blue screen with no sound. The menus could be called up, but they were partly off the top of the screen. This was a clue - the EEPROM had lost its settings.

With the SAA5290ZP-026 the option byte should be set to 5D.

With the SAA5290ZP-042 the option byte should be set to CA.

Once a new EEPROM had been fitted and the option byte set up, the menus were in the correct place on the screen and snow had replaced the blank display. But no signals could be tuned in. Pin 1 of the microcontroller chip, where the PWM tuning voltage signal should be present, was short-circuit to
chassis. A new microcontroller chip and a picture size and grey-scale set up completed the repair.

If you need to order a service manual for a CI5079T, quote the chassis type - you will find it on the solder side of the PCB, by the LOPT pins. P.B.

## Hitachi C1414T

Although this set's power supply appears to be quite conventional it won't start if you connect a light bulb as a dummy load across its output. If you switch on then connect the bulb, it will light.

The basic fault was that the overvoltage zener diode ZD952 (P6KE130R) and the line output transistor Q702 (BU2508DF) had gone short-circuit. Replacing these items and the optocoupler IC901 (CNX82R) cured the fault. But before doing so I wanted to test the power supply running on its own. Hence the comments above. M.M.

## Sony KV2553MT

This multi-standard set had been imported from the USA. There was no picture: the owner complained about a thin white line across the screen with a black band at the bottom. The cause of the trouble was C681 ( $560 \mu \mathrm{~F}, 25 \mathrm{~V}$ ) which on test read under $90 \mu \mathrm{~F}$. A new $680 \mu \mathrm{~F}$, 50 V capacitor rated at $105^{\circ} \mathrm{C}$ cured the fault. M.M.

## Philips 2A Chassis

When this set came in it was tripping. Fortunately the engineer who brought it along mentioned that there was a width fault. I found that R3601 (5.6ת) in the EW modulator driver stage was open-circuit. A replacement stopped the tripping, but there was now excessive width with the control having no effect.

A voltage check at the emitter of the EW modulator driver transistor TR7599 produced a reading of
approximately 2.2 V instead of the usual 15.5 V . A check at the width control itself revealed that the -26 V supply was missing. R3602 (15 ) was open-circuit because the supply's reservoir capacitor C2602 ( $10 \mu \mathrm{~F}, 63 \mathrm{~V}$ ) was short-circuit. When I removed it I found that its case had burst. Replacements followed by setting up restored correct operation. M.M.

## Matsui 209R

The fault symptoms were field bounce and partial field collapse. The cause turned out to be dryjoints at the scan plug connector. Resoldering put matters right. M.M.

## Philips CP110

This one came in from another dealer who thought that the cause of the blown mains fuse was the degaussing posistor, which rattled. Checks revealed that two of the mains bridge rectifier diodes were short-circuit. When these were replaced the fuse held but the set didn't come on.

The voltage at pin 9 of the TEA1039 chopper control chip was low. So I replaced the usual items the BUT11AF chopper transistor TR7665, the TEA 1039 chip, the $120 \Omega$ and $100 \Omega$ resistors in TR7665's base circuit etc., but still no joy. The BYD33J HT rectifier D6664 was short-circuit. When this had been replaced the set came on and the channel numbers lit up. Time to reconnect the scan-coil plug, restoring the HT supply to the line output stage. The set then tripped. I had a working set once the line output transformer had been replaced - pity the tube was as flat as a pancake! M.M.

## Samsung Cl6230

There were two faults with this set: no remote control and flyback lines at the top of the screen when the set had been on for a while. The customer mentioned that the field output chip had been replaced several times. I replaced the associated flyback boost capacitor, but the field fault persisted. The cause was the chip itself, proved by a squirt of freezer.

When I removed the chip I found that the previous engineer hadn't bothered to clean off the old heatsink compound. So the chip wasn't making proper contact with its heatsink. All-was well when I'd cleaned off the old grease and fitted a new chip.

The cause of the remote control system failure was simple: the pre-
vious engineer had forgotten to refit the plug from the remote control sensor/amplifier! M.M.

## Ferguson TX90 Chassis

Field collapse superimposed on a normal picture was the unusual symptom with this 14 in . set. At first I thought that the screen had been burnt by a previous field collapse fault. But this was not the case: after about five minutes the line almost vanished.

The field output stage bias resistors were all OK. They are fed from the same 150 V line that supplies the RGB output transistors. The cause of the problem was this supply's reservoir capacitor C190 ( $22 \mu \mathrm{~F}, 160 \mathrm{~V}$ ). A replacement also improved the picture. K.F.B.

## Hitachi C2114T (G7PS Chassis)

The field output chip IC601 had failed. It failed again after a few months and was replaced, along with C605, only to fail yet again. On Hitachi's advice we fitted a $10 \mathrm{nF}, 50 \mathrm{~V}$ capacitor across the field scan coils, on the print side of the panel, and made sure that R613 was fitted. But the set continued to destroy its field output chip.

The latest modification is to add two BZX79-33V zener diodes in series, with their cathode to pin 2 of IC601 and the anode to chassis. If this fails, it seems that a new CRT is required. K.F.B.

## Ferguson ICC9 Chassis

If the symptom is loss of one of the primary colours, check the relevant surface-mounted buffer transistor first. Use a scope - these transistors can test OK with a multimeter. TV71 is for red, TV76 for green and TV81 for blue. M.Dr.

## Tatung $\mathbf{1 8 0}$ Chassis

The power supply pumped at switch on. When the feed to the line output stage was disconnected the power supply fired up first time. But connecting a 60 W bulb as a dummy load made it trip again. The usual cause of this fault is C806 and C807 (both $100 \mu \mathrm{~F}, 25 \mathrm{~V}$ ). Not this time however. The capacitance of the mains bridge rectifier's reservoir capacitor $\mathrm{C} 805(100 \mu \mathrm{~F}$, 385 V ) had dropped to a very low value. M.Dr.

## Sanyo EC1-B Chassis

One of these sets would shut down after three seconds. The chassis incorporates a protection circuit that's monitored by the

PCA84C840/062 microcontroller chip IC701. The idea is that the protection line is held high by the $10 \mathrm{k} \Omega$ pull-up resistor R706. Various diodes connect this line to the supply rails. When a supply is lost, the relevant diode conducts and the protection line goes low. The exception to this circuitry is the HT line (B1), which is checked for overvoltage by a potential divider/zener diode/transistor arrangement which likewise pulls the protection line low in the event of a fault.

In this particular case however IC701 had developed an internal leak of about $2 \mathrm{k} \Omega$, which made the protection line go low. I assume that the three-second delay is programmed into the chip's software to allow the supply rails to be established before checks are made.

I've now had this fault three times, with two other variants of the same chassis. P.G.

## Hitachi CPT2508 (G7P Mk II Chassis)

This set was dead with the mains fuse blackened and the $3.9 \Omega$, 7 W surge limiter resistor R901 opencircuit. As a $300 \Omega$ reading was obtained across the mains bridge rectifier's reservoir capacitor C909 I at first suspected that the chopper transistor Q901 was leaky. The culprit was the snubber capacitor C919 $(4.7 \mathrm{nF}, 1 \mathrm{kV})$ however. It's one of those disc capacitors and on closer inspection I could see that it had split along its length. A replacement rated at 2 kV restored normal operation. P.G.

## Toshiba 1510tBT

This set had died during an electrical storm. Unusually the power supply worked, but the set was stuck in standby. The 5 V supply for the microcontroller chip ICA01 is derived from the AC mains supply via a $3.9 \mathrm{k} \Omega$, 10 W resistor (RA60) which acts as an integrator in conjunction with a $470 \mu \mathrm{~F}, 16 \mathrm{~V}$ capacitor (CA45). The 9 V supply produced by these components is clamped by a couple of series-connected 4.7 V zener diodes and fed to a BC547B 5V regulator transistor (QA03).

Checks showed that the 5 V supply was low at 4 V while the voltages at the pins of ICA01 were haywire. In particular the voltage at its reset pin hovered at 1.2 V instead of being 5 V . Thus ICA01 refused to initialise. The reset line is fed by QA04, which is in QA03's base circuit. QA03 was the cause of the
trouble: it had slight base-emitter leakage. P.G.

## GoldStar CIT2180F

This set was dead. There was plenty of voltage across the mains bridge rectifier's reservoir capacitor C808 but nothing at the collector of the chopper transistor Q801. The cause was hairline cracks around all the pins of the chopper transformer, though a magnifier was required to see them. Resoldering restored normal operation. P.G.

## Huanya 37C3

Some quick ones on these sets. If the set fails to start, check R710 ( $10 \mathrm{k} \Omega, 3 \mathrm{~W}$ ) which provides the line oscillator with a start-up feed.

No colour usually means that the D7193AP colour decoder chip IC501 is faulty. Replace with a TA7193.

If there's no field flyback blanking, check the two $1 \mu \mathrm{~F}, 50 \mathrm{~V}$ seriesconnected electrolytics C612/3.
Note that in some versions of the chassis only one of these capacitors is fitted, the other one being linked out. Non-linear field scanning usually means that C611 $(2 \cdot 2 \mu \mathrm{~F}, 50 \mathrm{~V})$ is open-circuit. P.G.

## Mitsubishi CT25MITX

The complaint was intermittent loss of the picture. When the loss occurred it lasted for only a few seconds. The fault could not be instigated by heating/freezing or by tapping, and during a soak test put in an appearance just once in three days. When it occurred the picture blanked completely, but both text and the on-screen graphics still worked.

Eventually the fault lasted for longer than its usual brief period and I had a chance to make some checks. The signals were OK at the TDA356l colour decoder/switching chip, including the sandcastle pulses. Data input switching is carried out at pin 9 , which goes high for text/on-screen graphics. In the fault condition the voltage here was 0.9 V instead of 0 V . Two transistors, Q7705 (text) and Q702 (onscreen graphics), control this voltage. Q702 had 3.2V at its emitter instead of 0 V , and much the same at its base. At first I suspected the microcontroller chip IC701, but breaking its connection to Q702's base still left the incorrect voltage here. A replacement transistor, type JC501QR, cured the fault - the original one had been intermittently leaky.

The JC501QR is a general-pur-
pose, low-voltage transistor. I've found that a BC182L works quite well as a substitute. P.G.

## Saisho CTI4IX/Matsui 1420A

The owner of this 14 in . portable complained about an extremely intermittent bright picture. When the fault finally put in an appearance I found that $\mathrm{C} 431(4 \cdot 7 \mu \mathrm{~F}, 250 \mathrm{~V})$ had gone open-circuit. It's the reservoir capacitor for the 180 V supply to the RGB output stages. P.G.

## Hitachi G7P Chassis

One of these sets would intermittently fail to start. We'd had it in for the same fault about six months previously, and thought we had cured it by replacing C914 ( $2 \cdot 2 \mu \mathrm{~F}$, 50 V ) which had fallen in value. It's part of the start-up supply for the TDA4601 chopper control chip IC901. This time C914 was OK. The culprit was $\mathrm{C} 916(33 \mu \mathrm{~F}, 25 \mathrm{~V})$, which takes over as the reservoir capacitor for IC901's supply once the circuit gets going. As with C914, it had fallen in value. P.H.

## Mitsubishi CT2964ST (Euro 4 Chassis)

This monster set's reported fault was no teletext. After attending to a multitude of dry-joints in the power supply and timebase sections of the main board I turned attention to the complaint. In fact the set seemed to be switching over to the teletext mode but produced only a blank screen. The 5 V teletext supply was low because C922 ( $100 \mu \mathrm{~F}, 25 \mathrm{~V}$ ) was open-circuit. Once this capacitor had been replaced the set performed as it should, which is more than can be said for me after I'd lifted it! P.H.

## Bush 2114T

The customer said that this set had gone bang. When I opened it up I could see why. The HT reservoir capacitor C810 (220 $\mathrm{FF}, 160 \mathrm{~V}$ ) had exploded. There was debris everywhere - it took an absolute age to clean it all up. To avoid a bounce I also replaced $\mathrm{R} 808(270 \mathrm{k} \Omega)$ and C818 ( $1 \mu \mathrm{~F}, 50 \mathrm{~V}$ ). When faulty these items can be responsible for a blown chopper transistor and high HT respectively. P.H.

## Ferguson C5IND (ICC7 Chassis)

Intermittent sound was the complaint with this Nicam set. The audio was sometimes low and couldn't be changed even though the on-screen level moved when
told to do so by the remote control unit. In addition the sound menu had only the volume level control present: the displays for balance, bass, treble and mono/stereo were not there. After attending to some suspect joints on the main and Nicam boards the problem was still present. Thinking it might be a microcontroller fault I replaced this item. Again to no avail.

Ferguson Technical was very helpful and suggested that I resolder pins 24,25 and 26 of the TDA6200 chip IS04 on the Nicam board. These pins handle the clock and data traffic. As I'd already done this, the next suggestion was to resolder all the links on this dou-ble-sided board. Doing this cured the fault. Note that ISO4 can be the cause of the fault.

I also found that the on-screen graphics were a bit too far to the right. This was corrected by adjusting LB03 in the on-screen display oscillator circuit. P.H.

## Philips CP90 Chassis

I thought this was going to be an easy one - the set had lost its memory. A new nicad battery fixed that. I then found that the tuning would not stop at a signal. As the transmission tuned through, I briefly saw a picture that was shifted to the left.

So it appeared that there was a problem with the line oscillator, which is in the IF unit. This module is not covered in the manual, and Philips seems to regard it as unrepairable. A replacement module is expensive, so an attempt at repair seemed preferable to a declined estimate. In fact replacing the TDA2579 chip cured the problem. P.H.

## Salora J Chassis

This set took a long time to come on and the mains switch wouldn't latch. When the electrolytics on the primary side of the Ipsalo circuit were checked with a bridge CB712 and CB726 (both $4.7 \mu \mathrm{~F}, 35 \mathrm{~V}$ ) were found to be low in value. They were replaced, along with the switch, but this wasn't the end of the matter.

There was pronounced ripple on the screen when the set was still cold. CB5 $14(1,000 \mu \mathrm{~F}, 25 \mathrm{~V})$, the 15 V supply reservoir capacitor on the secondary side of the Ipsalo circuit, was low in value. In addition field lock was not too good. This was cured by replacing the field scan coupling capacitor CB410 $(2,200 \mu \mathrm{~F}, 25 \mathrm{~V})$ which had also fallen in value. P.H.

## Philips KT4 Chassis

The complaint with this set was intermittent loss of the picture, sound OK. Fortunately the fault became permanent after a few days. When the picture went off, the line frequency whistle changed pitch. But there was still EHT.

The chassis has an unusual power supply/line timebase arrangement. Drive for the line output transistor is obtained from a secondary winding on the chopper transformer. A TDA3576B chip, IC7200, is used for line sync purposes. It controls an oscillator in the power supply. The TDA3576B chip was faulty. So was the screen printing on the PCB - at first we fitted the replacement chip the wrong way round. Fortunately it suffered no damage. M.Dr.

## Hitachi C2114T (G7PS

 Chassis)This set had died because of the usual failure of R901. When it had been revived there was a hum bar, yet no ripple could be detected on any of the supply lines. It was eventually removed by a slight tweak to the AGC preset. All chan-
nels, both strong and weak, had been affected. C.J.G.

## GoldStar CIT2168

This set bounced following a power supply repair, the complaint being no teletext. There were dry-joints at connector P102 on the text board. Why are we always expected to do two repairs for the price of one? My local garage doesn't! C.J.G.

## JVC C1480

Tuning drift was the complaint with one of these sets. For tuning control they have an unnecessarily complicated and ridiculously expensive thick-film module. Oh dear. We were able to trace the cause of the trouble to a surfacemounted electrolytic capacitor on the module however - C016, $0.47 \mu \mathrm{~F}$. It's the same type that gives trouble with certain JVC capstan motors. C.J.G.

## Sony KVX2952 (AE1C Chassis)

The chopper transistor was shortcircuit and a replacement got very hot and threatened to go the same way. $\mathrm{C} 611(47 \mu \mathrm{~F})$ in its base circuit
was the cause, and the $100 \Omega$ sur-face-mounted resistor R651 was open-circuit.

It's always worth checking the waveform carefully where an electrolytic capacitor is used to couple the drive to a chopper or line output transistor. C.J.G.

## Datsura CDR9009 (Sanyo <br> Al-14 Chassis)

For a rolling, non-linear field scan, check the value of R548. It varies with the model. This one was fitted with a $180 \mathrm{k} \Omega$ resistor that had risen in value to several $\mathrm{M} \Omega$. C.J.G.

## Fidelity CTV1405R

These portables are getting a bit long in the tooth now but can still produce excellent pictures. This one suffered from erratic tuning, sound buzz etc. A replacement AFT coil cured all these faults. C.J.G.

## GoldStar CIT2168 (PC04A Chassis)

The cause of intermittent failure to start was traced to D401 (1N4003). It provides a start-up supply for the line driver stage. C.J.G.

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## Reports from

Alan Bonhomme
Adrian Spriddell and Ian Field

## Elkay EM14 SVGA

There was a red screen. Replacing C22 on the tube base PCB restored the missing green. All was well for several hours, after which there was a green screen with flyback lines. This time coil L10 had gone open-circuit. It's value is $22 \mu \mathrm{H}$, and it looks like a resistor. A.B.

## AOC CMLB346

The symptom was very fine line tearing on verticals. Checks revealed that $\mathrm{C} 232(1 \mu \mathrm{~F})$ was open-circuit. Its position is near the centre at the front edge of the main PCB. A.S.

## Viglen CA1428LE

The customer was an electronics engineer and had already tried to deal with the fault - no green. I expected a difficult job and got one! Most of the checks that should have been carried out had been, so I decided to deflux the CRT panel and start again. I repeated some of the checks and thought of a few more.

By now the fresh flux on the PCB was beginning to look a mess again. I decided, while it was still obvious which soldering had been reworked in the course of removing components for test, to unsolder and remake all the others including the many wire links. Once I'd completed this process and again defluxed the PCB it worked correctly.

During the solder reworking I noticed that many of the wire links

## Monitors

only just made it through the PCB. The customer had obviously been aware of this, as most of the wire links had been 'levered' to check their strength. This is a valid test method. I think that if slightly more force had been applied the faulty link would have been found before I got a job out of it! I.F.

## Digital PCX-BC

When this monitor was powered it produced only a 'warm, damp smell' which reminded me of the Fidelity ZX2000/3000 chassis. Looking at the cabinet design I expected to find an AST inside, but the innards more closely resembled a Philips 7CM5279.

Occasionally a shower of sparks was seen within the LOPT cage at switch on! The spring clip that holds the IRF730 boost regulator MOSFET protrudes through slots in the heatsink/LOPT cage and had cut into the windings of coil 5613. When this coil had been replaced fortunately the MOSFET had not been damaged - the monitor worked, though the scan was too wide. The MUR460 diode that was the cause of this hides under the heatsink clips on the line output transistor and efficiency diode. The PCB print was blurred - the diode could have been 6624 or 8824. I.F.

## Taxan EV420-4R

The original complaint was intermittent operation. During fault assessment it became so intermittent the monitor didn't come on at all! Some poor soldering around the TDA8172 field output chip I301 was dealt with while carrying out a visual examination, but the fault was still present at power-up. The power supply was working, and was driving the CRT's heaters, but there were no scan-derived supplies.

Line drive was present, but the HT supply was missing at the line output transformer. When tracing
back to the source I came to Q802 (IRFS630), an all-plastic version of the IRF630. It acts as a chop-per-type EW/width modulator, driven by 1804. This is a second UC3842 chip, the first one being in the power supply. I804 was providing pulses at the gate of Q802, but this device's drain voltage was missing. So back to the power supply, specifically D813, which is mounted on a folded-metal standup heatsink. The solder fillet had torn away from the rest of the track. Once the solder and detached piece of pad had been removed and a brace link had been soldered in to provide connection and mechanical strength all was well. I.F.

## RML RM1439

There was a blank screen, though power supply activity was evident at switch on. A scan-derived 12V supply is provided by the rectifier circuit D532, R545 ( $2.2 \Omega$ ) and C533 ( $100 \mu \mathrm{~F}, 25 \mathrm{~V}$ ), followed by IC501 (7812) for regulation. It was missing because R545 was opencircuit. This item had recently been replaced by someone else, and had been soldered on the print side of the PCB. The markings on D532 had been partly rubbed off and were unidentifiable. I decided that IC501 was unlikely to be the culprit, so I replaced C533 and R545 and fitted a UF5404 diode in position D532 - I had a strong suspicion that the original diode had been breaking down at running temperature. As I was unable to check the diode's specification, I had to select a replacement with an undisputable safety margin. Anyway the monitor then produced a normal raster.

These monitors were made by Mitsubishi and also turn up wearing Dell badges. A similar chassis was custom-built for RML for its educational machines. But don't assume that parts will be interchangeable. I.F.


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| HA13 | 65 | LA | 35 | LA | 20 | LF | 48p | MC | 50 p | SA |  | ST |  | ST | p | STR |  | 281 | Op |
| HA13002 | 200 | LA3120 | 200p | LA7113 | 276 | LFF355 | 60p | MC3401 | 5 | SAB3035 | 27 | STK3106 | 2500p | STK5 | － | STR 17006 | p | TA7282 | 60p |
| HA1300 | 400 | LA3150 | 200 p | LA7176 | 125 p | LF357 | 70 p | MC3423P | 100p | SAB3036 | 72 | STK3122 IIf | $725 p$ | STK | ， | STR20005 | Op | TA7210 | 200p |
| HA13007 | 300p | LA3160 | 120p | L47123 | 1300p | L＇F398 | 300p | MC3488AP | 250p | SAB3037 | 700p | STK3152 If | 900p | STK5482 | 285p | STR20012 | 450p | TA7283 |  |
| HA13108 | ${ }^{260 p}$ | L43161 | 40 p | LA7210 | 60p | $\mathrm{LH}^{\mathrm{H} 24265}$ | 600 p | MC34063AP | 300p | SAB3042 | 825p | STK3156 | 600p | STK5483 | 440 p | STR20015 | 450 p | TA7284P | 400p |
| HA1317 | 175 | L43210 | ${ }^{65 p}$ | La7212 | 150 p | LM301 | ${ }^{26 p}$ | MN1220T | 600 | SAB3064 | 130 p | STK4017 | 400 p | STK5486 | 450 | STR30110 | 330p | TA7288 | 20p |
| HA 13118 | $140 p$ | L43226 | ${ }^{60 p}$ | La7214 | 150 p | LM311 | 35p | MN1226 | ${ }^{4500}$ | SAB3209 | 225p | STK4019 | 480 p | STK5487 | 525 p | STR30115 | $276 p$ | TA7291P | 200p |
| HA13119 | 140 p | LA3246 | $75 p$ | LA7220 | 125 p | LM319 | 185 p | MN1228 | ${ }^{800 p}$ | SAB3210 | 250 p | STK4021 | 380 p | STK5488 | 480 p | STR30120 | 400p | TA7292P | 200p |
| HA13127 | 350p | La3300 | 140p | L47222 | 110 p | LM324 | 30p | MN1276 | 1300p | SAB6456 | 125 p | STK4024 1 | 550 p | STK5490 | 450 | STR30123 | ${ }^{450}$ | TA7292P | 325p 450p |
| HA13128 | 400 p | LA3301 | 110 p | LA7224 | 150 p | LM3352 | ${ }^{120}$ | MN 1280 | 70 p | SAB8048 | 225p | STK4025 | 630p | STK5632 | 450 p | STR30125 | 550 p | TA7294P | ${ }^{4500}$ |
| HA13130 HA13135 | 450p | L43361 | 100p | L47225 | 250p | LM339 | 35p | M 13004 | 600p | SAB8051AP | 700p | STK4026 | 480p | STK5720 | 400 p | STR30130 | 250p | TA7299 | ${ }^{200 p}$ |
| HA13135 |  | La3365 | 70 | La7292 | 275 | LM348 | 50p | MN3005 | 2000p | SDA2003 | 450p | STK4028 | 550p | STK5725 | 450p | STR40090 |  | TA7302P | $75 p$ |
| ${ }_{\text {HA }}$ | 600 | L43370 | 700 | L47294 | 200p | LM358 | 45p | MN3011 | 4000p | SDA2004 | 325p | STK4032 ${ }^{\text {H }}$ | 1050p | STK5730 | 450 | STR40115 | ${ }^{600}$ | TA7303 | 70p |
| HA13150A | 1150 | La3373 | 70 p | LA7295 | 180 p | LM380 | 80p | MN3101 | 110 | SDA2005 | 700p | STK4034 X | 925p | STK6316 | 300 | STR41090 | 3300 | TA7307 | 100p |
| HA13151 | 875 | LA3375 | 300p | LA7297 | 120p | LM381 | 150p | M 3102 | 110p | SDA2007 | 300p | STK4036 | 470p | STK63248 | 500p | STR43111 | 950 p | TA7310 | 100p |
| HA13403 | 400 p | LA3376 | ${ }^{80}$ | LA7305A | 3508 | LM382 | 130 p | MN3207 | 375 | SDA2008 | 400 p | STK4038 | 680p | STK6327 | 1200p | STR44115 | 475 p | TA7312 | 120p |
| HA13406 | 400p | L43380 | 300 p | LA7308 | 70p | LM386 | 60p | MN3208 | 950 | SDA2112 | 4500 | STK4040 11 | 650p | STK6328A | 800 p | STR45111 | 550p | ta7313 | 70 p |
| HA13408 HA13412 | ${ }_{6000}^{350 p}$ | La3390 | $260 p$ $260 p$ | LA7311 LA7320 | 200p | LM387 LM389， | ${ }^{1000}$ | MN60308 | 350p | SDA2120 | 200p | STK4042 11 | 800p | STK6431 | $850 p$ | STR50020 |  | TA7314 | 175p |
| HA 13412 <br> HA 13426 | 600p 500 p | L43400 L43401 | $\begin{gathered} 250 p \\ 90 p \end{gathered}$ | LA7320 LA7323 | $120 p$ 3259 | LM3893 | $105 p$ $45 p$ | MN6163A | 700p | SDA2131 | $225 p$ 450 | STK4044 STK4046 | 950p 980 p | STK6607 STK6722 | $\begin{aligned} & 400 \mathrm{p} \\ & 725 p \end{aligned}$ | STR50092 STR50103A | $\begin{aligned} & 550 \mathrm{p} \\ & \mathbf{2 6 0 p} \end{aligned}$ | TA7315 | 200p |
| HA 13432 | 400p | L43410 | $160 p$ | LA7330 |  | LM431 | 50p | NE555 | 20p | SDA4212 | 775 | STK4048 | 1280p | STK6732 | 1000p | STR50 |  | TA7317P | 120p |
| HA13449 | 450 | La3430 | 135p | La7331 | 250 | LM710 | 45p | NE556 | 40 p | SDA5241 | $726 p$ | STK4050 | 1800p | STK6822 | 900p | STR50115 | 500 p | TA7320P | 200p |
| HA17524 | 250 | La3600 | 60p | LA7332 | 225p | LM723 | 40p | NE558 | 80p | SDA5243－2 | 450p | STK4060 | 510 p | STK6922 | 500p | STR51041 | 500p | TA7322 | 130p |
| KA2102 |  | LA360 | 100p | LA7340 |  | LM741DIL | 18p | NE565 | 110 p | SDA5343 | 1460p | STK4065 | 650p | STK6932 | 525 p | STR50213 |  | TA7323 | 80 p |
| KA2130 | 150 | L43607 | $125 p$ | LA7376 | 150p | LM741MET | 45p | NE567 | 115p | SDA5640 | 200p | STK4101 | 500p | STK6962 | 275p | STR53041 | 400p | TA7234 | 75p |
| KA2131 | 110 p | L44030 | 180 p | LA7391 | 550p | LM747 | 5 | NE571 | 290p | SDA5642 | 450 | STK4111 | 600p | STK6972 | 490p | STR54041 | 320p | TA7325 | 90p |
| KA2206 | 150 p | La4031 | 140p | La7520 | 200p | LM1017 | 200p | NE592 | $85 p$ | SGSF444 | 500 | STK4112 | 500p | STK6981B | 600p | STR55041 | 450p | 26 | 200p |
| KA2209 | 125 p | L44032 | 140 p | LA7530 | 2009 | LM1035N | 350p | NE5532P | 1400 | SGFS465 | 500 | STK4121 | 480 p | STK6982 | ${ }^{600}$ | STR56041 | 550 | TA | 110 p |
| KA2210 | 230 p | L44051 | ${ }^{160 p}$ | La7535 | 175 p | LM1040 | 650p | SAA 1000 | 350 | SLA4031 | 750p | STK4122 | 560 p | STK6982H | ${ }^{600}$ | STR5804 | 250p | ta7330P | 80p |
| KA2212 | －${ }^{650}$ | L44100 | 85 | LA7545 | 160 | LM1203 | ${ }_{225 p}^{225 p}$ | SAA1004 | 650 3250 | SLA7020M | 450p | STK4131 | ${ }^{480}$ | STK7216 | 420 | STR5904 STR60001 | 300 5250 | ta7331P | 80p |
| KA2214 | 100 p | LA4102 | 100p | La7555 | 150p | LM 1875T | 330p | SAA1006 | 300\％ | STA34iM | 200p 180 | STK4133 II | 600p 750 p | STK7225 | 500\％ | STRG00015 | 525p | TA7333 |  |
| KA2224 |  | Las110 | 120p | La7620 | 500p | LM1881N | 375 | SAA100 | 450p | Sta 401 A | 220 | STK4141 II | 420p | STK7228 | 600p | STR81145 |  | TA7335 | 85p |
| KA2244 | 75p | La4120 | 270p | LA7680 | 675p | LM 1886 | 250p | SAA1010 | 400p | STA 403 A | 270 | STK4142 | 530p | STK7251 | 500 p | STR90120 | 425p | TA7336 | 80p |
| KA2261 |  | LA4138 | 105p | La7681 | 650p | LM1889 | 300p | SAA1024 | 250p | STA405A | 280 p | STK4147 II | 1450p | STK7253 | 450p | STRD1206 | 500p | TA7337P | 175 p |
| KA2263 | 100 p | La4140 | ${ }^{60 p}$ | L47710 | 250 p | LM1894N | 200p | SAA1025 | 250p | STA431A | 250p | STK4151 | 680p | STK7308 | 350p | STRD1406 | 60 | TA7 | 175p |
| KA2264 | 100p | La4142 | 65 | La7800 | p | LM1895N | 275p | SAA1026 | 400 | STA432A | 220 | STK4152 | ${ }^{650}$ | STK7309 | 400 p | STRD1706 |  | TA7341 | 250p |
| KA2284 | 75 p | L44145 | ${ }^{65 p}$ | La7801 | $100 p$ | LM2901N | 35 p | SAA1027 | 400 p | STA 434A | 270p | STK4161 | ${ }^{650} \mathrm{p}$ | STK7310 | 470 p | STRD1806 | 360p | TA7342P | 70p |
| KA2309 | 175p | La416 | 100p | La7802 | 30 | LM2902N | 40p | SAA1029 | 150p | STA 435A | 270 p | STK4162 | 650p | STK734 | 400 | STRD1816 |  | TA7343 | 120p |
| KA2401 | 160 | LA4162 | 110 p | La7806 | 280 p | LM2903N | Op | SAA 1042 | 325 p | STA441C | 220 p | STK4164 11 | 1175p | STK7356 | 425p | STRD1906 | 650p | TA7347P | 120p |
| KA2412 | 225 p | LA4178 | 1500 | La7808 | 250 p | LM3900 | 40 p | SAA1043P | 675p | STA451 | 2800 | STK4171 | 900p | STK7358 | 4400 | STRD3035 |  | TA7348P | 125p |
| KA2912 | 125 p | LA4180 | ${ }^{150 p}$ | LA 7820 | 100p | LM3909 | 100p | SAA1044 | 400p |  | 240p | STK417211 | ${ }^{680}$ | STK7402 | ${ }_{600} \mathbf{6 0 0}$ |  | ${ }_{550}$ | TA7349P | 175p |
| $\begin{aligned} & K A 2913 A \\ & K A 2914 A \end{aligned}$ | 175 <br> 200 <br> 10 | LA4182 LA4190 | 180 p 300 p | LA7823 LA7824 | 200p | LM391．1N | 200p | SAA1056 SAA1057 | $300 p$ 375 | STA471 STA901M | $210 p$ $\mathbf{2 8 0 p}$ | STK4181 | 680p 750 p | STK7 404 STK7406 | 600 p 650 p | $\begin{aligned} & \text { STRD4420 } \\ & \text { STRD4512 } \end{aligned}$ | 550p 400 p | TA7354P | 65p |
| KA22427 | 10 | LA4192 | 14 | La7830 |  | LM3975 | 16 | SAA10 | 225 | StK002 | 420 | STK4191 | 700 | STK740 |  | STRD5441 |  | TA7357 | 340p |
| KIA6213S | 60p | LA4200 | 130p | LA7831 | 85p | LM3916 | 270 p | SAA1060 | 375 | STK0029 | 1000 | STK4192 | 700p | STK7410 | 1500 | STRD5541 | 45 | TA7358 | $85 p$ |
| K1A6210A | 400p | La4201 | 120p | La7832 | 130p | LM8363 | 320p | SAA1061 | 250 | STK0039 | 600 | STK421111 | 1000 | STK7458 | 1250p | STRD6008 | 575p | TA7359P | 90 p |
| K1A6281H | 250p | LA4260 | 230p | LA7835 | 150p | LM8560 | 175j | SAA1062 | 250p | STK004 | 520 | STK4211V | 80 | STK755 | 600 | STRD6009 | 450p | TA7361 | 125p |
| K1A6283K | 150 | L44261 | 300 | La7837 | 150 | LM13600 | 150 p | SAA1063 | 250p | STK0049 | 510 | STK422111 |  | STK7561 |  | STRD6018 |  | TA7362 | 150p |
| K1A6299\％ | 210 | L44265 | 125 | LA7838 | 200 | LM13700 | 125 | SAA1064 | 275 | STK005 | 440 | STK42311 | 1050 | STK7562 | 100 | STRD6602 | 47 | TA7364P | 176p |
| A7227CP | 200 | LA4270 | 300 | La7850 | 225 | LM18293 |  | SAA1070 | 550 | STK005 | 620 | STK4241 | 1050p | STK756 | 80 | STRD6601 |  | TA736 | 65p |
| $\mathrm{KliAl313}_{\text {Li49V }}$ | 45 | L44282 | 350 p | La7851 | 200 | M491881 | 800 | SAA 1073 | 325 p | STK006 | 820 | STK4241 | 1260p | STK7573 |  | STRM6545 |  | TA7368P | 35p |
| Litict | 300 | LA4420 | 140 | La7910 | 150 | M 49481 | 700 p | SAA1075 | 350p | STK0070 | 1100 | STK4272 | 550 | STK7576 | 1500 p | STRM6546 |  | TA7373F | 150p |
| L165V | 2500 | LA4422 | 130 | La7913 | 35 | M5265P | 200 | SAA1086 | 175 | STK0080 | 1000 p | STK4273 | ${ }^{650 p}$ | STK7703 | ${ }^{1000 p}$ | STRM6549 |  | TA7374 | 175p |
|  | 20 | LM44 | 13 | LA79 | 35 | M50115P |  | SAA1089 |  | STK011 | 33 | － | 65 | SKK825 | ${ }^{1600 p}$ | STRS5941 |  | TA7376P | 100p |
| 1272 M | 110 | LA4440 | 200 | LA7953 | 300 | M50119P | 525 | SAA 1124 | 200 | STK016 | 780 | STK4332 | 36 | STK8260 | 1200 | STRS6307 |  | TA737 | 60 p |
| 1290 | 225 | La4445 | 200p | La9200 | 300p | M50422P | 750 | SAA 1130 | 550 | STK025 | 65 | STK4352 | 600 | STK8280 | 1850 | STRS6308 |  | TA7401 | 250 p |
| L2918 | 300 p | La4446 | 170 | L81205 | 170 p | M50461 | 350 | SAA1250 | 280 p | STK050 | 1600 | STK4362 | 450p | STK73405 II | 55 | STRS6309 |  | TA7402P | 200p |
| L292 | 750 p | L44460 | 120 p | L81216 | 150 p | M50784 | 300p | SAA1251 | 380p | STK077 | 520 | STK4372 | 600 p | STK73410 | 350p | STRS6707 | 100 | 03 | 325p |
|  | $225 p$ | LA4461 | 120p | L81258 | 100p | M50786 | 500 | SAA1271 | 400p | STK078 | 1800 | STK4392 | 500p | STK7340 ！ | 500p | STRS6708 | 575p | TA7404 | 150p |
| L293C | 325p | L44466 | ${ }^{225 p}$ | L81268 | $7{ }^{70}$ | M50790 | 600p | SAA1274 | 280p | STK080 | 55 | STK4412 | 450 p | STK73605 |  | TA7054 |  | TA7405 | 200p |
| L293D | 225 p | L44470 | 300 p | L81274 | 85 p | M51014L | 120p | SAA1290 | 750 | STK082 | 2000 | STK4432 | ${ }^{600 p}$ | STK73907 | 700p | TA7061 | 11 | TA7411AP | 150p |
| L293E | 250 p | La4475 | 226p | L81290 | 120p | M51143AL | 110 | SAA1293 | 550 | STK084 | 60 | STK4773 | 820 p | STK78617 | 2400p | TA7062 | 20 | TA7415P | 350p |
|  | 475p | L44476 | 225p | Le1292 | 110 p | M 51161 | 300 | SAA1294 | 800 | STK085 | 90 | STK4793 | 800 p | STR370 | 300 p | TA7066 | 120p | TA7417ap | 225p |
| L2 | 450 6250 | L44480 L44485 | 226 300 | L81407 | 70 p 130 p | ${ }_{\text {M }}$ | 250p | SAA 1310 | 200 | STK086 | 1000 900 | STK4813 | 8000p | STR380 |  | TA7089 |  | 21P | 350p |
|  | 40 | La44 |  | L8140 | 200 | M51164A |  | SAA13 | 275 | STK0100 | 1200 | STK | 85 | STR38 |  | TA7102P |  | TA7607 | 200p |
| L465 | 526 | LA4496 | 2500 | LB1412 | 300p | M51166P | 300 | SAA1351 | 750 | STK420 | 400 | STK4843 | 720p | STR383 | 420 | TA7119 | 150 | TA |  |
| 4482 | 400 | La4498 | 276 | L81415 | 100 p | M51182L | 110 | SAA1900S | 476 | STK430 | 500 | STK 4853 | 1700 | STR384 | 350 | TA7120 | 55p | TA7609 | 170p |
| L4978 | 525 | LA4500 | 200 | L81416 | 85p | M511914 |  | ， 3004 | 400 | STK433 | 400 | STK4863 | 700 | STR440 | 800 | TA7124 | 250p | TA7611 | 210 p |
| L7028 | 400 p | LA4505 | 220 p | L81426 | 125 p | M51231P | 200 | 300 | 2265 | STK435 | 375p | STK4873 | 1100 | STR441 |  | TA7130P |  | TA7612 | 300p |
| 7702N | 325 | L44508 | 200 | L81450 | 110p | M51308SP | 580 | SAA3007P | 130 | STK436 | 43 | STK4893 | 1000 | STR442 | 1600 | TA7137 | ${ }^{60 p}$ | TA7613A | 90 p |
| L2720 | 150 p | LA4510 | 100p | L81615 | 270p | M51310AP | 900 | SAA3008P | 200p | STK437 | 60 | STK4913 | 900p | STRA50A | 700 | TA7140 | 100p | TA7614 | 170p |
| 12722 <br> 4960 | 175 | L44520 | 170 p | L81620 | ${ }_{220 p}$ | M51316P | 300 | 3010P | ${ }^{300}$ | STK439 | 500 | STK5314 | 475p | STR451 | 800 | TA7141 | 825 p | TA7616 | 300p |
| ${ }^{\text {L4960 }} \mathrm{L6203}$ | 325p | LA4550 | 200p | $L 81622$ <br> LB1630 <br> 1863 | $220 p$ $80 p$ | M51320 $M 513568$ | 200 400 | SAA3027P | 375 p $\mathbf{5 5 0 p}$ | STK441 | ${ }_{70} 68$ | STK5315 STK5322 | $500 p$ 500 | STR452 STR453 | 60 | TA7150P | 250p | TA7621 | 300 p |
| L6210 | 250 | L44557 | 150 | LB1639 | 300p | M 51358 P | 150 | SAA4700 | 425 | STK457 | 47 | STK5323 | 600 | STR454 | 1300 p | TA7172P | 15 | 22 | 420 p |
| L6221AS | 300 p | LA4558 | 125 p | L81640 | 150 p | M51365P | 350 | SAA5000 | 200 | STK459 | 56 | STK5324 | 450 p | STR455 | 550p | TA7193 | 320p | TA7628 | ${ }_{\text {120 }}^{110}$ |
| $\underline{6508}$ | 300p | L44570 | 130p | L81641 | 75 p | M51366P | 360 | SAA5010 | 220 | STK460 | 860 | STK5325 | 370 | STR456 | 470 | TA7200 | 200 | 7629 |  |
| LA1130 LA1135 | 240 p | L44571 | 175 | L81642 | 150 p | M51381P | 200p | SAA5012 | 400p | STK461 | 60 | STK5326 |  |  |  | TA7205 | 1200p |  |  |
| $\begin{aligned} & \text { LA1135 } \\ & \text { LA1145 } \end{aligned}$ | 120 p 200p | L44581 | ${ }_{1750}^{1750}$ | $L 81645$ <br> $\mathbf{L 1 6 4 8}$ | 100p | M51384AP | 750p 600p | SAA5020 | 350p 440 | STK463 STK465 | 95 | STK5330 STK5331 | 850 p 300 | STR470 STR1096 | 40 | TA7207 TA 7208 | 1250 | TA7632 | $\begin{array}{r}\text { 400p } \\ \mathbf{9 0 p} \\ \hline\end{array}$ |
|  | 150 p | La4620 | 400 p | L81649 | 190p | M51392P | 300p | SAA5040A | 280p | STK501 | 55 | STK5332 | 180 | STR119 | 350 | TA7210 | 200p | TA7641 | 140 p |
| LA1170 | ${ }^{90 p}$ | L44630 | 325 p | L83500 | 125 p | M51393AP | 360p | SAA5040B | 400 | STK561 | 450 | STK5333 | 850p | STR1229 | 325 p | TA7214 | 220p | TA76448P | 480p |
| 177 | 130 p | La4700 | 350p | LC4966 | 65 | M51395AP | 450p | SAA5041 | 560p | STK563 | 415 | STK5335 | 350 p | STR2005 | 400 p | TA7217 | ${ }^{145 p}$ | TA76545P | 65p |
|  | 75 | L44705 | 40 | LC7011 | 500 p | M51397AP | 425 | SAA5042 | 425 | STK583 | 50 | STK53 | 350 | STR20 |  | TA7220 | 220 | TA7658 | 100p |
| LA1186 | 35p | LA5112 | 2000 | LC7120 | ${ }_{350 p}$ | M51496P | 275p | SAA5051 | 400p | STK770 | 400 p | STK5338 | 2950 | STR2015 | 550 | TA7223 |  | TA | 400 p |
| L41201 | 75p | L45511 | 50p | LC7130 | 300p | M51533 | 300p | SAA5052 | 500p | STK772 | 650 | STK5339 | 400 | STR2024 | 575 | TA7225 | 3 |  |  |
| LA122 | $75 p$ | LA5512 | p | LC7131 | 280 | M51544 | 150 | 㖪 | 500 | STK7728 | 480 | 仿 | 350p | STR2105 | 600 | TA7226 | 290p | TA7668 |  |
| LA1207 | 120p | L45522 | 45 p | LC7132 | 400p | M51848 | 150 p | SAA5230 | 850 | STK780 | $675 p$ | STK5342 | 245 p | STR2124 | 675p | TA7227 | 700p | TA7672 |  |
| LA1210 | 140 | LA5523 | ${ }^{150 p}$ | LC7137 | 450 | M54523P | 200 | SAA5231 | 170p | STK795 | 450 | STK5343 | 380 p | STR3105 | 525 p | TA7230 | 100p | ta767676aP | ${ }_{450 \mathrm{p}}^{400}$ |
| LA1230 | 130 p | LA5527 | 150 p | LC7185 | 350 p | M 58484 | 500p | SAA5243PE | 360p | STK1040 | 640p | STK5361 | 375 | STR3115 | 4000 | TA7233 | 1209 | TA7679 | 475p |
| LA1235 | 130 p | LA5530 | ${ }^{65 p}$ | LC7191 | 300p | M51516 | 280 | SAA5244AP | 950p | STK1049 | 700 | STK5362 | 400p | STR3123 | 400 | TA7237 | 300 | TA7680AP | 200p |
| LA1240 | 80p | LA5531 | 65p | LC7207 | 275p | M51518 | 200 | SAA5246AP | 380p | STK105 | 650 | STK5372 | 260 | STR31 | 480 | TA7238 | 40 | ta7681AP | 425p |
| L41245 | $110 p$ | L45537 | 45p | LC7215 | 160p | M51995P | 250p | SAA5246P | 750 | STK1060 | 700 | STK5373 | $375 p$ | STR3130 | 500 p | TA7240 | 160 | ta7687AP | 100p |
| La1260 | 75p | LA5655 | $175 p$ $\mathbf{2 2 5 p}$ | ［C7217 | 350 p 250 p | M51977P M52307P | $300 p$ $900 p$ | SAA5250P | 760 3750 | STK1070 STK1080 | 850p | STK5393 STK5392 | 375 | STR313 | 275 | TA7241 |  | TA7688 | 150p |
| LA12 | 125p | ta5665 | 250p | ［C7230 | 700p | M54646AP | 400 p | SAA7000 | 550p | STK2025 | 620p | STK5421 | 450 p | STR3214 | 275 | TA7243 | 320p | TA7698 | 400 p |
| LA1266 | 130p | LA5667 | 200p | LC7267 | 550p | MB3708 | 275p | SAA7020 | 600p | STK2028 | 500p | STK5422 | 375p | STR3215 | 276p | TA 7245 | 225p | TA7705 | ${ }_{300 \mathrm{p}}^{600}$ |
| LA1267 | 150p | L45700 | 300p | LC7351 | 200p | M 33712 | 600p | SAA7210P | 1300p | STK2029 | 480p | STK543 | 550p | STR3315 | 275p | TA72458PO | 200p |  |  |
| LA1354 | 225p | L46339 | 35 | LC7364 | 200 | M83713 | 130 | SAA7220PA | 550 | STK2030 | 1000 | STK5434 | 570 | 4090 | 650 p | TA7248P | 575p | TA7709P TA7719P | 150 p $\mathbf{2 0 0 p}$ |
| LA1363 | 200p | －46355 | －${ }^{\mathbf{5 0 p}} \mathbf{1 5 0}$ | LC7522 | 425p | MB3714 M 3715 | 265p | SAA ${ }^{\text {S }}$ S2728P | －600p | STK2038 STK2048 | 700p | STK5436 STK5441 | 500 p 400 p | STR4211 | $460 p$ $315 p$ | TA72518P | $325 p$ $325 p$ | TA7727P | 125p |
| LA1365 | 120 | L46515 | 150 p | LC7535 | $300 p$ | M83722 | 200 | SAA9050 | 450 | STK20581V | 1600p | STK5443 | 575p | STR4512 | 400 p | TA7256P | 225p | TA7750 | 200p |
| LA1368 | 220 p | L46520 | 175 | LC7537AN | 400 p | M83730 | 900 p | SAA9057 | 476 | STK2101 | 1050p | STK5446 | 350 | STR5015 | 500 | TA7259P | 225 | TA7757 | 200 p |
| LA1385 | 200p | LA6531 | 250 p | LC7537N | 450 p | M83731 | 220p | SABO600 | 600 | STK2110 STK2125 | 550 | STK54 | 390p | STR STR5200 | 550 | TA7262P | 40 | TA7769 | 38 |
| LA1503 | 120p | La7011 | 220 | LC7565 | 300 p | M83735 | 400 | SA80602 | 6265 | STK2129 | 750 | STK5462 | 5000 | STR5315 |  | TA7 |  | TA7772P | ${ }^{150 p}$ |
| LA1805 | 175p | LA7016 | 45p | LC7582E | 300p | M83756 | 100 p | SAB1009BP | 226 p | STK2139 | $675 p$ | STK5464 | 300p | STR5412 | 280 p | TA7267 | 220p | TA7792P | 250p |
|  | 130 | La7018 | 100p | LC7800 | 175p | MB3759 | 200p | SAB1016 | e00p | STK2155 | 900 p | STK5466 | 500p | STR6020 | 270 | TA7267B | 120 p | TA7796P | 75p |
| LA1851 | 300 p | L47019 | ${ }^{130} \mathrm{p}$ | ${ }^{\text {LC77815H}}$ | $176 p$ | M83771 | 110 p | SAB1046P | ${ }^{350}$ | STK2230 | 470 p | STK5467 | 400 p | STR7001 |  | TA7269 | 260p | TAB101N | 230p |
| LA2000 | 150p | LA7033 LA7042 | ${ }_{2800}$ | ${ }^{\text {LC7818 }}$ | ${ }_{3250}^{280 p}$ | M83773 | 110p | SAB2015P | 525p | STK2240 STK2250 | $740 p$ 8500 | STK5468 STK5471 | 300 p | STR9005 STR9012 | 4000p | TA7270 | 170p | TAB105N | 140 p |
| 2101 | 270p | －47042 | 380\％ | ${ }^{\text {LCC7821N }}$ | 250p | MB8719 $\mathrm{MC1391}$ | 360p 120 p | SAB2022P | 525p | STK3041 | 370p | STK5472 | 375 | STR10006 | 450p | TA7272 | 220p | ta8110ap | 110 p |
| LA2110 | 150p | L47051 | 130p | ${ }^{\text {LC7822N }}$ | 160 p | MC1455 | ${ }^{45 p}$ | SAB3012 | 675p | STK3042 | 375 p | STK5473 | 480 | STR11006 | 325p | TA7273 | 300p | TA8119P | $70 p$ |
| La22 | 190 | L47053 | 130 p | LC78818 | 135 p | MC1488 | $35 p$ | SAB3013 | 200 p | STK3044 | 950p | STK5474 | 500p | STR12006 | 450p | TA7274 | 210 p | tabi22an | 250p |
| L42205 LA2211 | 150p 350p | L47054 LA7060 | 350p 150p | $\underset{\substack{\text { LF347 }}}{\text { LC781M }}$ | 325p $110 p$ | MC1489 MC1496 | 35p 65p | － | $\begin{aligned} & 320 \mathrm{p} \\ & 450 \mathrm{p} \end{aligned}$ | STK3062 STK3082 | 600p 850p | STK5476 STK5477 | $\begin{array}{r} 360 p \\ 450 \mathrm{p} \\ \hline \end{array}$ | $\begin{aligned} & \text { STR13006 } \\ & \text { STR15006 } \end{aligned}$ | 500p 500 p | $\begin{aligned} & \text { TA7279P } \\ & \text { TA7280 } \end{aligned}$ | 325p 190p | TA8127N TA8132AN | 100p 200p |

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| 2 SC1675 | 90p | $2 \mathrm{SC2}$ | 700p | 2 SC 2 |  | 2 Sc 3 | 280\％ | 2 CC 3 | 220p | 2SD25 | 195p | $2 \mathrm{SD8}$ | 40p | 2SD132 | 150 | 2SD17 | 80 p | 2SK312 | 750p |
| $2 \mathrm{SC1678}$ |  | 2s |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | p | 2SK315 | 70p |
| 2 2SC1683 | 10 | 2SC2270 |  | 2sc2724 | ${ }^{150}$ | ${ }^{25 C 3269}$ | 50 p | ${ }^{2 S}$ | ${ }^{70 p}$ | ${ }^{2525291}$ | 250 p | 2 SD | 35 | ${ }^{2 S D 133}$ | 60p | 2SD1765 | 70 p | 2SK320 |  |
| 2 SC1684 |  | 2SC2271 | 25p | 2SC2738 |  | $2 \mathrm{SC3270}$ |  |  |  | ${ }^{2 \mathrm{SD} 313}$ | 25p |  | 75 p |  | 70p | ${ }^{2 S D 1769}$ | 110 p |  | 130p |
| 2SC16 |  | 2SC22 | 15 p | $2 \mathrm{SC2749}$ |  | ， |  |  | 250 |  | 75 |  | 5p | 2SD |  | 2SD17 | 100p |  | 76p |
| $2 \mathrm{SC1729}$ | s00p | $2 \mathrm{SC2275}$ | 50 p | 2 SC 2750 |  | ${ }^{25 C 3277}$ | 280p | 2SC3832 | 135 p | 2SD325 | Op | 2SD89 | 100p | 2SD135 | 150p | ${ }^{2 S D 1776}$ | 70p |  |  |
| 2 SC 1730 | 10p | $2 \mathrm{SC2278}$ |  | 2 SC 2751 | 270p | $2 \mathrm{SC3279}$ |  | 2 CC 3833 | Op | 2 SD 330 | 65p |  | Op | 2SD1376 | 0 p | 2SD1783 | ， | 2SK |  |
| 2 SCl 1735 | 70 | $2 \mathrm{SC2283}$ |  | 2 SC 2752 |  |  |  | 2 S |  | 2S |  |  | 225p | 2SD1378 | 80p | 2SD1785 |  | 2SK363 | 50 p |
| 2SC17 | 10p | 2SC2290 | 1800p | 2SC27 |  | $2 \mathrm{SC32}$ |  |  |  | 2SD3 | 320 | 2S590 |  | 2SD13 |  | 2SD17 | 210 | 2SK364 |  |
| $2 \mathrm{SC1741}$ | 35p | 2SC2291 | 40p | ${ }^{2 S C 2769}$ | 4 | $2 \mathrm{SC3284}$ | 600p | 2SC385 | 220p | 2SD35 | 40 p | 2SD905 | 450 | 2SD138 | 100p | 2SD179 | 120p | 2SK367 | 40p |
| 2 2SC1755 | 90 p | 2 2Sc2298 |  | ${ }^{2 S C 2773}$ |  | $2 \mathrm{SC3293}$ |  | 2S | 220 p | 2 2S358 | P | ${ }^{25 D 916}$ | 130 | 2SD138 | $\mathrm{BOP}^{\text {p }}$ | 2SD1802 | 75 p | 2SK369 | 30p |
| 2 SC 175 | 35 p | 2SC230 |  | 2sc27 |  | 2SC3298 |  |  |  | 2SD3 | 50p | 2S091 |  | 2 SD 13 |  | 2SD18 | $75 p$ | 析 | 00p |
| ${ }^{25 \mathrm{SCl} 1758}$ | 30p | ${ }^{25 C 2308}$ |  | ${ }^{2 S C 2785}$ |  | ${ }_{2}^{2 S C 32}$ | 12 | ${ }_{2}^{25 C 33}$ | 560p | ${ }^{2 S D} 361$ | 100 p | ${ }^{2 S 592}$ |  | ${ }^{2 \mathrm{SD} 139}$ | 350 p | 2SD1812 | 45 p | 2SK374 | 5p |
| $2 \mathrm{2SC1760}$ | 70 | ${ }^{25 \mathrm{SC} 2312}$ |  | ${ }^{2 S C 2786}$ |  |  |  |  | 5p |  | 100p |  |  | 2S | 250 p | 2SD1815 | P | 2Sk386 | 800 |
| ${ }^{25 C 1775}$ |  | $2 \mathrm{SC2314}$ |  | $2 \mathrm{SC27}$ |  |  |  | ${ }^{2} \mathrm{2SC}$ | 200 | ${ }_{2 S}^{2 S}$ |  | ${ }^{25}$ |  | 2SD | ${ }^{850}$ | 2SD18 |  | 2SK | 15 p |
| 2SC17 | 20p | 2SC2316 | 150p | 2 SC 2791 |  | $2 \mathrm{SC330}$ | 13 | 2SC38 | 200 p | 2SD | 50 | 2SD94 |  | 2SD139 | 30p | 2SD18 | 120p | ${ }_{2 S K} 2100$ | \％p |
| $2 \mathrm{SC1789}$ | 100 p | $2 \mathrm{SC2320}$ | 10 p | ${ }^{25 C 2792}$ | 220p | ${ }^{25} 5330$ | 600p | 2SC388A | 5p | 2SD381 | Op | ${ }^{2 S D 950}$ |  | ${ }^{2 S D 139}$ | 120 p | 2SD184 | 70p |  |  |
| 2 2SC1809 | 40p | 2SC2324 |  | 2 SC |  | $2{ }^{2} \mathrm{C}$ |  | 2 S | ${ }_{2}^{210 p}$ | ${ }^{25 D 382}$ | p | 2 2S |  | ${ }^{25 \mathrm{D}} 1393$ | 1200 | 2SD184 | 360p | 2SK405 | 460p |
| ${ }^{2 S C 1810}$ | ${ }^{250}$ | ${ }^{25 C 2328}$ |  | 2SC2808 |  | 2SC3390 2Sc3316 | 1280 | ${ }_{\text {2SC3884 }}$ | 2500 |  | 70 150 | ${ }_{2}^{2 S D 957}$ | ${ }_{60}^{620}$ | ${ }^{2 S D 139}$ | 300p | 2SD1847 2SD184 | ${ }^{2750}$ |  |  |
| 2SC1815 2 SC1819 | 10p | ${ }_{\text {2Sc2310 }}$ | 25p 1750 | 2SC2810 | $360 p$ $40 p$ | 2SC3316 2 Sc 3317 | ${ }_{360 p}^{280 p}$ | $\begin{aligned} & 2 S C 3885 \\ & 2 S C 3885 A \end{aligned}$ | 250p 290p | ${ }_{\text {2SD388 }}$ | 150p | $\begin{aligned} & \text { 2SD958 } \\ & \text { 2SD965 } \end{aligned}$ | 60p $\mathbf{3 5 p}$ | $\begin{aligned} & \text { 2SD1399 } \\ & \text { 2SD1400 } \end{aligned}$ | $\begin{aligned} & 300 \mathrm{p} \\ & 280 \mathrm{p} \end{aligned}$ | $\begin{aligned} & \text { 2SD1849 } \\ & \text { 2SD1850 } \end{aligned}$ | 280p $\mathbf{3 2 5 p}$ | 2SK415 | 600p |
| 2 SC | 6 | $2 \mathrm{SC23}$ |  | 2 SC 2 |  | 2sc3 |  | ${ }_{2 S C 3}$ | 27 | 2SD |  | 2SD9 | 17 | 2 SD |  | 2SD1853 |  |  |  |
| ${ }^{25 C 1827}$ | cop | $2 \mathrm{SC2230}$ |  | ${ }^{2 S C 2824}$ | 75 p | 2 SC 332 |  | 2SC3890 | 150 | 2SD40 | Pp | 2SD972 |  | 2SD14 | 225 | 2SD1856 | 40p | 2SK | 200 p |
| 2 SC 1829 | 500p | 2SC2331 |  | 2 SC 2825 |  | $2 \mathrm{SC33}$ |  | 2 SC | 250p | 2 SD402 | p | $2 \mathrm{SD973}$ | p | 2SD140 | 80p | 2 SD1857 | 75 p |  |  |
| $2 \mathrm{SC1833}$ | 27 | $2 \mathrm{SC23}$ |  | 2SC28 |  | $2 \mathrm{SC3}$ |  | 2 SC | 225p | 2SD | P | 2SD973A |  | 2SD |  | 2SD1858 |  |  |  |
| $2 \mathrm{SC1834}$ | 50 | $2 \mathrm{SC2334}$ | 80p | 2SC282 | 130 | 2 Sc 33 | 25p | $2 \mathrm{SC3895}$ | 325 | 2SD4 | 55 | 2SD983 | 90 p | 2SD14 | 60p | 2 SD 18 | 35p |  |  |
| $2 \mathrm{SC1841}$ | 12p | 2SC2335 |  | ${ }^{2 S C 2832}$ |  | 2 SC |  | 2 SC |  | 2SD42 |  | 硅 |  | 2 2S14 | 125 p | 2 LD | P | 2 S | ${ }^{180}$ |
| $2 \mathrm{SC18}$ | 60 | 2SC2336A |  | ${ }^{2 S C 2834}$ |  | $2 \mathrm{SC3}$ |  | 2SC38 |  | 2SD4 |  | 2SD98 | 120 | 2SD | 170p | 2SD18 |  | 2SK531 |  |
| $2 \mathrm{SC18}$ | 15p | 2SC2344 | 150 | $2 \mathrm{SC28}$ |  | $2 \mathrm{SC3}$ |  | 2SC39 | 25 | 2SD42 | 360p | 2SD998 | p | 2SD14 | 85 | 2SD18 |  | 2SK | 700p |
| ${ }^{25 C 1846}$ | ${ }^{355}$ | ${ }^{25 C 2347}$ |  | ${ }^{25 C 28}$ |  | ${ }_{2} 2$ SC3 |  | 2 SC 392 | 250 | ${ }^{25 \mathrm{SD} 43}$ | 5p | ${ }^{2 S D 1010}$ | P | 2SD141 | 75 | 2 2S187 | ${ }^{2750}$ | 2SK537 |  |
| 2SC184 | 45p | 2SC2353 |  | $2 \mathrm{SC285}$ |  | 2 SC |  | ${ }^{2} \mathrm{SC} 3$ |  | 2 SD |  | 2SD1012 | 40 | 2 SD1413 | ${ }^{60}$ | ${ }^{2 S D 18}$ |  | 2 S | 350p |
| 2 SC |  |  |  |  |  |  |  | ${ }^{25} \mathrm{~S} 39$ |  |  | 15 | 2SD10 | ${ }^{40}$ | 2SD1 | 190 | 2SD1 |  |  |  |
| $2 \mathrm{SC185}$ | 25p | 2 sc 2361 | 150 p | ${ }^{25 C 2877}$ | 12 p | ${ }^{25 C 335}$ | 120p | ${ }^{2 \mathrm{SC} 3944}$ | op | 2SD473 | Op | 2 2S1021 | 120 | $2 \mathrm{SD141}$ | ${ }^{750}$ | ${ }^{2 S D 1884}$ |  | 2S |  |
| ${ }^{25 C 1865}$ | 700p | $2 \mathrm{SC2362}$ |  | ${ }^{25 C 2878}$ |  | $2 \mathrm{SC335}$ |  | ${ }^{2 S C 3950}$ | p | ${ }^{2 S D 476}$ | ${ }^{\mathbf{0 0 0 p}}$ | 2SD1022 |  | 2SD1425 2SD142 |  | 2SD1886 2SD 188 |  | 2 Sk | 80p |
| ${ }_{2 S}^{2 S C}$ |  | ${ }_{\text {2SC23 }}$ |  | 2SC28 |  | 2SC3 | 300 60 | $\xrightarrow{2 \text { 2SC3 }}$ |  | ${ }_{2}{ }^{2 S D 552}$ | 70p | ${ }^{\text {2SD102 }}$ | 85 | 2SD1 |  | 2 SD 1 |  | ， | 225p |
| $2 \mathrm{Cli8}$ | 220 | ${ }_{2 S C 2371}$ | P | 2SCz8 |  | 2Sc33 | （120p | 2Sc39 |  | 2SD545 | Pp | 2SDio3 | 76 p | 2SD14 | 180 | 2SD189 | 225 p | 2SK | 320p |
| $2 \mathrm{SC188}$ |  | $2 \mathrm{SC2373}$ | 210p | 2 SC |  | 2 SC 3 |  | 2SC39 | 25 | 2SD |  | 2 2SD |  | 2SD143 |  | 2 2D19 | 175p | 2SK | 500p |
| $2 \mathrm{SCl18}$ |  | 2sc23 |  | 2SC28 |  | 2 SC | 130 | 2SC39 | 21 | 2SD |  | 2SD1 |  | 2 SD |  | 2SD1 | 300p | 2SK | 400p |
| ${ }^{2 S C 1895}$ | 500p | 2SC23 |  | 2SC29 |  | $2 \mathrm{SC33}$ |  | $2 \mathrm{SC397}$ | 210 | 2 SD 55 |  | 2SD104 |  | 2SD143 |  | 2 2S1913 | Op | 2SK559 |  |
| $2 \mathrm{SC19}$ | 125p | 2 SC2407 | 110 p | $2 \mathrm{SC29}$ | 25p | $2 \mathrm{SC33}$ |  | $2 \mathrm{SC39}$ | 160 | ${ }^{2 S D 555}$ | 50 | ${ }^{2 S D 1047}$ |  | ${ }^{2 S D 143}$ |  | 2 SD 1929 | 60 p | 2S |  |
|  |  | $2 \mathrm{SC2}$ |  | ${ }^{2 S C 29}$ |  |  |  | ${ }^{25 C 3}$ |  | ${ }^{2 S 55}$ | 220 | ${ }^{2} 5$ |  | 2 SD |  | ${ }^{25 D 1}$ | 50 p | 2SK566 | 476p |
| $2 \mathrm{2SC190}$ | ， | ${ }^{25 C 24122}$ |  | ${ }^{2 \mathrm{SC} 2912}$ | 120 | ${ }^{25 \mathrm{SC} 3}$ | ${ }^{50}$ | ${ }^{25} 5399$ | 1250 | ${ }^{2 S D 558}$ | ${ }_{500}$ | 2SD105 |  | ${ }^{2 S D 143}$ | ${ }_{2005}^{1850}$ | ${ }^{25 D 1933}$ |  |  |  |
| 2 SC 19 |  | 2SC240 2SC245 |  | 2SC292 |  | ${ }_{2 \mathrm{LSC34}}^{2}$ |  | ${ }_{2 S}^{2 S C 3998}$ |  | ${ }_{2}$ 2SD569 | p | ${ }_{2}^{2 S D 106}$ |  | ${ }^{2 S D 144}$ | 22 | $\begin{aligned} & \text { 2SD1939 } \\ & \text { 2SD1941 } \end{aligned}$ |  | 2Sk |  |
| ${ }_{2 S C 19}$ |  | 2 S |  |  |  |  |  | ${ }_{2 S}$ |  | 2SD5 | 6309 | 2SD1 |  | ${ }_{2}$ 2S |  | ${ }^{2 S D 19}$ |  | 2SK6 | 950p |
| 2 SC 19 | 15p | 2SC24 | 56p | $2 \mathrm{SC29}$ |  | 2 SC | p | 2SC40 | 32 | 2SD5 | 25p | 2SD106 | 250 | 2SD14 |  | 2SD195 | 80p | 2SK | 16 |
| 2 SC 19 |  | 2SC248 | 275p | 2SC29 |  |  |  | 2SC40 |  | $2 \mathrm{SD5}$ | 25p | 2SD106 | 180 | 2SD1 |  | 2SD19 | 210p | 2SK |  |
| 2 SC 19 |  | 2 SC |  | 2SC2934 |  | 2 SC |  | 2sc40 |  | 2 2Sb | 30p | 2SD1 | 15 | 2SD |  | 2SD19 | 50p | 2SK719 | 300p |
| $2 \mathrm{SC1929}$ | 180 p | ${ }^{2 S C 247}$ |  | ${ }^{25 C 29}$ |  | ${ }^{25 C 34}$ |  | $2 \mathrm{SC4} 4$ |  | ${ }^{2 S D 6}$ | 40 p | 2 SD 10 |  | $2 \mathrm{SD145}$ |  | 2 2SD1 | 0p | 2SK7 | 500p |
| 2 SC 19 | 110 p | ${ }^{2 S C 2481}$ | 120 p | 2SC293 |  | 2 SC 34 | ${ }^{120}$ | 2SC40 |  | 2 SD 60 | 50 | ${ }^{25103}$ | 375 | $2 \mathrm{2SD145}$ |  | 2 2SD1 |  | 2SK725 | 650p |
| 2 SC 19 | 27p | 2 Sc 2 |  | 2SC294 |  | $2 \mathrm{SC34}$ |  | $2 \mathrm{SC4}$ | 40 | 2SD61 | ${ }^{50}$ | 2 2S109 |  | ${ }^{2 S D 14}$ |  | ${ }^{251} 1$ |  |  |  |
| ${ }_{2} \mathbf{2 S C 1 9}$ |  | $2 \mathrm{SC24}$ | 120 p | ${ }_{2 S}^{2 S C 29}$ |  | ${ }_{2 S C 3}$ |  | ${ }_{2 S C 406}^{2 S C 4}$ | 14 | 2SD6 |  | 2SD111 | ${ }_{2}^{2250}$ | $2 \mathrm{2SD145}$ |  | 2 SD2006 |  |  |  |
| $\left[\begin{array}{l} 2 \mathrm{SC} 19 \\ 2 \mathrm{SC} 19 \end{array}\right.$ | 350 | 2SC24 | ${ }_{\text {100p }}^{185 p}$ | ${ }^{2 \mathrm{LSC} 299}$ |  | ${ }_{2 S c 34}^{2 S C 34}$ |  | ${ }_{\text {2SC410 }}^{2 \text { 2S } 4107}$ | ${ }^{180 p}$ | ${ }_{\text {2SD617 }}$ | ${ }_{7} 70$ | l $\begin{aligned} & \text { 2SD1111 } \\ & \text { 2SD1113 }\end{aligned}$ | 22 | ${ }_{2}^{2 S D 14}$ | 60 | 2SD2006 2 SD 2010 |  | 2SK |  |
| 2 SC |  | $2 \mathrm{SC24}$ |  | ${ }^{2 S C 29}$ |  | ${ }_{2 \mathrm{SC}}$ |  | 2SC4 |  | 2 SD63 | 10p | 2SD112 |  | 2SD1 | 40p | 2 2D201 | 60p | 2SK | 300p |
| $2 \mathrm{2SC19}$ | 45 | ${ }^{25 C 2498}$ | ${ }^{50}$ | ${ }^{2 S C 298}$ | 150 | $2 \mathrm{SC3}$ | 150 p | 2 2SC4122 | 20 | 2SD6 | 15p | 2SD11 | ${ }^{66 p}$ | 2 SD 14 | 225 p | 2SD201 | 50p | 2SK7 |  |
| $2 \mathrm{SC195}$ |  | ${ }^{25 C 2500}$ |  | ${ }^{251295}$ |  | ${ }^{2 \mathrm{SC}} 3$ | 130 p | ${ }^{2 \mathrm{SC} 4125}$ |  | ${ }^{25063}$ | ${ }^{15 p}$ | ${ }^{2511135}$ |  | 2SD14 |  | 2 2SD2018 | P | 2SK7 |  |
| 2 SC 195 |  | $2 \mathrm{SC2502}$ |  | 2 SC 2999 |  | 2 SC | 200 | $2 \mathrm{SC41}$ | 40 p | ${ }^{25 D 63}$ | ${ }^{20 p}$ | ${ }^{2 S D 1138}$ | $4{ }^{40}$ | 2 SS 1 | 30 | 2SD20 | p | 2SK787 | 800p |
| ${ }^{2 \mathrm{SCC} 195}$ | 175 | ${ }_{2}^{25 C 2503}$ | 20p | ${ }_{2}^{2 S 53091}$ | 14 | $2 \mathrm{SC3}$ | 125 p | ${ }_{2}^{2 \mathrm{SC4} 4138}$ | 200 | 2SD6 | 360 | 2SD14 | 500 | ${ }^{2 S D 14}$ | ${ }^{2350}$ | 2SD2061 | 1090 | 2SK791 |  |
| $\begin{aligned} & 2 \mathrm{SC} 19 \\ & 2 \mathrm{SCl} 19 \end{aligned}$ | 11 | ${ }_{2 S C 25}^{2 S C 25}$ | ${ }_{120}^{20}$ | ${ }_{2 S C 30}^{2 S C 30}$ | 14 | ${ }_{2 S C 34}$ | 180p | ${ }_{\text {2SC4 }}$ | ${ }_{10}^{40}$ | 2SD6 | 18 p 00 p | 2SD114 | 350p | 2SD1497－920 | p | ${ }_{\text {2SD2066 }}$ | 250p $\mathbf{1 8 0 p}$ | 2SK792 | \％p |
| 2 S |  | 2 |  |  |  |  |  | $2 \mathrm{SC4}$ |  |  | 25p | 2SD1 | 17 | 2SD15 | 50 | 2 SD 21 |  |  |  |
| 2 SC 197 | 100 | ${ }^{2 S C 2527}$ | 300p | 2 SC 3025 | 500 | $2 \mathrm{SC3}$ | 225p | ${ }^{2 S} 4169$ | 60p | 2SD6 | 20p | 2SD115 | 30p | 2SD15 | 60p | 2SD21 | 35p | 2SK794 | ${ }^{315 p}$ |
| 2 SC 19 |  | $2 \mathrm{SC253}$ |  | 2 SC 302 |  | $2 \mathrm{SC3}$ | ， | ${ }^{2 S C 4199}$ |  | 2SD66 | P | $2 \mathrm{SD1159}$ | ， | 2SD150 | 100p | 2SD2151 | 1750 | 2SK |  |
| 2 SC 19 |  | 2 SC 25 | 300 | $2 \mathrm{SC30}$ |  | 2 SC | 30 | ${ }^{2 S C 4204}$ |  | 2SD67 | 35 | 2SD119 | 162 | 2SD15 | $76 p$ | 2SD2255 | 175 p |  | 50p |
| $2 \mathrm{2CC1} 97$ | 150 | ${ }^{2 S C 2538}$ | 100p | ${ }^{25 C 30}$ | 12 | ${ }^{2} \mathrm{~S} 3$ | 27 | ${ }^{25 C 42}$ | 550 | 2SD6 |  | ${ }^{2 S D 1163}$ | 220 | 2SD | 250 p | 2 SD 2 |  | 2SK8 |  |
| 2 SC 19 |  | ${ }^{2 S C 2540}$ | 㖪 | ${ }^{2 S C} 303$ |  | 23c5 |  | ${ }^{2 S C 4235}$ |  | 2 2SD7 |  | ${ }^{\text {2SD1164 }}$ | 75 | 2SD152 | p | ${ }^{25 D 23}$ | 1500 | SK8 |  |
| $2 \mathrm{SC19}$ |  | 2SC2542 | ， | 2 SC 303 |  | $2 \mathrm{SC35}$ |  | ${ }^{2 S C 4236}$ | 45 | ${ }^{2 S D 7}$ | ${ }^{850}$ | ${ }^{25 D 1168}$ | 27 | $2 \mathrm{2SD15}$ | ${ }^{450}$ | 2SD23 | ${ }^{2255}$ | 2Sk |  |
| $2 \mathrm{SC19}$ |  | ${ }^{2 S C 254}$ |  | 2 SC 30 | 280 p | $2 \mathrm{SC35}$ |  | $2 \mathrm{SC42}$ | 500 | 2SD7 | 24 | ${ }^{2 S D 1169}$ | 28 | ${ }^{25 D 1}$ |  | ${ }^{2 S J 48}$ |  |  |  |
| 2 SCl 198 | 1500 | ${ }^{2 S C 2546}$ |  | ${ }^{2 S C 304}$ |  | ${ }^{25 C 35}$ | 120 p | ${ }^{25 \mathrm{SC4242}}$ | 120 | ${ }^{2 S D 723}$ | 20 | 2SD1173 | 360 | 2 2SD15 |  | 25174 |  | 2SK | 475p |
| 2 SC 198 |  | 2SC2547 |  | ${ }_{2 S C 30}^{2 S C 3}$ |  | ${ }_{2 S C 35}^{2 S C 35}$ | 240 | 2SC4278 2SC4288 |  | ${ }_{2 S D 731}$ |  | 2SD1185 | 280 | ${ }^{2} 2$ 2SD15 | ${ }_{36}^{27}$ | ${ }_{\text {2SJJ7 }}$ |  |  |  |
| 2 SC 2 |  | 2SC25 |  | － |  |  |  | ${ }^{2 S C 4}$ |  | 2SD7 | 26 | 2SD11 | ${ }_{65 p}$ | 2 2S |  | 2S |  | 2SK | p |
| $2 \mathrm{SC20}$ |  | $2 \mathrm{SC255}$ | ， | 2 SC 30 |  | 2SC35 | 76 | ${ }^{2 \mathrm{SC4} 4301}$ |  | 2SD734 | 15 p | 2 2SD191 | 120p | 2SD155 |  | 2S．J79 | 225p | 2SK9 |  |
| 2SC20 | 20p | 2 SC 255 | P | $2 \mathrm{SC30}$ | 25p | $2 \mathrm{SC35}$ | 17 | $2 \mathrm{SC4304}$ | 22 | 2SD74 | 12 | 2SD1192 | 90p | 2SD155 | 16 | 2 SJ 103 | $75 p$ | 2SK952 |  |
| 2SC20 |  | 2SC25 |  | $2 \mathrm{SC30}$ | 10 | 2 SC | 20 | $2 \mathrm{SC43}$ |  | 2 2SD7 |  | 2SD119 | 150 p | 2SD1 | 2255 | $2{ }^{251109}$ |  | 2SK955 | Premer |
| $2 \mathrm{2SC2022}$ | 110 | ${ }^{2 S C 25}$ |  | C307 |  | 2SC35 | ${ }^{260}$ | ${ }^{25 \mathrm{Sc} 438}$ |  | 2 2SD7 |  | 2 2SD19 |  | 2SD15 |  | ${ }_{2 S}^{2 S 1113}$ |  |  |  |
| $2 \mathrm{SC202}$ | 180 p | ${ }^{2 S C 2563}$ | 200 p | ${ }^{2 S C} 30$ | 150 | ${ }^{25 C 35}$ | 750 | ${ }_{2}^{2 S C 4388}$ | 20 | ${ }^{2 S D} \mathbf{2} 76$ |  | 2SD119 | 60p | $2 \mathrm{LSD15}$ | 170 p | 2SJ11 | 1150 | 2SK9 | 700p |
| $2 \mathrm{SC202}$ |  | ${ }^{25 C 2558}$ | 120 | 2SC30 | 120 | 2SC35 | 750 | ${ }^{25 C 4}$ | 27 | 2SD76 |  | ${ }^{2 S D 120}$ | ${ }_{280}^{40}$ | ${ }^{2 S D 1}$ |  | $2 \mathrm{SJ11}$ |  |  |  |
| $2 \mathrm{2SC20}$ | 200 | ${ }^{25 \mathrm{SC} 2}$ |  | ${ }^{2} 2 \mathrm{SC} 3$ | 150 | $2 \mathrm{2SC}$ | 200 | ${ }_{2 S}^{2 S C 43}$ | 425 | 2SD7 |  | 2SD121 |  | $\begin{aligned} & 2 \mathrm{SDI} \\ & 2 \mathrm{SDD} \end{aligned}$ |  | ${ }_{2 S J 1}^{2 S J}$ |  | 2SK | 60 p |
| $2 \mathrm{SC20}$ |  | ${ }^{2 S C 25}$ | 360 p 110 p | ${ }_{\text {2SC31 }}$ | 76 | ${ }_{2 S C 35}^{2 S}$ | 270p | ${ }_{\text {2SC4429 }}$ | 276p | ${ }_{2 S D 772}$ | 200p | ${ }_{\text {2SD1213 }}$ | 220p | ${ }^{2 S D 15}$ | 250p | ${ }_{2 S J 16}$ |  | 2SK1 |  |
| $2 \mathrm{SC2}$ | 12 | $2 \mathrm{SC25}$ | 170 | $2 \mathrm{SC31}$ |  | 2SC35 | 200 | 2SC44 | 90 | 2SD7 | 20p | 2SD1218 | 75p | 2SD1 | S0p | 2SJ17 | 20 | 2SK10 |  |
| ${ }^{25 C 2055}$ | 15 | ${ }^{2 S C 257}$ | 170 | ${ }^{25 C 31}$ |  | $2 \mathrm{2SC35}$ | 275 p | ${ }^{2 S C 446}$ | ${ }^{325 p}$ | 2SD77 |  | 2 SD122 | 75 | 2SD1 | 80 p | 2SJ1 | 160p | 2SK |  |
| $2 \mathrm{2S}$ |  | ${ }^{25 C 2580}$ | ${ }^{176 p}$ | ${ }^{2 S C 31}$ | ${ }^{750}$ | ${ }^{2 S C 35}$ | 200 p | ${ }^{25 C 4467}$ | 176 | ${ }^{2 S D 777}$ | 400 | ${ }^{\text {2SD1225 }}$ | 70p | ${ }^{2 S D 15}$ | ${ }^{100 p}$ | ${ }^{25} 5200$ | ${ }^{625 p}$ | 2SK10 |  |
| $2 \mathrm{2SC2}$ | 40 | 2SC2581 | 225 | $2 \mathrm{SC31}$ | 120 | $2 \mathrm{CC35}$ | 200p | ${ }^{2 S C 4468}$ | 250 | 2SD784 | 650 | ${ }^{2 \text { 25D } 1227}$ | 40 p | 2 2S15 | 310p | ${ }^{2 S J 307}$ | 175p | 2SK11 | ${ }^{375 p}$ |
| $2 \mathrm{SC2}$ | 78p | 2SC25 | ${ }_{400}^{600}$ | ${ }^{25} 531$ |  |  | ${ }_{75} 22$ | ${ }_{2 S C 4517}^{2 S 4517}$ | 200 | 2SD78 | 20 | 2SD122 | 260p | ${ }^{\text {2SD15 }}$ | ${ }^{1250}$ | 2SK19 | 400 | 2SK |  |
| 2SC20 | 140p | ${ }_{\text {2SC25 }}$ | ${ }_{60 p}^{40}$ | ${ }_{2 S}$ | 186 | ${ }^{2 S C 35}$ | 140p | ${ }^{2 S C 4531}$ | ${ }^{2250}$ | ${ }_{2 S D 788}^{2 S D 87}$ | 20p | ${ }_{\text {2SDI238 }}$ | 300p | ${ }_{2 S D 160}$ | 210p | ${ }_{2 S K 40}^{2533}$ | S0p | ${ }^{25 K}$ | ${ }^{2255}$ |
| 25 C 20 | 40 | $2 \mathrm{SC25}$ | 200p | ${ }^{25 C 31}$ | 100 | 2 SC 3 | $175 p$ | ${ }^{2 \mathrm{SC} 4532}$ | 1000 | $2 \mathrm{SD789}$ | 20p | 2SD1244 | 25 p | $2 \mathrm{2S1}$ | 46 p | ${ }^{25555}$ | 100p | 2 |  |
| 25 C 2075 | 95 | ${ }^{25 C 2603}$ | 00p | ${ }^{25 C 315}$ | 130 p | ${ }_{2 S C 36}^{2 S 56}$ | 150 | ${ }^{2 S C 4542}$ |  | ${ }^{2 S D 792}$ | ${ }_{4}^{400}$ | ${ }^{25 D 1246}$ |  |  |  | 2SK68 | 7 p |  |  |
| 2SC2078 2SC2085 | 95p | ${ }^{2 S C 2610}$ | ${ }^{60 p}$ | ${ }_{2 S C 315}^{2 S C 315}$ | ${ }^{170 p}$ | ${ }_{2 S C 36}^{2 S C 360}$ | $160 p$ | 2SC4744 | ${ }_{360}^{276}$ | （e） $\begin{aligned} & \text { 2SD794 } \\ & \text { 2SD795A }\end{aligned}$ | 33 p 140 p | 2SD1247 | －${ }_{\text {180p }}^{40}$ | ${ }^{2 S D 163}$ | 60p $40 p$ | 2SK13 | 75p | 2SK12 |  |
| $2 \mathrm{SC20}$ |  | $2 \mathrm{SC26}$ | P | $2 \mathrm{SC31}$ | 36 | 2 SC 36 | 5 | $2 \mathrm{SC4745}$ | 55 | 2SD798 | 175 | 2SD1254 | 65p | 2 2S16 | 280 p | 2SK106 | 40 p | 2SK122 | 200 |
| 2 SC | 100p | $2 \mathrm{SC262}$ | 190p | ${ }^{25 C 31}$ | 200 | ${ }^{25 C 363}$ | 280 | ${ }^{2 S C 4747}$ | 375 | ${ }^{250799}$ | P | ${ }^{25 D 1263}$ | 90 p | ${ }^{2 S D 165}$ | ${ }^{180 p}$ | ${ }^{2} \mathrm{SK} 107$ | 40 p | 2Sk | $276 p$ |
| $2 \mathrm{2S}$ | 1200 | $2 \mathrm{SC26}$ | ${ }^{6000}$ | ${ }^{25 C 31}$ | 28 | ${ }^{25 C 364}$ | ${ }^{225 p}$ | ${ }^{25 C 4757}$ | 20 | $2 \mathrm{2SD809}$ | 5 p | 2 2S1264 | ${ }^{65 p}$ | 250165 | ${ }^{1550}$ | 2SK109 | 150 | 2561296 |  |
| $2 \mathrm{SC209}$ | 2300 | 2 SC2630 |  | $2 \mathrm{SC31}$ | 20 | ${ }^{2 S C 36}$ | 40 | ${ }^{2 \mathrm{SC} 4762}$ | 300 | 2SD81 |  | ${ }^{251265}$ | 75 p | 2SD | 25 | 2SK117 |  | 2Sk |  |
| $2 \mathrm{2SC209}$ | 25 | ${ }^{2 S C 263}$ | ${ }^{20}$ | $2 \mathrm{2S}$ | 27 |  | 800 p | $2 \mathrm{2SC}$ | 220 p | $2 \mathrm{2SD}$ | ${ }^{360 p}$ | ${ }^{25 D 12}$ | 65p | 2SD | cisiop | 2SK118 | 100p | 2SK13 |  |
| （2SC2118 |  | ${ }^{2 S 5 C 2632}$ | 35 p 10p | ${ }_{2 S 317}^{2 S C 316}$ | 300 | ${ }_{2 S C 36}^{25 C 36}$ | 100 | 2SC4820 | ${ }_{\text {225p }}^{260 p}$ | ${ }_{2 S D 821}^{2 S D 20}$ | 250p | ${ }^{2581267}$ | ${ }_{56 \mathrm{p}}^{65 p}$ | ${ }_{2}^{2 S D 166}$ | 120p | 2SK133 | 100p | 2SK1338 | 250 |
| 25 C 2122 |  | ${ }_{2}$ SC2636 |  | $2 \mathrm{SC31}$ | 180 | $2 \mathrm{SC36}$ | 280 | ${ }^{2 S C 482}$ |  | $2 \mathrm{SD82}$ | 290 | ${ }^{2 S D 1271}$ | 225 p | ${ }^{2} 516$ | 90p | 2 2K147 | 180p | ${ }^{25 K 1341}$ | ${ }^{\text {soop }}$ |
| 25 C 2131 |  | 2 SC2637 | 120p | 2sc3 | 260 | $2 \mathrm{SC36}$ | 140 | $2 \mathrm{SC4}$ |  | 2s082 | P | ${ }^{25 D 1272}$ | 200p | ${ }^{25 D 1}$ | p | ${ }^{25 K 152}$ | 40p | 25K |  |
| $2 \mathrm{SC2141}$ |  | ${ }^{25 C 2540}$ | 1800 | ${ }^{25 C 31}$ | 125p | ${ }^{2 S C 36}$ | 38 | ${ }^{25 \mathrm{SC4923}}$ | 40 | ${ }^{2 S D 829}$ | 375p | ${ }^{25 D 1273}$ | 50 | ${ }^{25 D 167}$ | 200 | ${ }^{25 K 161}$ | 30 p | ${ }^{256135}$ | 200p |
| ${ }^{25 \mathrm{C} 2153}$ | 40 p | ${ }^{25 C 2653}$ | 100 | ${ }^{25 C 317}$ | 70p | ${ }^{2 S C 36}$ | 45 | ${ }^{25 C 4923}$ | 250 | ${ }^{2 S D 836}$ | ${ }^{60 p}$ | ${ }^{25 D 1274}$ | 80 | ${ }^{25 D 168}$ | 2258 | ${ }^{2 S K 163}$ | 40 p | 2SK135 | 225p |
| ${ }^{25 C 21}$ | ${ }^{80}$ | ${ }^{25 C 2}$ |  | 2sc3 |  | $2 \mathrm{SC36}$ | S00 | ${ }^{25 \mathrm{C} 492}$ | 500p | ${ }^{25 D 83}$ | 60p | ${ }^{2512}$ | 60 | 2 SD 1 | P | 2SK | 40 p | 25K1357 |  |
| $25 \mathrm{SC2168}$ | ${ }^{120}$ | ${ }^{2 S C 2655}$ | 650 | ${ }_{2}^{253181}$ | ${ }_{1200}$ | 25 C 3688 | ${ }_{560} 5$ | ${ }^{25 C 5002}$ | 300 p | ${ }_{2}^{2 S D 837}$ | ${ }_{500}^{55 p}$ | 2581276 | 60p | ${ }^{25 D 1684}$ | 70p | 2SK170 | 50 p | 2SK135 |  |
| $2 \mathrm{SC2188}$ | 70 p | 2 2S2656 | 650p | 2SC3182 | 120 p | ${ }_{2 S C 3692}^{25 C 375}$ | 160 | ${ }_{2}^{2 S C 50027}$ | ${ }^{350}$ | ${ }_{\text {2SDB34 }}$ | 500p 110 p | 2SD1277 | 1900 | 2SD170 2SD170 | 325p 400 p | 2SK184 | 35p 460 | 2SK1377 | 180 p |
| $2 \mathrm{SC22}$ | 25 | $2 \mathrm{SC26}$ | 研 | $2 \mathrm{LC3}$ |  | $25 C 37$ | 480 | ${ }_{2} 2 \mathrm{SC502}$ | 100 | 2SD841 | 110 p | ${ }^{25 D 1279}$ | ${ }_{175}$ | 2 SD 17 | ${ }^{4700 p}$ | ${ }_{2 S}$ 2Sk193 | 45 |  |  |
| 2SC2209 | 50p 60p | ${ }^{2 S C 2665}$ | 200 p 10 p | 2SC3199 | ${ }_{20}{ }^{\text {20，}}$ | ${ }_{2 S C 3729}^{25 C 3717}$ | 120 p 460 p | 2SC5044 | 300p 250p | 2SD844 2SD850 | 200p | ${ }^{25 D 1288}$ | 175p 250p | 2581708 2581710 | 375p 200p | ${ }^{\text {2SK193 }}$ | 150p | 2 SK 140 | 290 |
| $2 \mathrm{SC2221}$ |  | $2 \mathrm{SC2}$ | 100p | ${ }^{2} \mathrm{SC32}$ | 120 | $25 C 3746$ | 100 | $2 \mathrm{SC5086}$ | 250 p | $2 \mathrm{SD856}$ | 48 p | 2SD1291 | 280p | ${ }^{25 D 171}$ | $278 p$ | 2SK197 | 140p | 2SK 146 | 220p |
| 2SC2228A |  | $2 \mathrm{SC26}$ | 170 | 咗 |  | $2 \mathrm{SC3747}$ | 120p | $2 \mathrm{SC5129}$ | 30 | 2SD85 | 250 p | 2SD1292 | ${ }^{60} \mathrm{p}$ | 2SD172 | 230p | 2SK212 | ${ }^{35}$ | 2SK1462 | 425p |
| 25 C 2229 | ${ }^{15 p}$ | ${ }^{25 C 2682}$ | $7{ }^{70}$ | ${ }^{25 C 3211}$ | 220 p | $25 \mathrm{C3748}$ | 1000 | 2 2C5148 | 300 | ${ }^{25 D 863}$ | 23p | 2SD1293 | 70 p | 2SD1730 | 275 | 2SK214 | 170p | ${ }^{25 K 148}$ | 250 p |
| 25 C 2230 |  | $2 \mathrm{SC2688}$ | 27p | $2 \mathrm{SC3212}$ | 280 | ${ }^{25 C 3752}$ | 250 p | ${ }^{2 S C 5149}$ | 300 | ${ }^{258884}$ | 200 p | ${ }^{25 D 1297}$ | 300p | 2SD1732 | 250p | ${ }^{\text {2SK216 }}$ | 200p | 2SK15 | 300p |
| 2S |  | 25 C 26 |  | $2 \mathrm{SC3}$ |  | $2 \mathrm{SC37}$ | 150p | ${ }^{2 S C 5250}$ | 30 | ${ }^{25 D 866}$ | 12 | ${ }^{251202}$ | 20 p | ${ }^{25 D 1739}$ | ${ }^{1805}$ | ${ }^{25 \mathrm{SK} 223}$ | 60p | 2SK 1529 | 700p |
| $2 \mathrm{SCC2235}$ |  | 25C2694 | 3500 p | ${ }_{2 S C 3242}^{2542}$ | ${ }^{300}$ | ${ }_{2 \text { 2SC3782 }}$ | 75p |  |  | ${ }^{25 \text { 25866A }}$ |  | 2SD1306 |  |  |  |  |  | 25 K 1 |  |
| ［2SC2236 | ${ }_{540 \mathrm{p}}^{20}$ | 2SC2705 2SC2706 | ${ }^{450}$ | ${ }_{\text {2SC3246 }}$ | 45p | 2SC3783 $2 \mathrm{SC3787}$ | 300p | 2SD198 2SD199 | 140p | 2SD867 | 360 p $\mathbf{2 6 0}$ | ${ }_{\text {2SD }}$ | 80p | 2SD1748 | －975p | 2SK246 |  | 2SK1544 | 90 |
| 2 SC | 45 |  | 26 | 2SC325 | 350p | 2 CC 37 |  | $2 \mathrm{SD200}$ | 180 | ${ }_{\text {2SDB69 }}$ | 150 p | 2SD1310 | 140 p | 2 2SD175 |  | 2SK300 | 25p | 2SK1767 | 275 |
| $2 \mathrm{SC2240}$ | 15 p | 25 | 20 p | 2 sc 3 | p | 25 | 75p | 2SD20 | 20p | 2SD8 | 40p | 2SD1311 | ${ }^{65 p}$ | 2sis | Sop | 2s | P | 2SK203 | 295p |
| 2SC2258 <br> 2SC2259 | 30p | （ $\begin{aligned} & \text { 2SC2714 } \\ & \text { 2SC2716 }\end{aligned}$ | ${ }_{\text {S0p }}$ | $2 \mathrm{SC3261}$ 2SC3262 | 230 p 280 p | 2SC3790 2S 39795 | 120p | 2SD213 2SD234 | 900 | 2S8871 2SD879 | 600p | 2SD1313 2SD1326 | 200p | 2SD1761 2SD1762 | 60p | SKK304 | 2 pp | 2SK2 | 22 |

REPLACEMENT VIDEO HEADS

| Model Price | Price | Model Pric | odel | Model Pric |
| :---: | :---: | :---: | :---: | :---: |
| AKA | VHSAN3 8 |  |  |  |
|  |  |  |  |  |
| 250, 301, 303, |  |  | N.E.C. <br> N9011, 9012, 9013E, 9014E, 9014G, 9015 , 9016, 901A, 902A, 9033, N9034, 9040, |  |
|  |  |  |  |  |
| 9300, VS9500 | VH |  | 9016, 901A, 902A, 9033, N9034, 9040, 9053, 9054, 9055, 9056, 9063, 9065, 9066, 906, 9077. |  |
|  |  |  |  |  |
|  |  |  |  | VHRDA610, 6700,4800 3100p |
|  |  | , | 2400 p | THR2000, 700,4800 |
|  | VHSTJ1, VHSTJ2, VHSTJ3, VHSWJ3, |  |  | VHR $5300, ~ V H R 6500, ~ V H R 7400 ~$VHR3500 |
|  |  |  |  |  |
| VSF $30,33,4,400,410,420,430,440,441$. |  |  | N834, N835, N83682611AH1 (FOR MODEL DX3000), 700p | VHR3500  <br> VHR16, 235, 335E, 4150, 4160, 4350,  <br> 2250, 7260,3250  <br> VTC 3000 1950 p |
|  | G |  |  | SHARP |
|  |  |  |  |  |
|  |  |  |  |  |
| 15EK, |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | VC200, 220, 300, 381, 383, 384, 385, 386 , |
|  |  |  |  | 387, 388, 471, 477, 481, 482, $V 483,486$, $3300,8381,9100,9300,9400,9500,9600$, |
|  |  |  |  | 8, 208, 382, 402, 405, 408, 500, 550, |
| VSA1100, 1110, 650, VSF500, 510, 550, | MADRID, SE5140, VS540, |  |  |  |
|  |  |  |  | 㖪 |
|  |  |  |  |  |
|  |  |  |  | $700,772,7810,782,7822$, VC783, 8481 8581, VCA10, 100, 102, 103, 1031, 103, 104, 105, 106, |
|  |  | OEK, HRJ415, HRJ416 |  |  |
|  |  |  |  | 211, 234, 244, 254, 255, 30, 35, VCA 40 . VCB311N, 320, VCD801, 802, VCM73, VCT212, 310, 410, VCT510, 72, VCT1314. |
|  | MVS660, SE6160, VERONA, VS660 ${ }_{3}{ }^{\text {V }}$ |  | VR6441, VR6540, VR6541, VR6640. VR6642 1300p |  |
|  | GRUNDIG |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| 100EDG, $100 \mathrm{EM}, 110$, VS 4400 | 崖, 2175, SE220 | MITSUBishl | VR692041DV2, 4 SB 1 18VR412, 415, 6485, 6490 , 2750 p | VC793, VC785, VC786 |
| VS 109, VS603, VS606, vS607 | ARI |  |  | VC699, VCA501, VCA602 2800 p <br> VC58, VC685 $\mathbf{2 0 0 0 \mathrm { p }}$ <br> VC90ET $\mathbf{3 9 0 0 \mathrm { p }}$ <br> VFH815 $\mathbf{2 8 0 0 p}$ <br> VC850  |
|  |  |  |  |  |
|  |  |  | 21DV3, 2SB01, 02, 11, 12, 30DV2, 310VI. 31DV2, 31DV3, 3SB02, 03, 05, 11, 12, 13. |  |
|  |  |  |  | VC800, VCH851, VCH852, |
|  |  |  | 31DV2, 31DV3, 3SB02, 03, 05, 11, 12, 13. 68SB4, 71 SB4, 86SBI, 91 SB2, 92SB2, |  |
|  |  |  | DV186, 190, 291, 292, 468, 471, VR201. 202, 203, 2115, 212, 213, 223, 231, 232, | VCHBO, VCHB1, VFHB15 ${ }^{\text {V/ }}$ |
|  |  |  |  |  |
|  |  |  |  | VCA55, VCA63 2200p <br> VC570  |
|  | VT35, VT350, VT38, VT39 $\quad$ 2300p |  |  |  |
| 20, VSF1010, VSF 1030 |  | HSE10, HSE11, HSE20, HSE21, HSE41.HSB10HS300, HS20 | 6185, 6290, 6291, VRG293,6362,6367 <br> 6467, 6468, 6470 <br> VR3260, 6349, 6442, 663, 6448, 6449. <br> 4800p |  |
|  |  |  |  | DSR-21 R FOR SLC 8-C9 2600p DSR-35R FORC20, C30, C40, SLF4UB, |
|  | VT410, 413, 414, 415, 416, 418, 510, 515, 517, 518, 520, 525, 526, | HS $300, \mathrm{HS351} \mathrm{HS} 302,, \mathrm{HS310}$, |  | SLFIE2 PIN, SLC 24 PS, $33 \mathrm{E}, 34,44 \mathrm{PS}$, SLF11, 30PF, 35, 60PS, SLK85. |
|  |  | HS337, HS347HSB12, HSE12, HSE22, HSM16G, 18.180 | VRGO1 <br> 49SB6, VR6548, VR6648, <br> VR6843 <br> 2760p |  |
| 7000, 7800 | VTM625, 626, 725, 210, 211, 215, 726, 727, 728, 820, 821, 825, 920 <br> 921 <br> 1400p |  | SAISHO <br> VR100, 605, 705, 805, 905, 1000, 1100, <br> 1200, 1600 1200p <br> VR3300X, VR3600X, VR3650X, VR3800 | SLT20ME, 30 ME, SL100 DSR-43R FOR SLC7 RANGE, SL5000, SL5100. SL3000 1 PIN SLC6E SL36ES |
|  |  |  |  |  |
|  | VT4000, VT 4200, VT5000, VT5500, |  |  |  |
|  |  |  |  | SL3000, SLBOOO, SL8080, SLCEE, SLTTME |
|  | $V T 77,080,6500,6700,6800,7000,8000$. $8030,8040,8100,8300,8500$ |  |  |  |
| 8600, 8602, 8700, 9005, DD8900, DD | VT8700, 9000, 9300, 9500, 9700. <br> 9900 , 1000p |  | VR2000, VR3300, VR3600 1400 p <br> VR2500 2850 p | SLV201, SLV202 $\mathbf{2 0 0 0 p}$ <br> SLK5, SLT50ME $\mathbf{2 9 0 0}$ |
|  |  | HS412.HS421G2 ${ }_{\text {HS }}$ |  |  |
|  |  |  | VRS5000X, VX6000A, VXL12X | SLV412, SLV427, SLV474 2200pDSR49R, SLHF $100 \mathrm{P}, \mathrm{m}$ |
|  | VT65VT130, 135, 138, 145, 250, 255, 258, 420, | HSM40 |  |  |
|  |  |  |  | SLHF100UB 3850 p |
|  | 425, 426, 428, 430, 431, 435 <br> VT438, 535, 536, VTL30, 301, VTM630, | HSM59, HSM68E <br> NV300, 322, 332, 333, 340, 390, 2000, 2010, 3000, 7000, 7200.7500, NV7800, | SV9200 |  |
|  |  |  |  |  |
|  | 635, 636VT52,VT60, VT61E, VT62E, VT63, VT64pVT640V1100p | 2850, 8170, 8200, 8400, 8600 8610,8620 |  | CCDF340E, CCDF500E, CCDV90E, <br> CCDV95E, CCDSP5E 4800p |
|  |  |  |  |  |
|  |  |  |  | SLV310, SLV315, SLV325, <br> SLV335 <br> 1800p |
|  |  | NATIONAL PANASONIC <br> AG1000, 1050, NV250, 260, 280, 450. |  |  |
|  | VT522, ,VTM212, 620, 622, 720, 722,822, |  | (623N, SV6800, SV6900, SV8850, ${ }^{\text {SV8870, }} 1750 \mathrm{p}$ |  |
|  | 2600pVT660EVT570, VT575, VT580, VT585, VT588, | AG6010, AG6015 $\mathbf{2 5 0 0 p}$ <br> AG6840, $\mathbf{2 4 0 0 p}$ | SVB8810, SV8910 S23N, SV8920 | SLV125, 213, 225, 252, 255, 262, 280, SLVX1, 20, 3 |
|  |  |  | $\mathbf{9 2 3 N}$  <br> SV8600, SV8700 $\mathbf{4 5 0 0 p}$ <br>  1550 p |  |
|  | VT570, VT575, VT580, VT585, VT588, <br> VTF70 <br> 3100p | NV100, NV200, NV370, NV380, NV630 |  |  |
|  | VTM598, 640, 645, 646, <br> VTM730, 731, 735, 736, 740, 745, 746, $748,753,754,830,831,835,838,840$. | NVDBO, NVH65 <br> AG5150, AG5250, NVF65, NVH75,NVH77 <br> 3200p <br> 3200 | SV8420 2400p <br> SV8620 2100 p | SLVX55, |
|  |  |  | SV8380 2200p <br> SV830  <br> SV8720 2250 p | StVE, SLVE |
|  |  | AG5150, AG5250, NVF65, NVH75, NVH77 <br> NVF51 3200 p <br> NVGI $\mathbf{4 2 0 0 p}$ |  |  |
|  | VTM730, 731, 735, 736, 740, 745, 746, <br> $748,753,754,830,831,835,838,840$ <br> 2800p |  | SV820  <br> SAM20  <br> SASUNG 19009 | SLV615,SLV625, SLVE600, SLVE700, ${ }^{\text {3450p }}$,SLVE800 |
|  | $\mathrm{VTF770}, 774,775,860,861$, $\mathbf{4 1 0 0 p}$ <br> B65  <br> VT85, VTB6, $\mathbf{2 6 0 0}$ | NVG19 NVJ30, NVHJ33, NVL 10. 20, NVL21, 2300p |  |  |
|  |  | NVG30, 31, 40, 130, NVJ37, 40, 42, | SAMSUNG | TOSHIBA |
|  |  | NVJ35, NVG46 1700 p <br> NVM1, NVM3, NVM5 $\mathbf{4 2 0 0 p}$ <br> AG2100, AG2200 $\mathbf{7 0 0 0}$ |  |  |
|  |  |  |  |  |
|  |  |  | 970, 971, 972, SV716, 717, SVX303, 305, |  |
|  |  | NV430, NV431, NV433, NVSD2, NVSD22. NVSD25, NVSD3 | VB510, 520, 610, 616, 617,619, 620,626, |  |
|  | J.V.C. 8 FERGUSON HR2200, 3300, 3320, 3330, 3350, 3360, |  | $627,629,710,971, V 1520,616,621,626$, 900,910, | V55,V57, , V74, V75, V77, V80, V81, V82, |
|  |  |  | SVX319, V8770, V1710, $730,731,730$ |  |
|  | 3292, 8900, 8901, 8902, 8903, 8906, 8922. | NV21 HQ, NV 180, NVD48 2000p <br> NV7881 $\mathbf{2 5 0 0 p}$ | 750, 751, 770, VB750, VK8220, VX750, VX7330, VK770, VKB225, VR1730, 1735, | V88, DV90, 96, 97, NM3, V108, 109, 1200p |
| FVHP1250, FVHP430S 1950p | 8928, 3V01, 3V06, 3V22 HR3660, $7600,7610,7650,7700$, HRD 110 . |  | V11560, VN1560, VN1561, VX 1530, |  |
| GOLOSTAR | HRS' $100,8904,8923,8924,8925,8929$, 8935, 8941, 8943, 8944. | NV810, NV8301 2400p <br> NV850, NV950 2750p <br> NV870, NV890, <br> NV970 3200p |  | 470, V5480 1300 p |
|  |  |  | PL30LR, PX3031, 31R, 32R, 990, 992, 991, PXP30, PXR30, VX 1260 , SVX503, |  |
|  | $3 \mathrm{~V} 16,3 \mathrm{~V} 233 \mathrm{~V} 24,3 \mathrm{~V} 31,3 \mathrm{~V} 35,3 \mathrm{~V} 36,3 \mathrm{~V} 38$, $3 V 39,3 V 49$ 625p |  |  | S |
|  |  | NVJ47. <br> 49, 700 PX, NVSD20EE, | PXP30, PXR30, VX 1260, SVX503, <br> S $\times 3230,3231,3260,3261, \mathrm{Vk} 30,300$, | 3700p |
|  | BR1600, HRD140, 141, 142, 143, 150, 152, 156,157 158, 1605101 |  | 1230, 1260, 1261, <br> VK30́R, 31R, 32R, VXK300, 301, 306, 320, | $\begin{array}{ll}\text { V500G, V509G } \\ \text { V9680 } & \\ \text { V }\end{array}$ |
|  | HRS $10,8947,8948,3 V 42,3 V 44,3 V 45$, $3 \mathrm{~V} 46,3 \mathrm{~V} 47,3 \mathrm{~V} 52,3 \mathrm{~V} 54$, | NVG  <br> 450,465 $16,14,16,120, ~ N V 250$, <br> NVG 18 1800 p <br> 1800p  | $321,326,336$$\mathrm{~S} 11230,1240, \mathrm{SV} \times 60, \mathrm{~S} \times 1230,1231$, |  |
|  |  |  |  |  |
|  |  |  | 7230, 7301 |  |
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| GSEQ121, RQ2011, RQ2031, RQ2051 |  |  |  |  |
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## VCR BELT KITS

| del Price | Model Price | Model Price | Model Pricer | odel |
| :---: | :---: | :---: | :---: | :---: |
| AKAI <br> VP7100, VS9300, VS9500, VS9700, VS9800 | TX3650, VCR3000, VCR3002, VCR9500 | 406, 407, 4092, 410, GV411, 412, 414, 415, 416, 417, 4192, 4200, 420, 430, 434, 435. GV437, 440, 450, 4592, 460, 464, 470, 500, 501, 5050, 5095, GV5105, 511, 530, 5395, 540, 560, 5695, MV4005, 4 105, SE $4100,4104,4120,5102$, 5104, 5106, TVR37001 | 100 |  |
|  | FISHER |  | 100 | 970.971.972  <br> $\mathrm{VX9880}$ 100 p <br> 110 p  |
| 3, VS5, VS12, VS $15, \mathrm{VP88}$ | - |  | PVC2300, PVC2400 ${ }^{\text {180 }} 18$ | SX71 |
|  | V8S9000 120 |  | DX 1000, 1600, 1800, 2000, 3000, N9012, 9013, 9014, 9016, N9033, 9034, 9053, 9054, 9055, 9056, 9066, 9096, 9110, 9120 . <br> N9510, 9520, 9530, 9610 <br> 80 p | SANYO <br> VTC5000, 5150, 6000, 6500, VTCM10, 11, 20, <br> 21, 30, 31, 50 <br> VTC5300, VTC5350, VTC5400. <br> 65p |
| VSX9, VS $105,112,115,116,120,125,126$, | FVHP520, FVHP530, FVHP420 60 |  |  |  |
| 155, 165, 205, 220, VS24, 240, 244, 245, 247 | 10, 711, 715,7 |  |  |  |
|  |  |  |  |  |
|  |  | VXL7, VXL8, VXL9, VXL $10, \mathrm{VXL11}$, VXL19, | NATIONAL PANASONIC NV300. NV330PX, NV332, NV333 NV340, | VPR5800 ${ }^{\text {a }}$, 80p |
| 55, vS6 |  |  |  | VTC9100, VTC9300 140p |
| VS4, VS6, |  | 200 | NV777, NV788 |  |
| VSA77 ${ }_{\text {V }}$ | VBS9900 | VXL4, VXL35, VTV300 | NV2000, NV2010, NV300 | VTC1100, 1300, 1500, VHR1100, 1110, 1150 . |
| VSS99 105p |  | VxL5, VXL6 100 | NV7000, NV7200, NV7800 | VHR1500 |
|  | FVHD140, FVHD40, FVHD55, FVHP1, FVHP10 | VXL3, VXL20 90p | NV8600, NV8610, NV862 ${ }^{145}$ | VHR2700 ${ }^{\text {a }}$ |
|  |  |  | NV230, 250, 280, 430, 431, 433, 450, 460, 465, $470,650,730$, NV70, $810,870,890,970$, AG |  |
| 00, |  | VT11, 14, 16, 17, 19, 33, 330, 34, 35, 350, 38, | 470, 650.730, NV770, 810, 870, 890, 970, AG <br> 1000, 1050 | VHR3100, 3110, 3150, 3300, 3310, 3400, 3500, 3700, |
| CR161, vCR222 |  |  |  | 3500 VHAD500, 700 , 351000 , |
| R3000X, VCR40 |  | VT5000, VT5500, VT18 |  |  |
| 000, VCR7800, VCR8000.VC |  | VT7000, VT8000, VT8030, VT8040, VT8300, | NV600. NV688, AG6010, AG6015 85p | 154, 15, 16, 171, VHR194, 220, 23, 235, 240, 244, 250, 251, 274, 297, 310, 330,VHR335, 390, |
| TV10 105p | 310, 320, 2000, 410, 420, 430, 440, 445, 470, | VT680, VT6500, VT6800, VT9300, VT9500. |  | $4100,4105,4150,4200,430,4300,4350,474$. |
|  |  |  | 400, NVH70. ${ }^{\text {a }}$, 12, 14, 15, 6, 18.30, 130,5 | VHR4770, 5080, 5100, 5200, 5300, 5350, 5700 . 6850, 7100 , VHR7200 7250, 7260, 7300, 7400 |
| TVR123, VCR4600, VCR 4700 , | (000, 5005, 5050, 5075, 5100, 975, 980, |  | NVFV1, NVM10, 3000, 3300, 40, 7, 9000, 9900, <br> $\begin{array}{l}\text { 70p } \\ \text { NVMSI, } 4\end{array}$$\qquad$ |  |
| VCR5200 |  |  |  | 6850, 7100 , VHR7200 7250, 7260, 7300, 7400 , $7500,7520,7530,7530$, VHR7540, 7700,774, |
| CR7000 |  | VT100, 110, 111, 113, 115, 118, 120, 125, 128, |  | 7800, 7810, 8000. 8100, 8200, 8250, 8500, VHR8800, 8801, VHRD4400, 4410, 4500 |
| CR 1000, 2000, 6000, 6100, 6200, 8600, 8602 |  |  | VR6460, VR6920 170p |  |
| 603, 8604 |  |  |  | VMD66, VMD68P |
| CR8700, 87 | 80 | VT145, 150, 168, i70, 175, 220, 225, 250, 255, | VR6442, VR6542 70p | VTR1000 70p <br> VTC6010 75p |
| 9244, 9340, | OLDST |  |  |  |
| D89 | GHV1221, 1232, 1233, 1240, 1241, 1242, 1243, | M500 VM600 | DV186, 190, 286, 291, 292, 468, 471, 562, 571, | SHARP |
| TX3650, UF20, 22 24, |  | J.v.c. <br> HR3300, HR3330, HR3360, HR3660, <br> HR4 100 <br> HR7200, HR7300 <br> ${ }^{130 \mathrm{p}}$ <br> 60p | 761, VR201, 202, 203, 211, 2115, 212, 213, 223, 311, 312, 313, 3210, 3219, 322, 32, 29, 323, |  |
| 9500 | GHV1246, 1247, 1248, 1250, 1266, 51, 8000, |  |  | VC200, 381, 384, 385, 386, 388. 390, 393, 838, 9100,930 , |
| VS1004 105p |  |  | 311, 312, 313, 3210, 3219, 322, 32, 29, 323, <br> 535, VR20DV1, 20DV2, 20RW7, 21DV1, 210V2, | VC7300, VC7700, VC7750, VC7800, |
| Aupu | VCP4100, VCP4130 |  | 210, V3, 25801, 25802, 11, 12, 302, 303, 305, | VC8300 |
| RTV100 | GHV1290, 1291, 1295, 1296, VCP4000, 4200, | HR7350, HR7600, HR7610, HR7650, | $310 \mathrm{VI}, 31 \mathrm{DVV}, 31 \mathrm{D}, \mathrm{V} 3,3 \mathrm{SE11,3} \mathrm{SB12}$, 3SB13. |  |
| RTV200, RTV222, RTV224 90p | 4300, 4301, |  |  |  |
| RTV202, RTX200 | VCP4305, 4306, 4310, 4311, 4315, 4320, 4321, |  |  | 496, 8481 |
| RTV322, RTV248 100 | 4325,4326 120p | HRD110. 111, 120, 121, 220, 225, |  |  |
| RTV306, 307, 309, 310, 311, 312, 328, 414. | Granada |  |  |  |
| 434, 444, 707 | VHSH1. VHSAH |  | VR6390, 6391, 6393, 6467. 6468, 6470, 6561, 6570, 6581, 6670, VR6676, 6710, 6760, 6761, | 108, 405, 408,550,600,651, 674, 681, 682 |
| RTV211. RTV214 140p | VHSVH4, VHSWH1, VHSXHI ${ }^{\text {VHS }}$ | 190, 250, 257, 310, HRD455, 565, 566, 725. 755, HRP50 | 6762, 6870, 6970, 6975, VR68SB4, $865 B 1$, <br> 92SB3 | VC700, 750, 783, VC6F3, VC6V3 70 p |
| RTV324, RTV32565p | H2 | HRD $170,171,180,210,211,217,230,300$.$320,321,330,337, H R D 350,370,400,430$, |  |  |
| RTV315, RTV316, RTV | VHSEH1. |  | VR44589, VR4458920, VR445B922, VR6443, | 787, 793, 800, VC7810, 7822, VCA 100,102 , |
| RTV317 | VHSBP1 135p | 440, 44 i, $500,530,700,750.950$, <br> HRS $5000,5500,8000,9000$, BR9060, BRS600 |  | 103. 104, 131, 140, 170, 202, 03, VCA234, 501, 502, 502, 5011, VCB311, 361, VCDS01, 802, |
| RTV301, | VH |  | VR3260, 6349, 6448 , $6449,6548,6848$,$4958620,644899, ~$ |  |
| RTV424 859 | 25 | HRS5000, 5500, 8000, 9000, BR9060, BRS600, 605, 920. 925 |  | 502, 502, 5011, VCB311, $361, \mathrm{VCD801}, \mathrm{802}$, |
| FERGUSON <br> 3292, 3V00, 3V01, 3V16, 3v22, 8900, 8901, 8902, 8903, 8904, |  | HRD227, 520, 52 1, 522, 527, 600, 610, 620. 637, 641, 650, 830. |  | VCA10, 103, 105, 106, 113, 11613, 211, 234, |
|  | VHSBY3 100 |  |  | 244, 254, 30, 33, 35, VCA $36,37,40,43,454$, |
|  | VHSEY\%, VHSEY2 | HRD840, HRD $\times 20,22$, HRJ200. 205, 300, 305, SR330, HRS 10 | VKR6800, VKR6810, VKR6820 70p <br> SE4104, VR231, 2310, 2319, 231, 232, 2329 |  |
| 8906, 8909, 8912, 8922 |  | SR330, HRS 10 HRD840, 550, 560, 580, 590, 640, 660, | 237, 23, 241, 2410, 2419, 242, 243, 245, 2469, |  |
| 3V23, 8923, 8924, 8929 |  | 730, 740, 770, HRD820, 860 | 247, ${ }^{\text {24, }}$ | 81, 85, 865, 910, VC5 1000 . VCT212, 310, 410, 610, VCT1314, VCTS312. |
| 3V29, 3V30, 8930, 8931, 893 | VHSTJ1, VHSTJ2 | 910, 960, 980, HRD 220,25, HRJ2 10, HRJ215, 315, 316, 318, 400, 405, 407, 410 , |  |  |
| ${ }_{3} 8931,3 \vee 32,8941,8942$ |  |  | 3329, 333, $3479,35,339,3419, ~ 342, ~ 343, ~ 3469, ~ 347, ~$ | 313, VC790ET <br> 80 p |
| $3 \mathrm{~V} 35,3 \mathrm{~V} 36,3 \mathrm{3} 38,3 \mathrm{~V} 39,3 \mathrm{~V}$ |  | 411, 415, 416, 507, HRJ6 10, 675, 715, 97, HRS 4700,5800, SR3200, SRS368E | 442, 4229, 432, 437, 442, 44, 5, 4469, 447, |  |
| 迷 |  |  | 4479, 451, 452, 457, 458, 459, 512, 522, 5229, | SONY |
|  |  |  | 8389 | SLC5, SLC7, SLJ7, SLJ9, SLT7ME $\mathbf{1 4 0 p}$ <br> SLC9, SL8000, SLB080, SLT50 $\mathbf{1 6 5 p}$ |
| 3V5s, |  |  |  |  |
| 8945, 8947, 8948 | VHSFG1, VHSFG |  |  |  |
| 3V58, 3V43, 3V44, 3V59, 3V64, 3V65, 8950 , | VHSFG4, VHSF63 180p | matsul <br> VX600. 730, 735, 750, 755, 765, 850, 6000. |  | $\underset{20,3}{\text { SLV255, 125, 213, 225, 262, SLVX1, } \quad 95 p}$ |
| , | DI |  |  |  |
| FV21, FV22, FV26, FV32, FV39, VC14tL 45p | MVS 400, 440, VS 400, 410, 415, 435, 440, 441, 55 p , | V 5888$\mathrm{v} \times 1000, \mathrm{v} 2000, \mathrm{v} 2500, ~ v \times 3000$,$v \times 6000$ |  | TOSHIBA <br> V55, V57 |
| FV31R 110 |  |  | SAMSUNG |  |
| FV61L, FV | VS 180, 200, 220, 226, 262, 265, 267, 2×40800, 0850, 0880, | $V \times 6000$ 80 p <br> $V \times 800$ 70 p | SV716, 717, V1616, V-621, V1626, VX616. v×617, VX619, X626, vX627, vx629, | V33, V31, V32, v51, V52, V53, v9600,v9680 |
|  |  | MITSUBISHI HS200 | VX714VB520, $510,610,616,617,619,620,626,627 p$ |  |
|  |  |  |  |  |
| 5 | VS 150 | HS300, 301, 302, 307, 310, 337, 338, 347, 349, 411, 412, 421, 480, HSB10, 20, 30, HSE10, 20, <br> 30, 70 <br> 80p | $629, \mathrm{~V} 1510,520, \mathrm{~V} 1611,616,621,626, \mathrm{~V} \times 510$$511,520, \mathrm{VT} 320,5600$ | 86 80p. |
| V41R, FV42L 100p |  |  |  | V108, 109, 110, 120, 130, 140, 199, 209, 210, |
|  |  |  | V8900. VB910, V1900, V1910 110p | 211, 220.221, 411,V421, 609, 610, 611, 659, |
| VCR1000, 2000, 600,600 |  | 30,70 $H S 303, ~ H S 304, ~ H S 306, ~ H S 307, ~ H S 330, ~ H S 400, ~$ |  |  |
|  |  | HS700  <br> HS318, HS319, HS410 110 p <br>  110 p | 319,322, VB750, $770,8220,8225, \mathrm{~V} 1770,790$, 8220, 8225, VK8220, VPX31, Vx750, VX770, | V212, 213, 22-2, 312, 322, 403, 412, 413, 610, |
| CR100 | VS 160, bARCELONA, FLORENZ, GV4000, 4000, 4001, <br> GV4002, 400, 401, 4010, 402, 403, 404, 405. |  |  |  |
| (1000, VTR1001 |  | HSM1000, 16, HSM $23,25,33,34,35,37,54$, | 790, 8220, 8225, SE9000, 9001, 90p$\mathrm{SV} \times 301,303,305, \mathrm{~S} \times 7301, V B 710,971$, | 703,813  <br> VCPB1E 50 p <br>  110 p |
|  |  |  |  |  |

## REPLACEMENT IDLERS \& PULLEYS

| Make | Models | Description | Make | Models | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Hitachi <br> Order Coda: | VT11, 14, 17, 19, 33, 34, 35, 38, 39, 52, 57, 61, 62, 63, 64, 65, 85 , $86,330,350,640,16 S, 5030$ <br> : IDL01 | FF Rew Idler 6886792 Price 100p | Ferguson | $3 V 39,3 V 30,3 V 31,3 V 32,3 V 353 V 36,3 V 38,3 V 39,3 V 49,8930$, $8931,8933,8940,8941,8942,8943,8944$ | Take Up Clutch PU 51380 |
| Hitachi Order Code: | VT680, 6500, 6800, 9300, 9500VT9700, 9900 <br> IDLO2 | Play Idler 68614826861481 Price: 180p | Order C |  | Take Up Clutch <br> PU 53462A PU 51380 |
| Blaupunkt | RTV301, 306, 307, 309, 311, 312, 315, 316, 317, 319, 320, 404, $414,424,434,444,478,707$ |  |  |  | Price: 200p |
| Goldstar |  |  | Sharp | VC600, 651, 681, 682, 684, 685, 693, 699, 700, 783, 6FR, 6V3, | Idler Assembly |
| Grundig National | GHV1248, 8000, 8200, 8210, 8215, GVHP51, VCP4100, 4130 MVS400, 440, VS400, 410, 440VS 450,460 NV230, $250,260,280,370,380$ NV $430431,433,450,460,465$ |  | Ordar Code: IDL88 |  | Price: 615p |
|  | 470, 480, 630, 650, 730, 780, NV810, 830, 850, 870, 890, NVG7 $9,10,11,12,14,15,16,18,30,130,400$. AG 1000, AG1050, 1200 1500, 1810, AG2100, 2200, NVH65, 70 | Ider Arm VXP 0521 | Philips Sharp | VR6843, 6943, 44SB9, VR44SB920, 44SB922, 6943 VC772, 780, 781, 782, 785, 786, VC787, 800, 793, 799, 7810, 7822, VCA100, 102, 104, VCA131, 140, 170, 202, 203, 234, 501, | Reel Drive Unit Ider NPLTV0111GEZZ |
| Philips Order Code: | VR6460, VR6520, VR6920 IDL08 | Idler Arm 40340162 <br> Price 100p |  | VCA602, 5011, VCD801, 802, VCH851, 852, VCH882, VCM73, VCT72, VC782MK11 |  |
| Amstrad Sharp | VCR7000 | Idler 150280 | Order Cod | IDL90 | Price: 700 p |
| Sharp <br> Order Code: <br> Phil | VC200, 381, 383, 384, 385, 386, VC388, 390, 393, 3300, 8381, 9100, 9300, 9500,9700 <br> IDL10 | Idler NIDL0005GEZZ <br> Price: 100p | N.E.C. N911, $915,916,917,9012,9013$ N9014, $9016,9033,9034,9053$, <br>   <br>  N9054, $9055,9056,9066,9096, ~ N 9110,9120,9510,9520,9530$, <br>  N9610, DX1000, 1600, 2000, DX3000, PX1200 |  |  |
| Philips Shatp | VR6540 <br> VC300, 387, 402, 471, 473, 477, VC481, 482, 483, 486, 488, 496, | Idier |  |  | Idler Arm Assembly Price: 270p |
| Order Code: | $\begin{aligned} & 500,571,571 \\ & 581,582,583,584,585,8481,5 F 3,5 \mathrm{~W} 20 \mathrm{E} \\ & : \text { IDL11 } \end{aligned}$ | Idler <br> NIDL0006GEZZ <br> Price: 100p | Philips | DV186, 190, VR211, 2115, 212, 213, 223, 286, 291, 292, 311, $312,313,3210,3219,322,3229,323,535 B 0$, VR486, 471, 562, 582, 571, 761, 201, 202, VR203, 302, 303, 305, 6180, 6182, 6185, $6285,6290,6291,6293$, VR $6362,6367,6390,6391,6393,6467$, $6468,6470,6561,6570,6581$ VR $6570,6676,6710,6760,6761$. 6762, 6870, 6970, 6975, 86B1, 63SB7, 68SB4, 71SB4, 71SB5, 72SB8, 72SB8, 92SB31, 20DV1, 20DV2, 20RW7, 21DV1, 21DV2, 2SB01, 2SB02, 2SB11, 2SB12, 30DV2, 31DV1, 31DV2, 31DV, 33SB02, 3SB03, 3SB05, 3SB11, 3SB12, 3SB13 | Pressure Roller Assembly PS403-40205 |
| Akai Ferguson | VS10 <br> $3 \mathrm{~V} 23,3 \mathrm{~V} 29,3 \mathrm{~V} 30,3 \mathrm{~V} 31,3 \mathrm{~V} 323 \mathrm{~V} 35,8923,8924,8929,8930$, | Reel Idler |  |  |  |
| J.V.C. Order Code: | 8931, 8940, 8941,8942 <br> HR7200, 7300, 7350, 7600, 7610, 7650, 7655, 7700 <br> IDL20 | Reel Idler PU48967 Reel Idler PU48967 Price: 175p |  |  |  |
| Ferguson | $3 \mathrm{~V} 39,3 \mathrm{~V} 30,3 \mathrm{~V} 31,3 \mathrm{~V} 32,3 \mathrm{~V} 353 \mathrm{~V} 36,3 \mathrm{~V} 38,3 \mathrm{~V} 39,3 \mathrm{~V} 49,8930$, 8931, 8933, 8940, 8941, 8942, 8943, 8944 | Take Up Idler PU 514 |  |  |  |
| J.v.C. | HR7200, $7600,7650,7655,7300,7350,7610$, HRD110, 111, 120, 121, 225 | Take Up Idler PU 51402A | Toshiba | V91, V95 | Pressure Roller Assembly PS403-40205 |
| Order Code: IDL22 |  | Price 100p | Order Code: PR232 |  |  |


|  |  |
| :--- | :--- |
| Akai | M32773 |
|  | MZ366960J2 |
| Goldstar | VXP0521 |
| Hitachi | 6861471 |
|  | 6861482 |
|  | 6886971 |
| JVC | PU48697B |

## REPLACEMENT IDLER TYRES

## PINCH ROLLERS

AKAI
VS $10, ~ V S 9300, ~ V S 9500, ~ V S 9700, ~ V S 9800, ~$ VP7100, VP77 VS4 VS5, VS6, VS8, VS9 140 p VS12, VS 15
140 p VS 105, 112, 115, 116, 120. 125. 126, 155, 165, 205, 220, 240, 244, 245,
VS247, 248, 250, 512, VS515, 516, VS247
VSX9
VS201, 301, 303, 304, 603, 606, 607, VSP8,
VSP92, VS201, 301, 303, 304, 603, 606, 607, VSP8, 140 140
VSP82, VP58, VP82, VS 125, VS155, VS 165, VS220, VS240, VS250,
VS512
VS20, VS $22,23,25,35,37,38$,
426, 427, 462, 465, 467, 426, 427, $462,465,467$,
VS $485,75,765,767,768,865,867,965,967$.
VSA7, VSA VSA77, VSA650,
VSF10
11 VSF10, 11, 12, 15, 180, 190, 200, 210, 220 $221,222,230,240,30,33$
VSF330, 4, 500, 550, VSP88,

## 450,470 VSF 230

 SF260, 261, 262, 265, 270,
290, $340,350,410,420,43 \mathrm{C}$
VSF44, 40, 450, VSF $441,440,450,455,480,490,497,510$.
$560,580,590,599,600$, $560,580,590,599,600$ $55,60,64,65,70,73,74,75$,
VSP $110, \mathrm{VS} \times 560, \mathrm{VS} \times 580$,
 55, VSA77
PINCH ROLL
PINCH ROLLER ASSEMELY
VS422, 425, 426, 427, 462, 465, 467, 485, 498,
$765,766,767,768,865$,
765, $766,767,768,865$,
$867,965,967$, VSA 650,
180, $190,200,210,220$,
231,
221, 222, 230, 240, 30, $300,301,310,320,33$, 330, 4, 500, 510,600 , VSR10, VSX $100,400,450,470 \quad 800 p$

PINCH ROL | PINCH R |
| :--- |
| VSS99 |
| ALBA |

## VCR3000X VCR 4000

VCR5000, VCRE000
VCR161, VCR222
VCR161, VCR222
VCR7000, VCR7800, VCR8000,
VCR8800
VTV10
VTV10

VCRT000, 2000, 4500, 4600, 4700, 5200, 6000,
$6100,6200,860$, VCR8602, 8603, 86 $8804,9000,9005$,
VCR9244, $9340,08900,8904$,
VCR12, 2,3,4
VCR7000
VCRTOOO
DCO900
 VCR8700, 8800, $900>9,9140,9244$, 9340
PINCH ROLLER ASSEMBLY PART NO: $\begin{array}{r}753148 \\ \hline 100\end{array}$ TX3650, UF20, VCR3000, VCR3002, VCR4000, VCR9500
PINCH ROLLER ASSEMBLY PART NO: 2554966
VCR3000, 3002, 9500
VF20, 22, 24, VS1004 VS 110
FERGUSON
$3 \mathrm{~V} 00,3 \mathrm{~V} 01,3 \mathrm{~V} 16,3 \mathrm{~V} 22,3 \mathrm{~V} 23,3 \mathrm{~V} 24,3292$, $8900,8901,8902,8903,8904,8906,8909$,
 $3 \mathrm{~V} 29,3 \mathrm{~V} 30,3 \mathrm{3V} 31,3 \mathrm{~V} 32,3 \mathrm{~V} 52,8930,8931$,
$8933,8940 \mathrm{p}$ 8933,694,
$3 \vee 55,3 \vee 38,3 \vee 39,3 \vee 42,3 \vee 43,3 V 44$,
$3 \vee 45,3 \vee 48,3 V 49,3 V 53,3 V 54,3 V 55,3 V 56$,
 3V57, $3 V 58,3 V 59,3 V 65$, FV10, FVII, FV12,

FV14, 8943, 8944, 8945, 8947, 8948 140 | FV14, |
| :--- |
| 3 V 52 |

${ }_{8950}^{3 V 52} 8951$, FVI0B. 11R, 13H, 14T, 20B, 140p $22 \mathrm{~L}, 26 \mathrm{D}, 31 \mathrm{R}, 32 \mathrm{~L}, \mathrm{FV} 33 \mathrm{H}, 39 \mathrm{~S}, 41 \mathrm{R}, 42 \mathrm{~L}, 50 \mathrm{~B}$, $51 \mathrm{R}, 52 \mathrm{~L}, \mathrm{VC141L}$, ,VISH, 39S, 41R, $42 \mathrm{~L}, 50$ FVV37H,
FV57
FV57H
$3 V 35,3 V 36,3 V 38,3 V 39,3 V 49,8943$,
PINCH ROLLER ASSEMBLY
$3 V 42,3 \mathrm{~V} 43,3 \mathrm{~V} 44,3 \mathrm{~V} 45,3 \mathrm{~V} 48,3 \mathrm{~V} 53,3 \mathrm{~V} 54$
$\begin{array}{ll}3 V 55, & 3 V 56,3 V 57,8945,8947,8948 \quad 1350 p\end{array}$ PINCH ROLLER ASSEMBLY
FV37 FV57 FV58
FV33, FV57, FV58
PINCH ROLLER ASSEMBLY FV31R
FV31R
FV41L, FV42L
PINCH ROLLER ASSEMBLY
3V58, 3V59, 3V64, 3V65, FVio, 11, 12, 925p 20, 21, 22, 26, 30, 32, 33
PINCH ROLLER ASSEMBIY $\quad 875 p$ FV43H, FV44L, FV45X, FV46T 700p PINCH ROLLER ASSEMBLY FV61, FV62, FV67, FV68. FV70, FV71, FV72,
FV74, FV77 FV14, FV77
PINCH ROLLER ASSEMBLY PINCH RO FISHER
FVHP420, 520, 530

## FVHP615, 618, 620, 622,710, 711, 715, 71

720, 721, 722, 725,730 .
FVUPP10
FVHPS10, 830, 840,
FVHP905, 906, 907, 908, 910, 911, 915, 916, FVHPP05, 906, 907, 900, 910, 911, 915, 916,
918, $970,975,980,990$, FVHP 5000,5005, 5050, 5075,5100
VBR330, VBS $3500,7000,7100,7500,7600, ~$ 9000, 9900
FVHO230, FVHD230, 250, 270, 370, 2000D, FVHP3, 210 , $250,300,310,1100$
FVHP1200, 1250, 130, 132, 1340, 1340, 1400, $1410,1440,1500,200$.
FVHP320410, FVHP320410, 420, 430, 440, 445, 470, 475,
FVSP2905, 495, 2905
 FVHP20
FVHD140, 40, 55, FVHP1, 10, 25, 30, 40, 4000, FVHS10, 30
PINCH ROLL GOLDSTAR GHV51, 1221, 1232, 1233, 1240, 1241, 1242, 1243, 1244, 1245, 1246,140p
GHV1247, 1248, 1250, 1266, GHV1247, 1248, 1250, 1266, 1290, 1291, 1295 . 1296, 1392, 1393, GHV1891, 1900, 2145, 3000, 3010, 4400, 4410,
$51,8000,8200, G H V 210, ~$ 51, 8000, 8200, GHV8210, 8215, 8430
GHVP1240, 1241, 1247,1248, 1290, GHVP1295, 1296, VCP $4000,4100,4130,4200$ 4300, 4301, 4305, VCP4306, 4310, 4311, 4315, 4316, 4320, 4321, 4325, 4326, 4350, GSE1290,
1291. 1295, 1296, 1297, 1891, 1910, 20005 $1291.1295,1296,1297,1891,1910,20005$.
2000 2000
VT7, 11, 14, 16, 17, 18, 19, 33, 34, 35, 350, 38, 39, 88, 330, 680, 4200,
V15000, 5030, 5500, 6500, 6800, 7000, 8000, $8300,8500,8700,930$, VT9500, 9700, 9900,
VM600 VT8, 52, 57, 61, 62, 63, 64, 65, 85, 86, 88, 100p, 110, 111, 113115,118 Vr $120,122,125,128,130,135,138,145,150$ VT250, 255, 258, 260, 400, 405, 410, 413, 414. 415, 416, 448, 420, 425
VT426, 428, 430, 431, 435, 438, 450, 498, 510. 515, 517,518, 520, 525,
VT526, 530, 535, 536, 540, 545, 546, 548, 570 $575,576,580,585,588$
VT640, 830, VTF650, 665. 780, 785, 860, 861, 865, 70, 770,774, 775, VTL.30, 1000,2000 . VTLC50, VTM 598,620, 622, 625, 626, 630, 635
VTM636, $640,645,646,720,722,725,726$, VTM $636,640,643,646,720,722,725,726$,
$727,728,730,731,775$, VTM 736, 740, 745, 746, 748, 753, 754, 820,
$821,822,825,830,831$, 81,
VTM8325, 838, 840, 841, $845,920,921,922, ~$ 925, 930, 931, 935,
VTS80, $85,890,895 \mathrm{VM} 200,2300,2380,3200$,
$3280,500, ~ V M S$ 3280, 500, VMS 7200

## VT3000 VT 410,420

VT410, 420, 428, 430, 450, 498, 518, 520, 140 530, VT7770, 780 ,
VTM598, 622, 722,740, 748, 753 650p PINCH ROLLER ASSEMBLY VTF150, 155, 180, 185, 250, 255, 260, 265, 280, 285, 350, 351, 355,
VTF 360,365, VTM VTF360, 365, VTM140, 141, 145, 145, 210, 211, 212,215, 220, 221,
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H13V, VTV 100,200 ,
140,
190, VXL2, VXL3
VXL4, VXL20, VXL35
VTV100, VXL10, VXL11, VLX9, VXLSO
PINCH
PINCH ROLLER ASSEMBLY
V2OH VXL5 VXIG MOD KIT V20H, V
$\begin{aligned} & \text { J.V.C. } \\ & \text { HR2200. }\end{aligned}$
HR2200, 3300, 3330, 3360, 3660, 4100,
7700 7700
HR2650, 7200, 7300, 7350, 7600, 7610, 7650, 7655
HRD $10,111,120,121,140,141,142, ~ 143,140, ~$ HRDIT0, IT, 120, 121,
150, 152, 156, 157, 158, HRD160, 220, 225, 250, 257, 445, 455, 565,
566, 725, 755, HRP50, BP5000, BR7000, 566,7611, 811,
HRD520, $540,550,560,580,600,610,620$,
637,640 637,640,641,650,660, HRD670, 720, 730, 740, 770, 820, 830, 840, $860,870,880,910,960$,
HRD980, HRDX20, 22, 25, HRJ200, 205, 210, 215, 300, 315, 316, 318
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$600,605,610,615,715,815$ $600,605,610,615,715,815$
HR.j97, HRS $4700,5800,5900,6800,6900$ HR, J97, HRS $4700,5800,5900,6800,6500,140$
SR3200, 330,368 HRD170, 171, 180, 210, 211, 217, 230, 300, 320, 321, 330, 337. 350,
HRD $370,400,430,440,441,470,500,530$,
$700,750,950$, H00, 750, 950 ,
HRS500,
HRS5000, 5500, 8000, 9000, BR7030, 7040,
9060

HRS10
BP5000.
P55000, HRD110, 111, 120, 220, 225,
PINCH ROLLER ASSEMBLY HRD140, 141, 142, 143, 150, 152, 157, 158 ,
$160,565,566,725,755$, $160,565,566,725,755$,
HRP50 HRP50
PINCH R
PNCH ROLLER ASSEMBIY 1350p HRD1520, 510, 520, 521, 522, 525, 527, 560 , 600, 610, 620, 637,641.
HRD650, 720, 830, 840. 910, HRJ205, HRS5800
FINCH ROLLER ASSEMBLY BR7030, BRS600, HRD160, 170, 171, 180, 190, 210, 211, 217, 227, RD230, 271, 300, 310, 320, 321, 330, 337. $350,400,430,443,441,750,950$, HRS 5000 ,
HRD $470,500,530,700,750,9$ 5500, 9000
PINCH ROLLER ASSEMBLY
HRD540, HRD550, HRD580, HRD650, HRD860, FRD960
PINCH ROLLER ASSEMBLY
HRJ600, HRJ605, HRJ815,
HRNG9200
HATSUI
V66000, 730, 735, 750, 755, 765, 800, 850, V $\times 1000$, VX2000, Wx2500, Vx3000 VX6000A
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HSE 12, 16, 17, 21, 22, 27, 31, 32, 41, 51, 52,
$0,16,170,190,210,23,25,250,27,33,34,35$, $36,37,370,380,45,450,5$
4,55, 555, 57, 58, 59,68, HSMS2, 9, HSS 11 . 14. 15, 17, 19, 25, 5600, HV 1125, $150,303,85$, SVB900, 8930
PINCH ROLLER ASSEMBLY PART $948 D 020010$
HSE11, 12, 16, 17, 21, 22, 27, 31, 32, 41, 51,
$31,32,41,51,52,82$, HSM1000, 110, 120, 150, HSM16, 170, 18, 190, 210, 23, 25, 250, 27, 30,
$33,34,35,36,37,370,38, ~ H S M 380,40,45$, $33,34,35,36,37,370,38$, HSM 380,40,
$450,50,54,55,555,57,58,59,60,68$, 450, 50, 54, 55, 555, 57, 18,59, HSS $68,12,14$,
HSMS2, 9 HSMX, 18, 19,2, HSS11, 15, 17, 19, 21, 25, 5600, HVF 125 , HVF 150,303 . 85, SV8900, 8930
HS200, HS300, HS301, HS302, HS303, HS304, HS310, HS320, HS330, HS360,
HS306. HS307, HS318, HS319, HS337, HS338 HS347, HS349, HS400, HS410, HS441, HS412, HS421, HS480, HS710, HSB 10, HSB20, 30 , HSE 10,20,
30,
30,70
NATIONAL PANASONIC $\quad 140 \mathrm{p}$ NV100, 180, 300, 330PX, $332,333,340,366$, $600,688,777,788,3321$
7450 , $6200,6400,6800$
NV230, 250, 260, 280, 370, 380, 430, 431, 433, 450, 460, 465, 470, 480
NV630, 650, 730, 770, 780, 810, 830, 850, 870, 890, 2000, 2010, 3000
NV7000, 7200, 7800, 8050, 8150, 8170, 8200, $8300,8400,8500,8600$
NV8610, 8620 ,
, NVG7, 10, 12, AG 1000, 1050, 1200, 1500, 2100, 2200, 6500, 6810, 7500, 7510,

## NVH70

AG6840, $6720,7150,7330,7350$ 7355, 7650, NVH65, 75, NVJ30, NVL20, 23, 25, 28, NVG300, NVF65, NVF70. NVFS1 NVFS 100, NVG 19, 20, 25. 33, 40, 50, NVVB000
NVD48, NVD80,
NVG21 NVG45 NV J700PX
NVHD 100, NVHD101, NCHD90, NVSD30 140 p NVSD40 1125 p PINCH ROLLER ASSEMBLY
AG5150, 5250, 5700, 6024, NVD38, 48, 80,
NVF55, $65,70,75,77,90, ~$ NVF55, 65, 70, 75, 77
25, 28, $200,33,408,90$, NVG 19, 20, 21, 22 , 25, 28, 300, 33, 40, 45, 46,
NVG50, NVH65, 75, 77, NVJ30, 33, 35, 37, 40, 42, 45, 47
NVL20,23,25, 28, NWW: 300 P PINCH' ROLLER ASSEMBLY
N.E.C.
N830,
831, 832,833,
895 N830, 831, 832, 833, 895
PVC2300, 2400, 740, 744, 746, 760, 764, 140p 766
DX1000, $1600,1800,2000,3000, \mathrm{~N} 9012,9013$, 140p, 9014,9016, 9033
N9034, 9053, 9054, 9055, 9056, 9066, 9096, $9110,9120,9510,9520$.
$N 9530,9610$ P 1200.
N 9530,9610 PX 1200
OS600GG, DX4000, N9077
$\mathrm{VH} 1, \mathrm{VH} 2$
VC150, 180, VH3, 33, 200, 201, 205, 212, 250 , 254, 288, $300,303,312$,
VH404, $555,700,704,712,770,780,844,900$ 1000, 2948, 3030, 3312 VHF2A. VP2948 COMB 15000,16000 , HVO3, LVH50, NEV 140 p NEVHM, NEVHML
TVP230RC, VCP, VH04, 30, 103, 300, 359, 360, $362,400,416,512$,
$362,400,416,512$,
VH530, $532,535,536,600,630,635,640,666$,
$730,735,74,74,790$
VH800, 820, 850, 888, 893, $900,930,940,942$.
97800, $820,850,888,8$
970
974, 1012, 1040, 1050,
VH1060, $900,930,940,942$.
VH1060, 1070, VH1100,
$1500,1660,1800,2004$
VH2151, 2308,22004,
VH2960, 2970, $3050,2400,2500,2600,2700$,
VH $3000,4000,4008,4010,4012,4015,4015$, $4020,4300,5020$.
VP $10,200,220$,
VP 10, 200, 220, 225, 245, VR821, 925, 1032, 2949, 2959, 2957, 2966, 2979, 2980, VTV 300 , PYILIPS
PHILLPS
VR6460 VR6920
VR2020, VR2021, VR2022, VR2023,
VR2024
VR6711
VR6540
DV856, 586, VR702, 703, 6485, 6585, 6589, ${ }^{140 \mathrm{p}}$ 6785, 6880,6948
VR445, VR6442, VR6542, VR6643. VR6843,
VR6943,
DV464, 662, VR2220, 2300, $2324,2330,2334$ 2340, 2350, 2414, VR2480, 2485, 2486, 2489, $2490,2498,2840,6462,6463,6464,6560$, VR6660, 6860, 6861, 6862, 6863
$\mathrm{~N} \cdot \mathrm{7700}$ VR2870 N-1700, VR2870
VR2005, VRO50
49SB6, VR3250, $6349,6448,6449,654140 \mathrm{p}$ 6648 PRESSURE ROLLER ASSEMBLY PS403-40205 DV186, 190, VR211, 2115, 212, 213, 223, 286, 291, 292, 311, 312, 313,
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VR6975, 86BI, $63 \mathrm{SB} 7,68 \mathrm{SB4}, 7$ ISB4, $71 \mathrm{SB5}$, 72SB8, 72SB8, 92SB31, 200V1, 200V2,
20RW7, 210V1, 210V2, 2SB01, 2SB12, 300V2, $310 \mathrm{VV}, 310 \mathrm{~V} 2,31 \mathrm{DV} 33 \mathrm{SB} 02$, $3 S B 03$,
$3 S B 05$
 VR231, 232, 332, 422, 4229, 512, 5229, 722,
72292, 723

VR50 | 7229,723 |
| :--- |
| VR50 |

PR38 140p
VHR1100, 1110, 1150, 1200, 1300, 1500, 2100 , 2300, 2370, 2500,
VHR2700, 3330 , MVR220 VTC5000, $5150,5300,5350,5400,5500,6000$ 6010, 6500, 9100 ,
VTC9300, VTCM10, 20, 11, 21, 30, 31, 40, 50 ,
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VHR3100.3300, $3310,3400,3500,3700,3800$ VHRDE500, 700
VTC3000
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$310,330,335,350,390$, VHR $4400,4105,4150$, $4200,430,4300,4350,4400,474,4770,5080$, VHR $5100,5200,5300,5350,5600,5700,6850$,
$7100,7200,7250$, VHR $7260,7300,7400,7440$, $7100,7200,7250, V H R 7260,7300,7400,7440$,
$7500,7520,7530,7540,7700,774480$, $7500,7520,7530,7540,7700,774,780$.
OVHR $7810,8000,8070,8100,8200,8250$. 8500, 8800, VHRO $4400,4410,4500,4600$. 8501,8870, , 4890,6700, VHRS 700
$4610,4710,480$ VCR100
VHR120, 135, 150, 190, 4150, 4i60, 1430 $5200,5240,5350,7200,7250,4260,4350$. VHRD $4410,4610,4710,4890,5450$, VHRS700 975 p VHR3100, 3200, 3300, 3310, 3400, 3700, 3800 . VHRD500, 7000
PINCH ROLIER ASSEMBLY
SHARP
VC200, 381, 383, 384, 385, 386, 388, 390, 393, VC6200, $6300,7300,7700,7750,7800,8300$, $838,9100,9300,9400$.
VC9500, $9600,9700,9800140140 \mathrm{p}$
VC300, 387, 402, 47, 473, 477, 481, 482, 483. 486, 488, 496, 500, 571. 573, 581, 582, 583, 584, 585, 8481, VC5F3. VC $108,208,405,408,550,600,651,671,674$

VC699, 700, 772, 750,779, 780, 781, 7810,
782, 782M $2,7822,783$.
VC785, 786, 787, 793, 800, 7810, 7822, VCT72
VC6F3, VC6V3, VCA 100, 102, 104, 131, 140
170. 202, 203, 211, 234, 303, 501, 502,

882, VCM73, VCT73, VCT72.
VCB361
VC220

211, 244, 254, 33, 35, 36, 106, 111, 113, 131, VCA37. 39, 40,
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VCA60, 605, 615, 62, 63, 67, $68,1031,11613$, VCB311, 320, VCBSS7, VCD805, 806, 810,8
VCH80, 81, 865, 910 VCS 1000, VCT310, VCT410, 610, VCT 1314, 5313, VC790 140p VC780, 790, VCA10, 103, 1031, 105, 106. 211. 244, 254, 255, 30, 35,
VCA340, 43, 47, 50, 60, 605, 615, VCD806,
B15, VCHO, 81, 83, 85,
815. VCH80, 81, 83, 85,

VCH865, 87, 910, VCS 1000, VCT212, 310, 410 510,610, VCT1314
VCTS 313 VCTS313
PINCH ROLLER ASSEMBLY
SAISHO

## VIDEO SERVICE KITS




```
    MODE SWITCH
NV2000, 2010, 7000, 7200, 7800 (VS50048)
NV230, 260, 430, 810, 870, 2300, 4300
(VSS0110)
NV830 (VSS0091)
NV300, 333, 340, 366, 688, 777, 778
(VSS0060
NVG21, 25, NVH65, NVD80 (VSS0175A)
```

MODE SWITCH
NV2000, 2010, 7000, 7200, 7800 (VS50048) V230, 260, 430, 810, 870, 2300, 4300 NV830 (VSS0091) NV300, 333, 340, 366, 688, 777, 778 NVG21, 25, NVH65, NVD80 (VSS0175A)

## VIDEO CLEANING STICKS

Price 17p each 15 p each pack of 10pcs 13 e each pack of 25 pcs Order Code: SP 14

VIDEO MAINTENANCE TOOLS
Set of 8 Allen keys packed in a plastic wallet
Order code: TOOL 9, Price 125p Specifically designed for video maintenance
UNIVERSAL HEAD EXTRACTOR
Hand tool designed for extracting hard to remove heads without damage to either the head or the mounting assembly. Adjustable so as to suit various heads. Order code: TOOL 8, Price 600p

## AUDIO CONTROL HEADS

AMSTRAD ORIGINAL NO: 15075
Used on: AMSTRAD TVR1, 2, 3, VCR4600, 4600MKII, 4700 FUNAI VS2, VCR4600, 4800, 5200, 5600, 6600, VIP3000, 5000 Also fits: FIDELITY, FUNAI, HINARI, PROLINE, SCHNEIDER, TOWADA, UNIVERSUM ORDER CODE: AH01 PRICE: 1350p
amstrad original no: 15313
Used on: AMSTRAD DD8900, 8904, VCR2000, 6000, 6100, 8600, 8602 8603, VCR8604, 8700, 8704, 8744, 8800, 9005, 8244

UNIVERSUM ORDER CODE: AHO2 PRICE: 1450p

Replacement Audio Control Video Sound Head for National Panasonic

| PART NUMBER | MODELS | PRICE |
| :--- | :--- | ---: |
| VBR 0091 | NVG7 etc | 875 p |
| VBR0050 | NV300, NV340 etc | 875 p |
| VBB0061 | NV777 etc | 875 p |
| VBR0103A | NV250, NV450 etc | 625 p |
| VBRO125 |  | 625 p |

## VIDEO TOOLS

## VCR ALIGNMENT KIT

CONTAINS: SET OF 7 HEAD \& TAPE PATH ALIGNERS

- RCA TYPE AUDIO \& CONTROL HEAD POSITIONING TOOL - RCA ADJUSTMENT TOOL FOR TAPE GUIDE POSTS
- RCA TYPE BACK TENSION TOOL
- TENSION ADJUSTMENT TOOL FOR VARIOUS USES
- VCR ADJUSTMENT TOOL

3 REVERSIBLE SCREWDRIVERS SPRING HOOK

VCR HEAD EXTRACTOR
Order code: TOOL 10, Price 2900p

## TRANSPARENT REPAIR/ADJUSTMENT CASSETTE

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

## BACK UP BATTERIES

## PHILIPS

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

## FERGUSON

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

SET OF 8 ALLEN KEYS
$0.77 \mathrm{~mm} \quad 0.90 \mathrm{~mm}$ $1.27 \mathrm{~mm} \quad 1.50 \mathrm{~mm}$ $1.60 \mathrm{~mm} \quad 2.00 \mathrm{~mm}$ $2.40 \mathrm{~mm} \quad 3.00 \mathrm{~mm}$

## CIRCLIP PLIERS

 CRO SCREWDRIVERREWDRIVER

SPRING HOOK

ITES

| MAKE \& MODEL | CODE | PRICE |
| :--- | :---: | :---: |
| PACE PRD800, PRD900 | SATPSU1 | 600 p |
| PACE SS9000, 9200, 9010, 9210, 9220 | SATPSU2 | 550 p |
| AMSTRAD SRD510, SRD520 | SATPSU3 | 600 p |
| AMSTRAD SRD500 | SATPSU4 | 600 p |
| AMSTRAD SRX340, SRX345, SRX350 | SATPSU5 | 600 p |
| PACE D100/150 | SATPSU6 | 650 p |
| CHURCHILL D2MAC | SATPSU7 | 650 p |
| PACE MSS100 | SATPSU8 | 730 p |

## SATELLITE TUNERS

PACE PRD800/MSS200 2Ghz (221-2077062) ORDER CODE: TUNER01 PRICE: 1400p + VAT
PACE PRD900/MSS1000 2Ghz (221-21770112) ORDER CODE: TUNER02 PRICE: 1400p + VAT

## SWITCH MODE TRANSFORMERS PACE 9000 <br> ORDER CODE: PACE9000 PRICE: 800p <br> PRD800/PRD900 <br> ORDER CODE: PRD800 PRICE: 550p

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

## SATMETER

The Satmeter is a professional portable satellite strength meter designed for the installation and maintenance of satellite TV systems. The Satmeter can be used as stand alone with powering the LNB as well as in loop.
Through operation with satellite RX powering the LNB.

* Acoustical signal: On signal strength *LED indicator: Vert/Hori
* Frequency Range: 900 to 2050 Mhz *input impedence: $\mathbf{7 0}$ Ohm
* Power amplifier: 18db *Detection Range: -60 to -10 DBM
* Max. input signal: -10 DBM

ORDER CODE: TOOL22
PRICE: 8500p

| REPLACEMENT TV SWITCHES |  |  |
| :---: | :---: | :---: |
| GRUNDIG | SONY | SONY |
| PART No: 29703, 29102 | USED ON: | USED ON: KV2020 |
| $\begin{aligned} & \text { USED ON: } \\ & \text { C7500, C8500. C8502, C8712 . . ETC } \end{aligned}$ | KV1612, KB1612, KV1614, KV2052, V2056 KV2062, KV2067, KV2212 . . .ETC | KV2020 <br> (POWER SWITCH $21 \mathrm{~mm}+$ Remote) |
| Order Code: SW1 Price: 140p | Order Code: SW5 ${ }^{\text {S }}$ | Order Code: SW6 Price: 200p |
| PHILIPS | USED ON: |  |
| USED ON: | KV1400, KV1440, KV2040, KV2060 (POWER SWITCH 26 mm ) | SONY 2 PIN FUNCTION SWITCH |
|  | Order Code: SW12 Price: 125p | Order Code: SW9 Price: 35p |


|  |  |  |
| :---: | :---: | :---: |
|  | TIME LAG |  |
| CURRENT RATING | ORDER CODE |  |
| 100 mA | FUSE36 |  |
| 160 mA | FUSE01 |  |
| 250 mA | FUSE02 |  |
| 315 mA | FUSE03 |  |
| 400 mA | FUSE04 |  |
| 500 mA | FUSE05 |  |
| 630 mA | FUSE06 |  |
| 800 mA | FUSE07 |  |
| 1A | FUSE08 |  |
| 1,25A | FUSE09 |  |
| 1.6A | FUSEIO |  |
| 2A | FUSEI] |  |
| 2.5A | FUSE12 |  |
| 3.15A | FUSE13 |  |
| 4A | FUSE14 |  |
| 5A | FUSE1S |  |
| 6.3A | FUSE16 |  |
| CDRAMED |  |  |
| CURRENT RATING | ORDER CODE | PRICE |
| 3A | FUSE33 | 100p |
| 5A | FUSE34 | 100p |
| 13A | FUSE35 | 100p |
| 32 mm CERAMIC SLOW BLOW |  |  |
| CURRENT RATING | ORDER CODE | PRICE |
| 8A | FUSE44 | 185p |
| 10A | FUSE4S | 185p |
| 15A | FUSE46 | 185p |
| 20A | FUSE47 | 210p |

NB. All fuses are made in the UK and fully meet BS4265 \& BS1362 safety standards and should not be compared with cheap imported types

## VOLTAGE TESTER

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

PRICE: 220p

\section*{20mm CERAMIC TIME LAG <br> | CURRENT RATING | ORDER CODE | PRICE |
| :--- | :--- | :--- |}


| 6.3 A | PRICE |  |
| :---: | :---: | :---: |
| 8 A | FUSE38 | 100 p |
| 10 A | FUSE39 | 100 p |
| 3.15 A | FUSE40 | 100 p |
| 4 A | FUSEA1 | 85 p |
| 5 A | FUSE42 | 85 p |



## FAULT FINDING / COMPARISON BOOKS

Satellite Fault Finding Guide Issue 1. Listing about 1,000 faults for over a range of 24 different brands. Order Code: BOOK05.
Price $£ 8.50$ - No VAT.
Video Recorders Edition 51997
Over 300 pages packed with more than 5500 faults for different brands
Price $\mathbf{£ 1 5 . 0 0}$ - No VAT. Order Code: BOOK01

| SERVICEADS |  |  |  |
| :---: | :---: | :---: | :---: |
| DESCRIPTION | VOLUME | COOE | PRICE |
| VIDEO HEAD CLEANER | 75ML | SPO1 | 145p |
| SWITCH CLEANER | 176ML | SP02 | 155p |
| SILICONE GREASE | 200 ML | SP03 | 180 p |
| FREEZE IT | 170ML | SP04 | 295p |
| FREEZE IT | 400ML | SP16 | 580p |
| FOAM CLEANER | 400 ML | SP05 | 180p |
| ANTI-STATIC | 200ML | SP06 | 180p |
| AEROXLEANE | 200ML | SP07 | 200p |
| AERO DUSTER | 200ML | SP08 | 340p |
| AERO DUSTER | 400 ML | SP17 | 580p |
| PLASTIC SEAL | 200ML | SP09 | 250p |
| GLASS CLEANER | 250ML | SP10 | 170p |
| COLDKLENE | 250ML | SPi3 | 235p |
| EXCEL POLISH 80 | 250 ML | SP18 | 180p |
| ADHESIVE 120 | 400 ML | SP19 | 225p |
| LABEL REMOVER 130 | 200ML | SP20 | 260p |
| REFURB 140 | 400 ML | SP21 | 260p |
| TUBE SILLCON GREASE | 50 GRAMMES | SPII | 225p |
| TUBE SILICON SEALANT WHITE | 75ML | SP22 | 250p |
| TUBE SILICON SEALANT CLEAR | 75ML | SP23 | 250p |
| TUBE HEAT SINK COMPOUND | 25 GRAMMES | SP12 | 150p |
| DRIVE CLEANER | 200ML | SP24 | 150p |
| SCREEN CLEANER | 200ML | SP25 | 145p |
| COMPUTER CARE KIT | - | SP26 | $2100 p^{2}$ |

All the above items are manufactured by Servisol If you purchase more than one Servisol Product, postage \& package will be charged as follows:
300p for $\mathbf{2 - 5}$ cans $\quad \mathbf{5 0 0 p}$ for more than 5 cans

## TELEVISION

 Edition 6Lists more than 8,450 faults with $\mathbf{4 6 0}$ pages covering 58 different brands Price: 1600p only - no VAT. Order Code: BOOK02

## Satellite Repair Manual Edition 4

A comprehensive guide to receiver reviewing, featuring stock faults and installation tips.
Price f15.00 Only No VAT Postage 100p Order Code: BOOK03

## SOLDERING ACCESSORIES

 CODE PRICE


ANTEX SOLERINGIRONS
25 WATT 240 VAC ( $\times$ SS25 240V)
15 WMTT ${ }_{25}$ WATT SPARE ELEMENT $\quad \$ 103.400 \mathrm{M}$ 15 WATT SPARE ELEMENT S104 450p
SOLDERING STAND \& SPONGES
SOLDERING STAND (MADE BY ANTEX) SPARE SPONGE
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170p
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170p
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## CD PICK UPS

| Modela \& Description | Order Code | Price |
| :---: | :---: | :---: |
| ANHA |  |  |
| XC007 | KSSS151A | 1900p |
| DX-990A, DX-DIA | KSS152A | 16000 |
| CXN550G, CXN990, CXN999, CXNV20, CXSL70, DXZ9100M, FDN636, FDN6636, FDN939, |  |  |
|  |  |  |
| NXS990, NSX992, NSX 999 , NSXD636, NSXC939, NSXV20, SXFN550.SXFN520, XC300, |  |  |
| XC550, XC750, XC900, $\mathrm{XC950}$, XCN992, XG320, XG360, XG400, XG990, $2 \mathrm{C} 3000 \mathrm{M}, \mathrm{ZD3100M}$ | KSS152A | 1800p |
| CXAP1, CXL7, CXL8G, CXLC50P, CXZ58, DXM740, DXM75, DXM76, DXM77, LCX50, LCX7, |  |  |
| LCXBG, LCXAP1, XC002, XC004, XCO05, XC777 | KSS210B | 2000p |
| XP31, XP33, XP55, XP80G | KS220A | 2500p |
| XP6. ${ }^{\text {P }}$ P7 7 | KSS331A | 3400p |
| AkAI |  |  |
| CD73, DC93 | KSS151A | 1900p |
| CD25, CD26, CD27, CD32, CD36, CD37, CD52, CD55, CD57, CD650, CD670, CD69, CD750, CD |  |  |
| CDM480, CDM 600, CDM 670, CDEM 770, | KSS210A | 1800p |
| DENON |  |  |
| DCD150011, DCD1520, DCDE3520 | KSS151A | 1900p |
| DCD1400, DCD600, DCD800 | KS152A | 1600p |
| DCD1420, DCD520, DCD610, DCD620, DCD660, DCD810, DCD820, DCD860, DCD910, DCD9920 | KSS210A | 1800p |
| DCD1015, DCD1290, DCD2060, DCD2060G, DCD315, DCD480, DCD580, DCD615, DCD715, |  |  |
| DCD825, DCD890, DCO895, DN2000F | KSS240A | 2500p |
|  |  |  |
| CD952A. CD952AJ, CDP52LL, CD952SJ, FFH 101KL, FFH101WL, FFH222AA, FFH272L, FFH 333 L , FFH 373 K, FJ606, FR 606 L | KSS210A |  |
| CD320AL, CD630S/L, FFH212A/L.FFH212E | KSS2108 | 2000p |
| GRUNDIG |  |  |
| CD360, CD435 | HOPM3 | 2150p |
| CCD 300, CD 101MCD904, MC10, NEW ORLEANS CD | KSS210A | ${ }^{1800}{ }^{19}$ |
| KRCD 100, RR1900CD, RR3100CD, RR4000CD, RR610CD, RR700CD | KSS2108 | 2000p |
| CDP60, CDP90 | KSS220A | 2500p |
| CDP65 | KS5331A | 3400 p |
| CDS05 | OPTIMA5 | 3000p |
| HITACH |  |  |
| DAW560 | HOPM3 | 2150p |
| FX-10 | KSS210A | ${ }^{1800} \mathrm{p}$ |
| AXC10 | KSS2108 | 2000p |
| J.V.C. |  |  |
| 1990-1992, LATE 1987.1988 - XLE3008K, XLE31BK, XLE51BK, XLE900BK, XLME91BK, XLV101BK, <br>  | OPTIMA3 | 4000p |
| CDRADIO CASSETIE, MINI SYSTEMS - MODELS 1990-1992 | OPTMA4S | 5000p |
| CAC $33, \mathrm{CA}$-MX 30 BK , CA-MX33BK, UX-A5, UX-A6, XL-M309, XL-M4038K, XL-M408, XL-M409, |  |  |
|  |  |  |
| XL-V241TN, XL-242BK, XL-V251TN, XL-V252BK, XL-Z1050TN, XL-Z551TN, XL-Z5528K | OPTIMA5 | 3000p |
| 1994 ONWARDS -CAE4BBK, CAMCG7, CAMXG9, CAS20BK, CAS30BK, VAS50, CAS60RB |  |  |
| MXS20, MXS30, MXS60, PCX 105, PCX130, PCX95, RCX230, RCX320, RCX520, RCX620, RCX720 UXA4 UXA5, UXA55, UXC7 UXT1 UXT3 XLF115, XLF 116 , XLF 215 XLF218 |  |  |
|  |  |  |
| XLMC100,M, XLMXG7, XLMXG9, XLV163TN, XLV164BK, XLV174, XLV263TN, XLV264BK, |  |  |
| XLV2748K, XL2463TN, XLZ464BK, XL2574, XLZ874, XTMXG7, XTMXG9, XTS60 | OPTIMA6S | 3300p |
| KENWOOD |  |  |
| DP47, DP660SG, DP8020, DP87, L1000D | KSS152A | 1600 p |
| DP1030, DP1510, DP2010, DP2030, DP3010, DP3030, DP3050, DP4030, DP491, DP5010, DP5030, DP5040, DP520, DP7030, DP7040, DP7050, DP730, DP920, DP930, DP950, DPM650, DPM6630, |  |  |
|  |  |  |
| DP5040, DP520, DP7030, DP7040, DP7050, DP730, DP920, DP930, DP950, DPM650, DPM6630, DPM7730, DPM850, DPM991, DX6620, M225, M25, M450, M850, PD3030, PDM991, RDX25, |  |  |
| RXDC3, RXDC3L, UD202, UD302 | KSS210A | 1800p |
| DPC42, DPC72, DPC77, DPC80, DPC92 | KSS220A | 2500p |
| DP1050, DP2050, DP3060, DP501, DP5060, DP722, DP76, DP85, DPB9, M774, PD3060, |  |  |
| UD502, UD70, UD701, UD90, XE5 | KS5240A | 2500p |
| DPC321, DPC521, DPC531, DPC631K, DPC721, DPC731 | KSS3314 | 3400p |
| DP1060, DP2060. PART No: RCTRH8136AFZZ | RH8136A | 45009 |
| panasonic |  |  |
| SLP177A, SLP202A, SLP212A, SLP222A, SLP277A, SLP377A, SLP477AK, SLP477A, SLPG100A, SLPG200A, SLPG400A, SLPG500AK, SLPG500AS, SLPJ24A, SLPJ26A, |  |  |
|  |  |  |
| SLPJ27A, SLP J28A, SLPJ325A, SLPJ325A, SLPJ37A, SLPJ38A, SLPJ46A | 691-30209 | 6500p |


|  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Description | Code | Price | Description | Code | Price | Description | Code | Price | Description | Code | Price |
| AKAI |  |  | A512120/230 | RCSOO | 650p | PANASONIC |  |  | SONY |  |  |
| RC-V10A | RC876 | $650 p$ | A514790 | RC901 | $650 p$ | EUR51200 | RC200 | 650p | RM604, RM605, RM606 | RC140 | 650p |
| RCV 378 | RC891 | 650p | A5088470 | RC902 | $650 p$ | TC2200 | RC204 | 650p | 32 CHANNEL | RC140 | 650p |
| V25A | RC896 | 650p | A518612 | RCS03 | 650p | VS00357/NV730 | RC202 | 650p | RM613 | RC141 | 650 p |
| DECCA |  |  | SCL002 | RC904 | 650 p | TNQ162t | RC203 | 650p | RM632, RM636 | RC160 | 600p |
| RC70 | RC894 | 650p | ${ }^{\text {C } 2096 ~}$ | RC905 | 650 p | PHILIPS |  |  | tatung |  |  |
| FISHER |  |  | A511940 655602 H | RC906 RC1920 | 650p | RC5002,5154 | ${ }_{\text {RC1 }}$ | 650 p | FXA | RC877 | 650 p |
| RC905B | RC879 | 650p | 655602 H | RC1920 | 650p | KT3 NON TEXT 69117032 | RC135 RC178 | 650p 650p | RC70 | RC883 | 650 p |
| GRANADA |  |  | IFB13, 14, 15 | RC143 | 650p | 69117194 | RC180 | 650p | FX70 FASTTEXT | RC894 | 650 p |
| UNIVERSAL TEXT | RC309 | 650p | FS4 ${ }^{\text {a }}$ | RC148 | 650p | RC5991-UNIV | RC300 | 550p | TELEFUNKEN |  |  |
| MK4 TEXT, 70155G, 70115G, 70133G | RC880 | 650p | RG305 | RC305 | 650 p | RC38 | RC301 | 650p | F8632 | RC632S | 650p |
| 95288 E ( ${ }^{\text {a }}$ | RC882 | 650p | RG306 | RC306 | 650 p | KT3 TEXT | RC5301 | 650p | FB639 | RC639 | 650 p |
| 94490D | RC884 | 650p | FS9/1-10/1 | RC307 | 650p | RC5352 | RC5352 | 650p | THORN/FERGUSON |  |  |
| GRUNDIG |  |  | VS5 RUK | RC308 | 650p | RC5375 | RC5375 | 650p | 3V35-42 | RC342 | 600p |
| TP IGOE | RC107 | 650 p | VS4-1 | RC308 | 650p | RC5 STANDARD | RC300 | 550p | 3V31-32 | RC344 | 650p |
| TP200, TP300 | RC107 | 650 p | MULTICONTROL (17C20) | RC311 | 650 p | RC5903 | RC5903 | 650p | 3V57-58 | RC628 | 650 p |
| TP200, TP300 | RC380 | 650 p 600 p | MULTICONTROL (17C20) | RC3II | 650p | SALORA |  |  | TXIO TEXT | RC732 | 575p |
| TP590-600 | RC600 | 6500 | LOEWE | RC146 | 650 p | SERIES L | RC190 | 650 p | TX10 STEREO TEXT | RC738 | 575p |
| TP390, TP610 | RC610 | 650p | 0 Cl | RC146 | 650p | 86173 | RC882 | 650p | TC9-90-100 | RC740 | 600p |
| TP621 | RC612 | 650p | MATSUI |  |  | SANYO |  |  | 3V55, FV11 | RC783 | 650p |
| TP630, TP650 | RC650 | 650p | 010270801 | RC889 | 650 p | RC218, RC222, RC228, RC238 | RC140 | 650 p | TX100 FASTTEXT | RC789 | 650 p |
| TP666 | RC660 | 650p | VX770 | RC892 | 650p | ${ }^{\text {JXGE }}$ | RC878 | 650 p 650 | TX 100 ST, FASTTEXT | RC789 | 650p |
| TP661 | RC661 | 650p | NOKIA |  |  | VHR2300 | RC890 | 650 p | PROFESSIONAL | RC790 | 650p |
| HITACHI |  |  | SATELLITE | RC550 | 650p | RC628 | RC865 | 650 p | TOSHIBA |  |  |
| CLE800-CLEB30 | RC140 | 650p | ORION |  |  | SHARP |  |  | CT937 | RC950 | 650p |
| A617402/655602 | RC1920 | 650p | RC53 | RC892 | 650p | G0121CESA, 123CESA, 204, 251 | RC140 | 650p | CT9117 | RC951 | 650p |

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A single remote control to operate Televisions, Videos and Satellite Receivers Plus Auxiliary Options!

- Replaces up to 8 remotes with one - Simple 4 digit setup routine
- Controls 1000 s of models - Teletext functions with Fastext
- Clear (large key) layout Code Seareh broken
- Original remote not required

Order Code: 8 WAY

## 2 way Preprogrammed Universal Remote

- Replaces up to 2 remotes (TV/Satellite)
- Simple key arrangement

Order Code: 2 WAY

| Part No. | Code | Price | HITACHI |  |  | 45150119 | LOT169 | 1500p | Tif 14520 F | LOT40 | 1500p | 094-01020/0.7 | LOT59 | 1400p | 1-439-303-31 | LOT94 | 1300p |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| AKAI |  |  | 2424593 | LOT44 | 1050p | 45150124 | LOT137 | 1600p | TLF 14521 F | Lотз9 | 1850p | 094-01021/0.6 | LOT59 | 1400p | 1-439-303-32 | LOT94 | 1300p |
| 45150344 | LOT56 | 1650p | 2432101 | L0779 | 1600p | 45150146 | LOT136 | 1800p | TLF 14567 F | LOT39 | 1850p | 094-01027/0.0 | LOT186 | 1825p | 1-439-311-00 | 10795 | 1550p |
| 101-214017-03 | LOT278 | 1300p | 2432461 | LOT169 | 1500p | 45150301 | LOT169 | 1500p | TLF 14568 F | LOTAO | 1500p | 094-01038/0.7 | LOT245 | 1900p | 1-439-311-11 | LOT95 | 1550p |
| 101-220005-03A | L0772 | 1600p | 2432611 | LOTBO | 1800p | 45150302 | LOT180 | 1550p | TLF 14584 F | LOT4 4 | 2000p | 094-01052/0.8 | LOT186 | 1825p | 1-439-317-13 | LOT95 | 1850p |
| D 050/37 | LOT27 | 1450p | 2432651 | LOT80 | 1800p | 45150304 | LOT169 | 1500p | TLF 14586 F | LOT42 | 1800p | 094-01057/1.1 | LOT285 | 1450p | 1-439-311-31 | LOT95 | 1550p |
| D 053/37 | LOT207 | 1550p | 2432761 | LOT169 | 1500p | 45150305 | LOT180 | 1550p | TLF 15606 F | LOT256 | 2000p | 610.018.6620 | LOT189 | 1850p | 1-439-311-32 | LOT95 | 1550p |
| D 056/37 | LOT56 | 1850p | 2432981 | LOT37 | 1200p | 45150306 | LOT188 | 1550p | TLF 70012 | LOT78 | 1800p | 610.018.6637 | LOT215 | 1800p | 1-439-331-22 | LOT96 | 1550p |
| D 059/37 | LOT200 | 1400p | 2432981 | LOT37 | 1200p | 45150308 | LOT22 | 1250p | TLF 70012 F | L0778 | 1500p | SHARP |  |  | 1-439-331-41 | LOT98 | 1550p |
| D 069/37 | LOT56 | 1850p | 2432982 | LOT37 | 1200p | 45150309 | LOT178 | 1500p | TLF 70012A | LOT78 | 1500p | RTRNF 1220 CEZZ | L0T39 | 1850p | 1-439-332-00 | LOT99 | 1600p |
| FCM 2015 AL | 10178 | 1500p | 2433011 | LOT171 | 1050p | 45150310 | LOT168 | 1650p | TLF 70018 | LOT274 | 1650p | RTRNF 1783 BMZZ | LOT202 | 1800p | 1-439-332-11 | LOT9 | 1600p |
| FERGUSON |  |  | 2433012 | LOT171 | 1650p | 45150313 | LOT30 | 1250p | TLF 70018F | LOT274 | 1580p | RTRNF 1783 CEZZ | LOT202 | 1800p | 1-439-332-21 | L0T99 | 1800p |
| $00 \mathrm{D}-3-508-001$ | LOT38 | 1250p | 2433014 | LOT171 | 1850p | 45150314 | LOT174 | 1400p | TLF 70161 | LOT278 | 1300p | RTRNF 1786 BMZZ | L0 | 1850p | 1-439-332-4 | LOTIOO | 1500p |
| 00D-3-508-002 | LOT38 | 1250p | 2433212 | LOT168 | 1500p | 45150315 | LOT22 | 1250p | TLF 70162 | LOT72 | 1800 p | RTRNF 1786 CEZZ | LOT211 | 1850p | 1-439-332-42 | LOT101 | 1450p |
| $00 \mathrm{D}-3-508-003$ | LOT276 | 1400p | 2433291 | LOT172 | 1350p | 45150318 | LOT192 | 1550p | TLF 70162A | LOT72 | 1600p | RTRNF 2000 BMZZ | LOT214 | 1000p | 1-439-332-52 | LOTIOO | 1500p |
| 000 -3-515-001 PL1 | LOT276 | 1400p | 2433301 | LOT246 | 1000p | 45150319 | LOT30 | 1250p | TLF 70162B | LOT72 | 1600p | RTRNF 2002 BMZZ | LOT307 | 1460p | 1-439-333-00 | LOT270 | 1550p |
| 00 D-4-208-001 | 10779 | 1600p | 2433441 | LOT188 | 1900p | 45150320 | LOT190 | 1850p | TLF 70162G | LOT72 | 1800p | RTRNF 2002 CEZZ | LOT307 | 1450p | 1-439-333-11 | LOT270 | 1550p |
| $00 \mathrm{C}-4-208-002$ | 10779 | 1600p | 2433442 | LOT191 | 1000p | 45150322 | LOT196 | 1550p | TLF 77001 B | LOT274 | 1650p | RTRNF 2003 BMZZ RTRNF 2004 BMZ | LOT30 | 1350p | 1-439-333-12 | LOT270 | 1550p |
| $00 \mathrm{O}-4-235-002$ | LOT240 | 1250p | 2433451 2433452 | LOT81 LOT82 | 1350p | 45150324 45150325 | LOT194 | 1550p | PHILIPS 482214010142 | LOT142 | 1800p | ATRNF 2004 BMZZ RTRNF 2005 BMZZ | LOT308 | 1450p | 1.439-363-11 | LOT268 | 1400p |
| $00 \mathrm{D}-4-235-002 \mathrm{HTI}$ | LOT81 | 1350p | 2433452 243453 | 10782 | 1250p | 45150326 | LOT198 | 1550p | 4822140101145 | LOT134 | 1460p | RTRNF 2006 BMZZ | LОт308 | 1350p | 1-439-363-21 | LOT268 | 1400p |
| $00 \mathrm{D}-4-235-00201 \mathrm{G}$ | LOT81 | 1350p | 2433455 | LOT234 | 1600p | 45150328 | LOT27 | 1450p | 482214010146 | LOT112 | 1700p | RTRNF 2007 BMZZ | Lотз07 | 1450p | 1-439-387-11 | LOT311 | 1450p |
| $00 \mathrm{D}-4-260-004 \mathrm{HT}$ | LOT38 | 1250p | 2433521 | LOT85 | 1600p | 45150329 | LOT193 | 1550p | 482214010151 | LOT102 | 1700p | RTANF 2023 BMZZ | LOT310 | 1500p | 1-439-387-21 | LOT311 | 1480\% |
| $00 \mathrm{H}-0.701-2400$ | LOT182 | 1450p | 2433581 | LOT22 | 1250p | 45150330 | LOT179 | 1550p | 482214010161 | LOT103 | 1250p | SONY |  |  | 1.439-466-11 | LOT255 |  |
| $06 \mathrm{D}-3.083-001$ | LOT82 | 1250p | 2433721 | Lот83 | 1400p | 45150331 | LOT207 | 1550p | 482214010171 | LOT104 | 1600p | 3753100 | LOT275 | 1500p | 1.439-46-21 | LOT255 |  |
| $06 \mathrm{D}-3-083-002$ | LOT82 | 12500p | 2433751 | LOTO1 | 1300p | 45150334 | LOT56 | 1850p | 482214010176 | LOT114 | 1150p | 1-439-243-00 | LOT91 | 1600p | 1-439-416-23 | LOT255 | 1800p |
| 06 D-3-084-001 | LOT23 | 1400p | 2433752 | LOTO1 | 1300p | 45150335 | LOT193 | 1550p | 482214010194 | LOT105 | 1500p | 1-439-243-11 | LOT91 | 1600p | 1-439-416-41 | LOT255 | 1800p |
| 06 D-3-088-001 | LOT84 | 1450p | 2433752 | LOT250 | 1350p | 45150338 | LOT27 | 1450p | 482214010198 | LOT116 | 1600p | 1-439-243-12 | LOT91 | 1600 | 1.439-416-51 | LOT255 | 1600p |
| 06 D-3-093-001 | LOT204 | 1600p | 2433891 243392 | LOT23 | 1400p | 45150340 45150341 | LOT200 | 1400p | 482214010201 482214010236 | LOT104 | 1500p | 1-439-243-31 | LOT229 | 1700p | 1-439-430-21 | LOT271 | 1550p |
| 06 D-3-095-001 | L0787 | 1000p | 2433893 | LOT23 | 1400p | 45150343 | LOT196 | 1550p | 482214010246 | LOT111 | 1500p | 1-439-243-41 | LOT229 | 1700p | 154125A | LOT275 | P |
| 06 D-3-095-002 | L0787 | 1000p | 2433952 | Lотз3 | 1000p | 45150344 | LOT56 | 1650p | 482214010247 | LOT105 | 1500p | 1-439-244-00 | LOT48 | 1600p | TOSHIBA |  |  |
| $06 \mathrm{D}-333-512-001$ | LOT204 | 1600p | 2434002 | LOT200 | 1400p | 45150346 | LOT201 | 1550p | 482214010254 | LOT107 | 1460p | 1-439-244-11 | LOT48 | 1600p | 37010 | LOT131 | 1450p |
| FETX 10090 DEG | LOTO4 | 1500p | 2434141 | LOT33 | 1000p | 45150350 | LOT27 | 1450p | 482214010263 | LOT117 | 1550p | 1-439-244-21 | LOT48 | 1600p | 37011 | LOT131 | 1450p |
| FETX 90 WHTTE | LOT06 | 1650p | 2434141 | LOT33 | 1000p | 45150351 | LOT27 | 1460p | 482214010269 | LOT210 | 1350p | 1-439-244-31 | LOT48 | 1600p | 37012 | LOT131 | 1450p |
| FETX 100100 DEG | LOT34 | 1500p | 2434274 | LOT44 | 1050p | 45150375 | LOT56 | 1650p | 482214010271 | LOT208 | 1650p | 1-439-256-00 | LOT45 | 1650p | 37013 | LOT131 |  |
| GRUNDIG |  |  | 2434274 | LOT44 | 1050p | 45161601 | LOT22 | 1250p | 482214010274 | LOT 123 | 1450p | 1-439-256-11 | LOT45 | 1630p | 37014 |  |  |
| 29201.008 .01 | LOT153 | 1750p | 2434453 | LOT86 | 1600p | MITSUBISHI |  |  | 482214010282 | LOT122 | 1300p | 1-439-256-21 | LOT45 | 1650p |  |  |  |
| 29207.014.01 | LOT140 | 1500p | 2434455 | LOT234 | 1800p | 731003 | 10 T 51 | 1550p | 482214010283 | LOT104 | 1500p | 1-439-256-22 | LOT45 | 1650p | 37016 37017 | LOT131 LOT131 | $\begin{aligned} & 1450 \mathrm{p} \\ & 1450 \mathrm{p} \end{aligned}$ |
| 29201.015 .01 | LOT149 | 1400p | 2434593 | LOT44 | 1050p | 276-16399 | LOT49 | 1500p | 482214010294 | LOT125 | $2150 p$ | 1-439-276-21 | LOT230 | 1700p | 37017 37018 | LOT131 LOT131 | $\begin{aligned} & \text { 1450p } \\ & \text { 1450p } \end{aligned}$ |
| 29201.017 .01 29201.018 .01 | LOT60 LOT163 | 1250p | 2435062 | LOT296 | 1400p | 334 B 07803 | LOT50 | 1450p | 482214010306 | LOT110 | 1200p | 1-439-280-00 | LOT92 | 1600p | 37018 37019 | LOT131 | $\begin{aligned} & 1450 \mathrm{p} \\ & 1450 p \end{aligned}$ |
| 29201.018 .01 29201.018 .02 | LOT163 | 1300p $1700 p$ | 2435121 | LOT87 | 1000p | 334 B 078030 | LOT50 | 1450p 1600 p | 482214010325 482214010326 | LOT132 | 1500p $1300 p$ | $1-439-280-13$ $1-439-286-00$ | LOT92 | 1600p 13000 | 1810951 | LOT55 | 1400p |
| 29200.019.01 | LOT62 | 1250p | 2435131 2435141 | LOT251 | 1450p | 334 B 08104 334 B 08108 | LO174 | 1600p 1600 p | 482214010326 482214010328 | LOT122 | 1300p 1450p | 1-439-286-00 | LOT46 | 1300p 1300p | 2433751 | Lот01 | 1300p |
| 29201.019 .02 | LOT62 | 1250p | 2435301 | LOT88 | 1450p | 334 P 18506 | LOT51 | 1550p | 482214010349 | LOT106 | 1250p | 1-439-286-12 | LOT46 | 1300p | 2433752 | LOT250 | 1350p |
| 29201.022.01 | LOT63 | 1700p | 2435671 | LOT89 | 1800p | 334 P 18507 | 10775 | 1500p | 482214010353 | LOT284 | 1450p | 1-439-286-13 | LOT46 | 1300p | 23236023 | LOT281 | 1300p |
| 29201.022.02 | LOT166 | 1600p | 2436201 | LOT109 | 1200p | 5908-05008A-AA | 10170 | 1500p | 482214010356 | LOT284 | 1400p | 1-439-286-21 | LOT46 | 1300p | 23236052 | LOT131 | 1450p |
| 29201.022.03 | LOT165 | 1350p | 2436202 | LOT109 | 1200p | D 108/37 | LOT49 | 1500p | 482214010367 | LOT286 | 1400p | 1-439-288-00 | LOT228 | 1750p | 23236098 | LOT288 | 1400p |
| 29201.022.04 | LOT165 | 1350p | $2432101-2$ | $\underline{0179}$ | 1600p | DCF 1577 | LOT273 | 1700p | 482214010369 | LOT109 | 1200p | 1-439-288-12 | LOT228 | 1750p | 23236198 | LOT288 | 1400p |
| 29201.022.04A | LOT165 | 1350p | 2433451H | L0781 | 1350p | DCF2077A | LOT272 | 1300p | 482214010381 | LOT128 | 1300p | 1-439-289-00 | LOT47 | 1400p | 23236255 | LOT289 | 1500p |
| 29201.024 .01 | LOT65 | 1500p | 2433453H | 10782 | 1250p | KFS 602268 | LOT279 | 1550p | 482214010384 | LOT127 | 1550p | 1-439-289-21 | LOT47 | 1400p | 23236424 | LOT129 | 1400p |
| 29201.024.04 | LOT164 | 1400p | 2433891H | LOT23 | 1400p | MSH-1FBW08 | 10178 | 1500p | 482214010395 | LOT116 | 1600p | 1-439-289-22 | LOT47 | 1400p | 23236425 | LOT288 | 1400p |
| HINARI |  |  | 2433892G | LOT84 | 1450p | NIKKAI |  |  | 482214010406 | 10173 | 1150p | 1-439-289-31 | LOT47 | 1400p | 23236428 | LOT289 | 1500p |
| 154138 K | LOT24 | 1500p | I.T.T. |  |  | BABY10 | LOT67 | 1450p | 482214010421 | LOT109 | 1200p | 1-439-294-00 | LOT93 | 1450p | 3122113837019 | LOT131 | 1450p |
| 5113914 1 | LOT24 | 1500p | 45150108 | LOT113 | 1400p | ORION |  |  | 482214017078 | LOT103 | 1250p | 1-439-294-11 | LOT93 | 1450p | 150F6D | LOT131 | 1450p |
| 51149841 | LOT24 | 1500p | 45150115 | LOT136 | 1600p | 3714002 | LOT02 | 1500p | SANYO |  |  | 1-439-294-21 | LOT269 | 1550p | TFB 4039 AD | LOT293 | 50p |
| CF 44 A | LOT24 | 1500p | 45150116 | LOT139 | 1675p | PANASONIC |  |  | 094-00020\%.9 | LOT113 | 1400p | 1-439-303-00 | LOT94 | 1300p | TFB 4048 AD | LOT281 | 1300 p |
| HM51-1411834-1 | LOT24 | 1500p | 4515017 | LOT139 | 1675p | TLF 14512 F | LOT39 | 1850p | 094-00035/0.2 | LOT162 | 1350p | 1-439-303- | LOT94 | 1300p | TFB 4048 BD | LOT281 | 30 op |



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# HELP WANTED 


#### Abstract

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


Wanted/for disposal: Require circuit diagram/spec information for the Tripole Data TC1017 17in. monitor. Have for disposal a Microvitec 16in. open-frame RGB/PAL monitor with separate Philips UHF/VHF/teletext tuner at £30. Adrian Casper, 25 Cheltenham Place, Kenton, Harrow, Middx HA3 9NB. 0956398452.
Wanted: Service information for the National TV Model TC212MRN and the Sony Model HCD-H7 mini hi-fi system. D. Leong, PO Box 350, Seria KB1133, Brunei-Darussalam. Wanted: Power supply and/or service manual for the Brother BCN3286/52 80286-16 computer. Mike Newsome, 28 Horne Street, Denby Dale Road, Wakefield, W. Yorks WF2 8EA. 01924379867. For disposal: 240 V input autotransformer with 120 V output at 17.4A, 2,000VA. Upright shrouded. US style outlet. $4.5 \times 6.6 \times 6 \mathrm{in}$. $£ 50$. Very heavy - buyer to collect. David Martin, 10 Alpha Place, Bishop's Stortford, Herts CM23 2HN. 01279656426.
Wanted: Complete plug-in power supply for the Philips VR6585/05 VCR or whole working machine. W. Murgatroyd, 7 Currie Hill Close, London SW19 7DX. 0181 9460415.

Wanted: Main PCB with RF converter for the Amstrad VCR6100, also 8-push button unit for the Ferguson TX100 chassis (mechanical tuning). M.J. Putt, 32 Raynham House, Massingham Street, Stepney, London E1 4EB. 0171 7027501 or 0956195760.
Wanted: Circuit diagram and any other servicing information for the Heathkit OS2 oscilloscope. O.C.
Wells, 45 Levendale Road, Forest Hill, London SE23 2TP. 0181291 4402.

Wanted: Lower drum unit for the Panasonic VCR Model NVF65 - or complete upper/lower drum assembly if the lower drum is known to
be working. Duncan Hutson, 72 Winterhill Road, Richmond Park, Kimberworth, Rotherham, S. Yorks S61 2EN. 01709558750.
Wanted: A TDA1770 and a TDA1950 IC for the Grundig CUC95 chassis - alternatively a panel would do (no. 29504-00792). Also require circuit diagram for this chassis, photocopy or loan OK. S. Hooper, 74 Gloucester Road, Littlehampton, W. Sussex BN17 7BS. 01903722936. Wanted: Service manual (photocopy OK) for the Sanyo CP17 CD player. F.D. Kemplay, 85 Marina View, Hebburn, Tyne and Wear NE31 1RY. 01914835634. Wanted: Module F1 or F2 (VTF0560409T) for the Pioneer PD70CD. T. Hand, 36 The Close, Portchester, Hants PO16 8AZ. 01705371148.

Wanted: Syscon/timer IC, circuit reference no. IC6001, for the Amstrad Model VCR9000 (new version). Or does anyone know of an alternative or a supplier? CPC no longer do it, nor do the companies that purchased the Amstrad spares. H. Clifford, 12 Heol y Foel, Llantwit Fardre, Pontypridd CF38 2EQ. 01443202553.
Wanted/for disposal: Require Tatung TT17 teletext PCBs; service manual for the Grundig SC303; Television Jan. 1988, Nov. 1989, Feb. and March 1990 issues. I have for disposal Television Nov. 1992 to Jan. 1993 and May 1993 to Jan. 1994. A Plenderleith, Border Electronics, Unit 10, Edenside Workshops, Kelso TD5 7JR. 01573 224864.

For disposal: Two Betamax VCRs, a Toshiba V9600B working OK and a Toshiba V8600B working but no colour. Also a Philips TV Model G20C560/05 (G8 chassis) in working order. Rafe Greenacre, 33 High Street, Airmyn, Nr. Goole, Yorks DN14 8LF. 01405764160. For disposal: Gould OS3000A dual-trace scope, $£ 100$. Tektronix

475 series 200 MHz scope, $£ 350$. Gould SG200 RF signal generator, $16 \mathrm{kHz}-230 \mathrm{MHz}, £ 30$. Leader $2-$ channel AC millivoltmeter, 1 mV $300 \mathrm{~V}, £ 45$. Insulation tester 250 V 1 kV , tests to $1,000 \mathrm{M} \Omega, £ 65$. All in good condition. Moving house so must reduce size of collection! J.P. Bell, 23 Barn Common, Woodseaves, Stafford ST20 0LR. 01785284388 (tel/fax).
Wanted: For local school, an early JVC or Hitachi video camera, 1985 era, with the round multipin plug for a 3V32 or Hitachi VT6000E (not camcorder). Working if possible. Also wanted a main board with working power supply for the Ferguson ICC5 chassis, or complete set if cheap. Items would be collected or carriage paid. Ken Darville, Avia Electronics, Station Road, Yeoford, Devon EX17 5HU. 0136384017 or 01815695696 and leave message.
Wanted: Working U20 control module for the Philips VR2020 or VR2021 VCR. Sound coil (T101) for the Bush 1006. Sound coil for the Nikkai TLG100T (T101) or TLG2121 (T203). These sound coils are no longer available but any one used with a TDA4505E chip would probably do. Also a circuit diagram for the Granada C22BY4. Paul Hardy, 43 Sheridan Avenue, Caversham, Reading RG4 7BQ. 01189475869.
Free to collector: Electronics World issues from May 1991-July 1997 and Television issues from July 1989-April 1997. Geoff Lewis, 63 Mount Road, Canterbury, Kent CT1 1YF. 01227769567.
Wanted: Remote-control handsets for the following VCRs: Mitsubishi HSM55, Sanyo VHRD4410E. E.J. Edwards, 43 Hoose Court, Market Street, Hoylake, Wirral L47 5AB. 01516320614.

Wanted: Tuner for the Philips Model 10CX1120/05R. Robert Crooks, 42 Edenderry Village, Shaws Bridge, Belfast BT8 8LG.


Reports from
Michael Maurice John Coombes
M. J. Cousins, MIEEIE Pete Gurney, LCGI Russ Phillips and Owen Green

## Panasonic NVJ30B

This machine would intermittently load or unload, sometimes stopping at various modes. I replaced the rather worn and blackened mode switch, but this failed to cure the problem. A replacement solenoid was the solution, proved by a prolonged soak test. M.M.

## Toshiba V411B

This machine wouldn't accept a tape. The belt that connects the cassette housing to the eject gear next to the capstan motor had fallen off. Replacing it wasn't the end of the story however. The machine still wouldn't load, because the motor 14V supply was low. TR201 (BD202) was found to be open-circuit. It had failed because the loading motor was faulty: when I tested it with a 12 V supply it became hot and drew 3A! A replacement loading motor finally completed the repair. M.M.

## Sony SLVE40

When play or record was selected there was a clicking noise from the mechanism and, in play, an unsteady picture would appear with wow on the sound. I found that in these modes the clutch wasn't slipping. In this mechanism there's a gear that engages with the clutch in the rewind, fast-forward and unlace modes: it engages with both sections of the clutch to give full torque in these modes. In play and record it should disengage, but didn't.

## VCR Clinic

The cause of the problem was on the top side of the mechanism, where the arm assembly trigger gear (item no. 932) that engages with the top plate was missing. Fortunately I was able to obtain one from a scrap Alba machine. This provided a complete cure. The part number is 3 -
946-920-01. M.M.

## Osaki VCR34

The cause of intermittent playback with these machines can usually be traced to dry-joints at the plugsocket connections on the top side of the deck. J.C.

## GoldStar GSE1290IQ

If one of these machines won't accept a tape, check whether diode D521 is open-circuit. J.C.

## Akai VSF410

The cause of intermittent no results was traced to dry-joints at transistor TR3. Resoldering restored normal operation. J.C.

## Samsung SV421K

There was no rewind or fast-forward operation. After the usual checks to ensure that the brakes were not jammed on and the spools were free to move I found that the lever pinch cam (T228) was incorrectly seated. Once its position had been corrected I had rewind and fast forward. J.C.

## Matsui VX1100

The problem was intermittent cutting out in the playback, rewind and fast-forward modes. After a lot of checking, the mode switch was found to be the cause. J.C.

## Sony SLV353

This fault occurs only after very fast rewind: when play is pressed at the end of the rewind, the cassette is ejected. The cause is the end-of-tape leader overlapping the sensor, thus preventing correct operation. In this
case however I found that the PH001 supply-reel sensor Q001 was open-circuit. J.C.

## Tatung TVR6111

A fault you sometimes get is intermittent operation/display. The mechanical operation can also be intermittent. Check crystal X801 which may be faulty or dry-jointed.

The cause of no rewind/fast forward is usually the rubber damper, part no. U153091. J.C.

## Matsui VP9402

It said no rewind on the ticket, but fast forward didn't function correctly either - it consisted of a series of very violent, erratic jerks. The deck mechanism, which is the same as in the VXA1100, lifts off the mother PCB. To start with I checked the mode switch, timing and idler, which were all OK.

I then turned to items 31 and 34, the clutch-gear supply and take-up assemblies respectively. They can be inspected by removing the polyslider washers. The assemblies flew apart to reveal that the shafts, which should have been hexagonal, were completely rounded on the supply assembly and partly worn on the take-up assembly. This explained the loss of rewind and erratic fast forward, as the shafts would just slip to varying extents. Replacement assemblies restored correct operation.

The only other problem I've had with these decks has been intermittent stopping and shut down, caused by the two reel sensors. M.J.C.

## Ferguson FV80B (R4000 Series)

There was cassette loading failure: when a cassette was inserted it flopped in rather than being drawn in, and the mode motor laced up without the cassette even being seated.

Tape loading should take place as
follows. When a cassette is inserted it activates a microswitch to power the loading/mode motor which drives the master cam. This is linked to the 'lever cam gear casting', which is in turn connected to the cassette rack.

Because of metal fatigue the lever cam gear casting had failed. It's positioned under the master cam. The replacement was easy to fit and restored normal operation. M.J.C.

## GoldStar GHV1240I

Tape damage was the main complaint. An initial check revealed a worn reel idler: once this had been replaced the sluggish rewind/fast forward speeded up. So far so good. But there was an extra fault comment, that the tape wouldn't rewind fully. This was a more troublesome problem.

When I watched the tape in the rewind mode it would just stop, with no sign of slowing down, struggling etc. A new reel sensor optocoupler made no difference.

A scope check showed that reel pulses were present at pin 23 of the syscon chip IC501, but they were of low amplitude. The only components between the reel sensor and the chip form a digital transistor circuit on the deck junction board. The culprit was the $8.2 \mathrm{k} \Omega$ resistor R601. It feeds Q6D0, which amplifies and sharpens the reel pulses. M.J.C.

## JVC HRJ220

The customer complained about tape damage. Tests showed that when rewinding and stopping there was much spillage from the take-up pool. I cleaned the brake pads hey are of the black-material type hat seems to disintegrate on touch but this made no difference. So eplacement brakes were ordered, also a mode switch as a preventative neasure. The brake part nos. are PQ46308A-2 (main brake) and PQ46309A-4 (sub-brake).

Mode switch replacement is quite complex, as it's buried beneath the sontrol cam. Once the mechanism las been removed, along with the iassette housing, the machine can be jut into the "mechanism assembling node". This is done by turning the node motor belt towards the front intil a hole in the cam aligns with a tole in the deck: at this point the arious holes in components line up with holes in the deck. Thus alignnent is easy.
The replacement brakes comletely cured the tape damage probem. M.J.C.

## Sanyo VHRD4890E

The complaint with this S-VHS machine was poor sound/picture in the standard VHS mode, S-VHS operation being OK . When I plugged it in however the power supply was tripping and failed to start. A quick check on the capacitors on the primary side of the power supply revealed that C5013 $(22 \mu \mathrm{~F}, 10 \mathrm{~V})$ was leaking electrolyte. When this and C5010 ( $1 \mu \mathrm{~F}, 25 \mathrm{~V}$ ) had been replaced - they are both rated at $105^{\circ} \mathrm{C}$ - the VCR powered up.

Before the power supply was recased, I checked the capacitors on the secondary side for ripple with a scope. C1 (47 $\mu \mathrm{F}, 50 \mathrm{~V}$ ) and C10 ( $330 \mu \mathrm{~F}, 6.3 \mathrm{~V}$ ) were low in value and, on removal, were found to be leaking electrolyte. At this point all the other electrolytics on the secondary side were replaced as a precaution.

Finally to the original fault, which turned out to be severe patterning and hiss on sound. They were not present in the S-VHS mode or at the scart socket. The UHF modulator was the cause. P.G.

## Sharp VCA63

This centre-deck machine frequently died then returned to life again. In view of the customer's report I suspected dry-joints, and a good look around revealed that plug PA in the power supply was virtually unsoldered. But after resoldering it the fault was still present. A further check around the power supply, with a magnifier, brought to light the fact that one leg of C9 had a hairline crack around the joint. This turned out to be the actual cause of the fault. P.G.

## Mitsubishi HSB32

This VCR came in with a partially laced-up tape stuck inside. At switch on the machine returned to standby after five seconds or so. Checks in the power supply produced correct voltage readings during the brief period before shutdown, so attention was turned to the loading motor where a voltage check confirmed the lack of any drive.

I disconnected the motor at the plug and socket on the servo deck and, to unlace the tape, applied to its contacts 9 V from a variable-voltage power supply. I find that this is usually the best way, before proceeding further, of checking the deck for correct operation - customers have a nasty habit of attempting tape removal by force, which results in additional problems once the origi-
nal fault has been put right. While the tape was unlacing I noticed that the motor had a bad spot on its commutator. As a result the motor frequently stopped and drew excessive current.

After replacing the motor I checked the TA72915 drive chip IC4A2 and found that this had also died - in fact it had split in two! Once this item had been replaced the machine worked correctly. P.G.

## Ferguson FV72

The mechanism was jammed and there was a tape in the fully loaded position. At power up the capstan motor could be heard to run just before the machine shut down. Removal of the base plate gives only limited access, but enough in this case to be able to see that the plastic pulley on the capstan motor had fallen off. It hadn't split, and could be reattached soundly with a small amount of Araldite. After that the machine worked correctly. P.G.

## Panasonic NVSD260

This reasonably new K-deck machine intermittently failed to load a tape. The cause was dry-joints at the end sensors. To be on the safe side, and because the mechanism had to be removed to get at the offending items, I also resoldered the sensor LED. R.P.

## Panasonic NVD80

This machine worked all right but the display didn't light up. There was no 33 V feed from the power supply because R1016 (2.2, $0.5 \mathrm{~W})$ was open-circuit. R.P.

## Hitachi VC102

The power-on indicator switched off after about ten seconds because the microcontroller chip sent an 'off' signal to the power supply. There was a tape inside the machine. After chasing a few red herrings I found that the STK5471 regulator chip was the cause of the fault. O.G.

## Ferguson FV105HV

Tape loading problems were caused not only by broken gears on the cassette housing but also by a tiny microswitch on the main circuit board, underneath the mechanism assembly. O.G.

## Samsung SI7220

There were no mechanical functions and the loaded tape wouldn't eject. Checks showed that the 12 V supply was low at only 2 V . The cause of the problem was the STK5333S power regulator chip. O.G.

## Sony Chassis Guide

The following list of the models fitted with each Sony CTV chassis released over the past ten years can be particularly helpful when the service manual for a particular model is not available.

## AE1 Chassis

A modular, large-screen chassis produced during 198790. Model numbers that end in T or 1 incorporate a teletext decoder. An M in the model number indicates mono sound. Nicam adaptor kits were available for some sets. Remote control units RM670, RM671. Models are as follows:

| KV21XMTU | KV21XMU | KVDX21TU |
| :--- | :--- | :--- |
| KVDX2112U | KVDX27TU | KVDX271TU |
| KVM21TU | KVM21U | KVM2511U |
| KVX2121U | KVX2129U | KVX2521U |
| KVX2529U | KVX21TU | KVX25TU |

## AEIA/AEIB Chassis

These chassis are similar to the AE1 but have different power and system control circuits. Nicam sound is standard. Produced in 1990. Remote control unit RM689. Models are:
$\begin{array}{ll}\text { KVD2512U } & \text { KVD2912U } \\ \text { KVE2512U } & \text { KVE2912U } \\ \text { KVX2132U } & \text { KVX2532U }\end{array}$
KVX2932U

## AEIC Chassis

As AE1A/B but with different microcontroller circuits. Some sets have a sophisticated colour decoder with a digital comb filter. Produced during 1991-2. Remote control units RM816, RM817, RM813. Models:

| KVA2112U | KVA2122U | KVA2512U |
| :--- | :--- | :--- |
| KVA2522U | KVA2912U | KVA2922U |
| KVC2122U | KVC2522U | KVE2922U |
| KVE2925U | KVM2521U | KVM2531U |
| KVX212U | KVX2152U | KVX2542U |
| KVX2545U | KVX2552U | KVX2942U |

KVX2952U

## BE1 Chassis

Basic mono sound chassis for small-screen sets produced during 1989-91. Model numbers that end with T or 1 incorporate teletext. Remote control units RM670, RM657, RM658. Models:

| KVM14TU | KVM14U | KVM16TU |
| :--- | :--- | :--- |
| KVM16U | KVM19TU | KVM2120U |
| KVM2121U | KVM2130U | KVM2131U |

BE2/BE2A Chassis
Basic mono sound chassis for small-screen sets pro-
duced during 1991-94. Model numbers that end with 1 incorporate teletext. Remote control units RM694, RM841, RM820, RM826. Models:

| KVM1400U | KVM1401U | KVM1410U |
| :--- | :--- | :--- |
| KVM1411U | KVM1420U | KVM1421U |
| KVM1620U | KVM1621U | KVM2101U |
| KVM2140U | KVM2141U | KVM2150U |

KVM2151U

## AE2 Chassis

Replaced the AE1C chassis for large-screen sets. Many functions controlled by an I2C bus. The first Sony sets to have service mode for all adjustments. All sets have Nicam and teletext. Produced during 1992-93. Remote control units RM830, RM832. Models:


These two chassis are very similar. They differ from the original AE2 in that they don't have a separate teletext board - the teletext circuitry is incorporated on the $M$ board. Models with $G$ in the number have a built-in Astra satellite receiver with a VideoCrypt decoder. The KVA2542/2942U have Dolby Pro-Logic sound. Sets produced during 1993-94. Remote control unit RM831. Models:

KVA2132U
KVA2932U
KVE2942U
KVS2922U
KVX2172U

## AE2F Chassis

This is a top-of-the-range chassis with 100 Hz scanning. The KVW2812U was Sony's first widescreen model. The KVW3212U is fitted with a PAL Plus decoder. Produced during 1994-95. Remote control unit RM842. Models:

## KVS2942U KVW2812U KVW3212U

## BE3B Chassis

A stereo sound chassis to replace the AE2B, though the AE2B Dolby Pro-Logic sound models were continiued. Produced during 1994-96. Remote control units RM833, RM837. Models:

| KVX2102U | KVX2502U | KVX2902U |
| :--- | :--- | :--- |
| KVX2182U | KVX2582U | KVX2982U |
| KVX24WS1 | KVX28WS1 | KV25T1U |

## :3 Chassis

p-of-the-range digital chassis with 100 Hz scanning, ilby Pro-Logic sound and digital picture effects such picture-in-picture (PIP) and picture-and-picture AP). Production started in 1995. Model KVS2952U is urrent model. Remote control units RM831, RM838. bdels:

## '28WS3U

KV32WS3U
KVS2952U

## :4 Chassis

nilar features and specification to the AE3 chassis. jduced in 1996. Remote control unit RM862. Models:

## '32WS4U <br> KV32WX4U

## BE3D Chassis

New stereo sound chassis to replace the BE3B. Much of the circuitry on the main board remains the same as in the earlier chassis, but the A board is quite different. Production started in 1996, still current. Remote control units RM839, RM862. Models:

| KV25F1U | KV29F1U | KV25F2U |
| :--- | :--- | :--- |
| KV29F2U | KV25F3U | KV29F3U |
| KV25X1U | KV29X1U | KV24WS2U |
| KV24WX1U | KV28WX1U | KV28W2U |
| KN28WS2U | KV28WF1U | KV32WF1U |
| KV29FX11U |  |  |

## BE4/BE4A Chassis

Mono sound chassis to replace the BE2 series. The BE4 chassis is used for portables, the BE4A in 21in. models - much of the circuitry is identical however. The first

Sony chassis to incorporate all the teletext circuitry within the main microcontroller chip. Production started in 1995, still current. Remote control unit RM836. Models:

## KVM2171U KV21T1U KV14M1U <br> KVM1441U KV16WT1U KV21M3U KV14T1U <br> KVM2170U <br> KV21M1U <br> KV21T3U

## BE5 Chassis

A stereo sound chassis for use in small-screen sets. Production started in 1996, still current. Remote control unit RM836. Models:

## KV21X1U KV21X4U KV16WS1U KV20WS1U

## GE1 Chassis

A very sophisticated digital chassis with 100 Hz scanning. The first sets to feature Sony's completely flat FD Trinitron tubes. Also the first Sony domestic TV sets to have VGA inputs to provide direct connection to a PC. Production started in 1997, still current. Remote control unit RM862. Models:

## KV28FD1E <br> KV32FD1E

## LE1 Chassis

Sony's first LCD back-projection models for domestic use. Sets are considerably more compact than conventional CRT projection ones. Production started 1996, still current. Remote control unit RM838. Models:

KL37W1U KL50W1U KL50W2U

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| ind | DECCA ${ }^{\text {DNB652 }}$ |  | 22.00 | ${ }_{\text {BAE }}^{\text {BAE } 19}$ | $\stackrel{\text { 1.99 }}{\substack{\text { 1.909 }}}$ | ${ }^{\text {M M }}$ M54549L | ${ }^{3.50}$ | ${ }_{\text {Tasta }}^{\text {TAB22 }}$ | \% 8.98 | £39.99 |
|  | $\begin{array}{ll}\text { DT9476 } \\ \text { DV9499 } & \text { 16.99 } \\ \text { 16.99 }\end{array}$ |  | 22.00 28.00 | ${ }_{\text {BAG622 }}$ | -1.99 | M54648L ${ }_{\text {MCi } 3 \text { 306T3 }}$ | - | - | ${ }^{3.89}$ |  |
| Macro function key |  | ${ }^{\text {PHALILPS }}$ |  | ${ }^{\text {BAGA }}$ | - |  |  | ${ }_{\text {TAB6S69AN }}$ | $\begin{array}{r} 3.99 \\ \mathbf{1 2 . 8 9} \end{array}$ |  |
|  |  |  | 16.09 16.09 1 | ${ }_{\text {BAG6247 }}$ | ${ }^{260}$ | ${ }_{\text {PALLOO3A }} \mathbf{2 0}$ | 14.98 | TAB6690AN |  | GENERATOR |
| 24 bit processor | (1) ${ }_{\text {T } \times 90}$ | GHA1AX GA2.2A | 16.99 22.00 20 |  |  | ${ }_{\text {STK463 }}$ | 10.00 | TDAAS | 3.25 | Colour bar, Cross hatch, |
|  |  | ${ }_{\text {CPFo }}$ | ${ }^{22.09}$ |  | 1.99 <br> 1.99 | ${ }_{\text {STK465 }}^{\text {STK082 }} 1{ }^{11}$ |  |  | 3.50 |  |
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| designed keypad | 66M3 ASTIF | SAISHO CTI4R | 16.99 | $\underset{\substack{\text { CNAT65 } \\ \text { HAL23 }}}{ }$ | ${ }_{2}^{4.28}$ | STK4131\|| | 6.60 <br> 7.00 | TDA3654 | . 398 | COMPACT PORTABLE ع84.99 only |
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| Child security featu | $\begin{array}{ll}\text { CTVV14R } & 16.99 \\ \text { CTV2180 } & 16.99\end{array}$ | C8p2146 | 22.00 <br> 22.00 | ${ }_{\text {HA13130 }}^{\text {HA13150 }}$ | ${ }^{16.99}$ | STK4171410 | 8.0.0 <br> 8.00 <br> 8.50 <br> 0.00 | ToA601 | ${ }^{1.99}$ |  |
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|  |  | KV2096US KV21xRTu | 16.898 | La | 2.98 1.60 | STK7253 |  | ${ }_{\text {TVAA }}^{\text {TDA }}$ | ${ }_{7}^{7.08}$ |  |
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# The Mitsubishi Euro 12 Chassis 

## John Coombes on what to check when tracing the causes of faults in these 21, 25 and 29in sets

The Mitsubishi Euro 12 chassis was used in a number of models that were on sale during the period 1991-93, including the CT21A2STX, CT21A3STX, CT25A2STX, CT25A3STX, CT25A4STX, CT25A6STX, CT29A4STX and CT29A6STX. As usual, we'll start with the power supply.

## Power Supply Faults

The power supply circuit is shown in Fig. 1. It's a chopper arrangement that uses a master-slave IC control system, with transformer coupling (T902) between the master chip (TEA5170) on the secondary side of the circuit and the slave chip (TEA2261) on the primary side.
The most common fault is no results. The mains on/off switch S 991 may have failed - it tends to go open-circuit, possibly at only one pole, live or neutral. Check the 2AT mains input fuse F991, which may have blown violently. Also check whether the $4.7 \Omega$, 10W surge limiting resistor R901 is open-circuit. If either of these items is open-circuit, the things to check are the four BYW56 mains bridge rectifier diodes D901-4, the degaussing posistor RP901 and the 2SD1887 chopper transistor Q901. If the latter is short-circuit, the RD3.0FB1 zener diode D908 that's in series with it will probably also have shorted: don't check D908 in-circuit - the lowvalue current-sensing resistors R911/12 in parallel with it may result in a false short-circuit reading.
Q901 may have failed because of a dry-joint at its collector. Check this carefully. Also check for dry-joints at its heatsink. A dry-joint here can result in a flashing picture for several weeks before Q901 fails. It may be necessary to replace the two chips, IC901 (TEA2261) and IC950 (TEA5170) if Q901 has failed. Always replace them as a pair. Another item to check is zener diode D909 (RD4-3EB2) which may be short-circuit.
Another possible cause of fuse blowing is the chopper transformer T901. It may have shorted turns.
If the receiver is just dead, check the start-up resistors R902 ( $10 \mathrm{k} \Omega, 2 \mathrm{~W}$ ) and R903 ( $8.2 \mathrm{k} \Omega$, 2W) which may have gone high in value or open-circuit. If they are OK, check whether R920 $(5 \cdot 6 \Omega, 3 \mathrm{~W})$ is open-circuit. Other things to check if necessary are D911 (EQA02-14B), which may be short-circuit, and D905 (BYD33G) and R904 ( $15 \Omega, 2 \mathrm{~W}$ ), either of which may be open-circuit. It may be necessary to replace IC901/IC950, again as a pair. On a few occasions we have found that dry-joints at the chopper transformer T901 are the cause of this problem. Resoldering should cure this
Another thing to check on the primary side of the circuit is whether L902 is dry-jointed.
The set may be dead because of a fault in the HT cir-
cuit. The HT at TP91 should be about 120 V . If there is no voltage here or a very low reading, check whether the RU4AM HT rectifier diode D951 is open-circuit or its reservoir capacitor $\mathrm{C} 972(100 \mu \mathrm{~F}, 200 \mathrm{~V})$ is short-circuit. A low HT voltage reading could be because C972 or C971 (also $100 \mu \mathrm{~F}, 200 \mathrm{~V}$ ) is open-circuit. The alternative is a short-circuit in the line output stage. This can be checked by disconnecting one end of R557 (8.2 $2,10 \mathrm{~W}$ ) and adding a 60 W bulb across C 971 as a dummy load. If the lamp lights and a multimeter connected at test point TP91 produces a reading of 120 V , the fault is in the line output stage. See later. If the reading is low or missing check the power supply.
You might however find that the HT voltage is high. In this event check whether Q901's base drive coupling capacitor $\mathrm{C} 906(47 \mu \mathrm{~F}, 50 \mathrm{~V})$ is open-circuit. In this event the HT line usually rises to about 200 V and the line output transistor Q552 goes short-circuit. If C906 is OK, check D907 (RD3.0FB1) and R907 (18 $\Omega$, 0.5W). It may be necessary to replace all three components.
No results may mean that the 5 V supply is missing. Check whether circuit protector Z953 (PRF3150) is open-circuit. If so, D954 (RU4Z) and/or C958 (1,000 FF , 16 V ) is probably short-circuit. Alternatively the SI3050C 5 V regulator chip IC952 might be dead or dryjointed - possibly at all of its connections.
The 12 V supply is protected by Z952 (PRF3150). When it goes open-circuit there is no feed to the tuner and IF unit. If the SI3120C 12V regulator IC951 is faulty there may be patterning on the screen. If necessary check whether C952 ( $2,200 \mu \mathrm{~F}, 25 \mathrm{~V}$ ) and/or C973 $(3,300 \mu \mathrm{~F}, 16 \mathrm{~V})$ is open-circuit or intermittent.
Loss of the 5 V or 12 V supply could of course be due to a short-circuit across the line. Loss of the 24 V supply means no audio - also no degaussing, see below. Check whether protector Z956 (PRF5000) is open-circuit. If so D955 (BYW95B) and/or C960 ( $1,000 \mu \mathrm{~F}, 35 \mathrm{~V}$ ) could be short-circuit. If they are OK the short is in the audio section - see later.
The 28 V line supplies the field output stage. If this supply is missing, check whether R 976 ( $0.82 \Omega$ ) is opencircuit and/or D952 (RU4Z) or C956 ( $1,000 \mu \mathrm{~F}, 35 \mathrm{~V}$ ) is short-circuit. Otherwise check for a short in the field output stage - see later.
The degaussing circuit is a little unusual, see Fig. 2. In addition to the conventional posistor there's a relay to control the degaussing. The relay driver transistor Q903 receives at its base a command from pin 5 of the microcontroller chip IC701. When it's switched on, the relay contact closes and degaussing takes place. The relay circuit is supplied by the 24 V line.


## The Line Timebase

The majority of line timebase faults will also produce the no results symptom. The most common fault is a short-circuit line output transistor (Q552), which is type 2SD1877 in 21in. sets and type 2SD1878 in largerscreen sets. A short-circuit line output transistor could mean that the HT is high because of failure of C906 in the power supply, see the previous section. If the HT is correct, check for dry-joints at Q552's heatsink. The first symptom that these produce may be interference lines on the picture. If this is allowed to carry on, Q552 will eventually be destroyed. The interference on the picture plus an arcing sound can also be caused by dryjointing at the collector of Q552. Shorted-turns in the line output transformer T552 will also destroy Q552. Another thing to do if necessary is to check for dryjoints at the small choke (L556) that's in series with the emitter of Q552. For repeated failure of Q552, check whether there are dry-joints at the line driver transformer T551.
If there are no short-circuits in the line output stage, check whether the 120 V supply is reaching the collector of Q552. The feed resistor R557 ( $8 \cdot 2 \Omega, 10 \mathrm{~W}$ wire-
wound) could be open-circuit if this supply is missing. If R557 is OK with no voltage at its input side, check back to the power supply. If there is voltage at both sides of R557, check carefully for open-circuits or dryjoints at pins 1,6 and 2 of T552.
There could of course be no line drive. If there is no supply at the collector of the 2 SC 2482 line driver transistor Q551, check the driver transformer T551 for an open-circuit or dry-jointed primary winding and, if necessary, whether the feed resistor R554 $(6.8 \mathrm{k} \Omega, 5 \mathrm{~W})$ is open-circuit.
If there is no line drive at the base of Q551 or the waveform is incorrect, the MC44000VCJ colour decoder/timebase generator chip IC201 is suspect. It may be necessary to check this chip by replacement.
If there is still no line output stage operation, the scan coils might have shorted turns.

## Field Timebase Faults

Field collapse is the most common fault here. First check whether the 28 V supply is present at pin 2 of the TDA8178S field output chip IC451. If not, check R976 ( $0.82 \Omega, 0.5 \mathrm{~W}$ ), D952 (RU4Z) and C956 ( $1,000 \mu \mathrm{~F}, 35 \mathrm{~V}$ )

Fig. 1: The chopper power supply circuir used in the Mitsubishi Euro 12 chassis. Some sets have more than one mains filter choke.

Fig. 2: The degaussing circuit is unusual in hoving a relay for control.

AC from mains filter/switch

in the power supply. R976 will go open-circuit if D952 or C956 is short-circuit or there's a short in IC451. If there is still field collapse after replacing IC451, check whether the flyback boost capacitor C452 (220 $\mu \mathrm{F}, 35 \mathrm{~V}$ ) is open-circuit. IC451 will be ruined if this capacitor is faulty. Also check whether the associated 1N4003ID diode D451 is open-circuit.
If necessary check for field drive at pin 7 of the MC44000VCJ colour decoder/timebase generator chip IC201, and that there's a field ramp at pin 6. IC201 is suspect if these waveforms are missing - check it by replacement.
If still in trouble, check whether the field scan coils are open-circuit and for dry-joints at the connection plug and socket. Ensure that they are making correct contact. If there is intermittent field collapse, check all the pins of IC451 for dry-joints. Check pins 6 and 7 of IC201 if necessary.

## Colour/display Faults

If there's just a bright raster, check for a dry-joint at pin 6 of the line output transformer T551. Then check whether R553 ( $2.2 \Omega, 0.5 \mathrm{~W}$ safety) and/or D556 (BYD33G) is open-circuit. If so, check whether C565 ( $47 \mu \mathrm{~F}, 250 \mathrm{~V}$ ) is short-circuit. Check the connector (LB) to the tube base panel: ensure that there are no dry-joints at pin 1 at either end.
If there is a bright raster and the 200 V supply at the tube base panel is OK, check the RGB outputs at pins 17,18 and 19 of the MC44000VCJ chip IC201.
If the raster is very bright with flyback lines, the tube's first anode supply control may be defective. This fault may intermittent, flickering up and down.
The reverse condition, a blacked out screen or just very low luminance, can also be caused by a faulty screen (A1) control. Alternatively, the luminance output at pin 29 of IC201 may be missing. If so replace IC201. It may be necessary to check the luminance signal path via pins 3 and 6 of the NJM2209S sharpness control chip IC202 to pin 17 of the TDA4565 CTI chip IC602. Check the waveforms and DC conditions at these pins carefully.
For loss of one colour, check the relevant 2SC2688/2SC2482 output transistors on the tube base panel. These are Q651/658 red, Q652/659 blue and Q653/660 green. The loss may be intermittent. In this case check for dry-joints at these transistors. Check the DC conditions at their pins carefully.
Loss of one colour can be caused by a faulty tube. The emission of one gun could be very low. Check also for a possibly open-circuit heater - this fault can usually be seen, with only two of the heaters in the row lit. Check for dry-joints at the CRT pins and ensure that they are making correct contact with the base.
If the symptom is incorrect grey scale, check the 1N4148 diodes D655/6/7 which can become leaky. Otherwise the output transistors and IC201 are suspect.

If necessary check Q710 (JC501Q, R) by replacement it's associated with the microcontroller chip.
For complete loss of colour IC201 (MC44000VCJ) is suspect, but check for dry-joints at its pins before trying a replacement. The 17.7 MHz crystal X601 is also suspect. It may be dry-jointed or faulty. On rare occasions you might find that the CXP80424 microcontroller chip IC701 has set the colour at a low level. It may be incorrectly programmed or need replacement.

## Tuner/IF Faults

A broken aerial socket can be the cause of snowy/grainy pictures: if the fault is intermittent, the socket could be dry-jointed. Check the aerial as well. If there is white, chalky dust in the socket, water is probably coming down the inside of the aerial lead. The water usually enters at the aerial connection on the roof and is then sucked down by syphonic action. Another cause of snowy pictures is a low-gain tuner (TU101) - the RF amplifier packs up. Because of the compact construction, it's advisable to replace rather than try to repair the tuner. If there's no tuning, check for 33 V at pin 14 of the tuner unit. Absence of this voltage usually means that $\mathrm{R} 971(18 \mathrm{k} \Omega, 2 \mathrm{~W})$ is open-circuit or IC955 ( $\mu \mathrm{PC} 574 \mathrm{JK}$ ) is short-circuit.
Dry-joints in the tuner and/or IF module can cause many intermittent symptoms such as a blacked out picture, black lines flickering across the screen, loss of signals when the set has been on for a long time or a blank screen with loss of the on-screen graphics. Dry-joints in the IF unit can cause a double-image effect, akin to picture ghosting. It's best to replace the tuner and IF module as a pair. The tuner is part no. 295P397030, the IF module (IP101) part no. 305P700030.

## Sound Faulis

The sound output chip is IC361 (TA8200AH). If there's no sound, check the DC conditions at the pins of this chip, which may have failed. If still in trouble, check the DC voltages at the Nicam board's connection pins. Crackling on sound or Nicam dropout is usually caused by dry-joints on the Nicam PCB.
With some earlier sets you can get an audible whistle at about 1 kHz when a Nicam transmission is being received. Use of the volume control varies this whistle. To cure the fault, connect a wire link between the negative terminals of C3342 and C3346 on the print side of the Nicam PCB. This link should be insulated and run as close to IC3305 as possible.

## Incorrect EEPROM Operation

Corrupted data in the X24C04P EEPROM IC702 can cause many different faults such as no text, no Nicam sound, and incorrect height, width, brightness etc. settings. A kit is available from Mitsubishi, part no. 263P434020. It includes two pull-up resistors and an $0 \cdot 1 \mu \mathrm{~F}$ capacitor. After fitting it, refer to the service manual for reprogramming information.

## Remote Control Faults

If the handset does not emit command signals, check the batteries and/or the battery terminals. Check for corroded contacts or dry-joints. If necessary check the LED for dry-joints and the crystal (X1) for dry-joints or broken connections.
A cracked PCB or liquid contamination can result in non-operation, intermittent operation or incorrect operation of the pushbuttons.
The M50461-113FP chip may be faulty. Contamination can cause corrosion or clogging between its pins.

## A Hi-8 Video Problem

0ne of our customers asked us to look at his Sony EVS1000E Hi-8 VCR, which he used for editing camcorder tapes and for transfer to VHS. It had suffered from an unusual fault from new. When he used it to play back a standard-play (SP) Hi-8 recording made by his camcorder, the picture was covered with white spots - similar to the effect produced by a poorly earthed head drum. Playback of the VCR's own recordings was reasonably good. LP camcorder recordings were also played back with little problem. The EVS1000E is a well-specified machine, with good slow-playback modes via a jog/shuttle feature, Nicam offair sound, PCM and hi-fi stereo etc.
Our first checks were on the anti-static brush and the earthing of the head drum and head amplifier sections. Everything was OK. We next checked and set up the tape path alignment, tape tension etc. The FM signal was checked, also the supplies and the signals to the head amplifier assembly. No problems. After finding that the DOC adjustment was correct, we decided to check the head $Q$ (playback frequency) adjustments, using the relevant test tape.
There are two SP-mode adjustments, one for each head. Both could be set up all right, but the ch. 1 adjustment also altered the picture's spottiness. Unfortunately we didn't appreciate the significance of this at the time! Our next step was to replace the upper drum assembly. This was not a good move - it's expensive, and made only a small difference to the symptom.
What was going on? The important points were that only SP
camcorder recordings produced the fault symptom, and that the EVS 1000 E has an unusual head drum configuration. It has separate SP and LP heads, unlike the customer's CCDV800E and most 8 mm camcorders which use LP heads for both tape speeds. LP heads have a narrower gap than SP ones of course.
As the camcorder has only LP heads, its SP-mode recordings have guard bands between the tracks (the VCR has full trackwidth SP heads that don't produce guard bands). The cause of the trouble was that one of the VCR's LP heads was permanently switched on. During playback of the machine's own SP recordings some off-tape information was picked up. This did not degrade the picture significantly - after all, the two LP heads are active in the trick-playback modes, providing good still pictures etc. But when an SP camcorder tape was being played back the active LP head was looking at either the guard band or was completely off-tape, thus producing the 'static' type interference. It took us a while to figure out what was happening!
Why was one LP head permanently active? Because of a manufacturing error: C102 ( $1.5 \mu \mathrm{~F}$ electrolytic) had been fitted the wrong way round. It's part of the head switching circuit, which normally shorts out the ch. 1 LP head in the SP mode.
You are unlikely to come across exactly the same component problem, but the effect on the picture produced by different head types and thus different track layouts may be worth bearing in mind.
D.C.W.

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## Test report $\Delta$ <br> <br> Powermax and Clipper <br> <br> Powermax and Clipper Remote Control Extenders

 Remote Control Extenders}
## Eugene Trundle tests some UHF remote control extender systems imported by Celtel Ltd. The user in one part of a house can operate equipment in another part

Most households now have more than one TV set. Typically there's a large-screen set in the living room and one or more smaller ones in other rooms. Very often they are all fed from the main, external aerial via an RF distribution amplifier: indoor types are readily available from DIY stores. The satellite receiver and VCR are seldom duplicated elsewhere in the house - because of the expense and the need for a dualLNB where two satellite boxes are to be fed from one dish.
But satellite TV and video playback can be viewed on any of the smaller sets so long as the aerial feed to the RF distribution system is looped through the satellite box and VCR, whose UHF outputs can be added to the off-air broadcast signals. They can then be tuned in by any of the receivers. The problem that arises is how to control the satellite receiver and VCR from the bedroom or wherever: IR commands cannot pass through walls and floors!

## Mode of Operation

Hence the Celtel units reviewed here, which extend the operating range of an IR handset housewide. Working to Approval Standard MPT340, they use an RF link at about 418 MHz , with a maximum power of $250 \mu \mathrm{~W}$. Basically the $\mathbb{R}$ light beam is detected and converted into a low-UHF signal for transmission to a small telescopic aerial on a repeater unit. The latter is placed within sight of the equipment in the living room and recreates the original $\operatorname{IR}$ control code. Hey presto, the gear does what it is told, maybe freeze-framing a winning goal kick or zapping through late-night satellite programmes, wherever you happen to be using the handset.

## Clipper

With this version the transmitter consists of a batterypowered extension at the front of the handset. About half the size of a matchbox, it's fixed by a Velcro pad - two pad sets are provided. A LED flasher shows when it is working: there's no need for an on-off switch or aerial. Its RF output is picked up by the mains-powered repeater unit, which is a stylish, dark-toned 'squashed dome' with a 17 cm telescopic aerial. This design has the advantage of complete freedom of handset movement, because you carry the tiny transmitter with you
I tried it at various sites and at most of them had no communication problem - modern houses tend to have plasterboard internal walls that RF signals pass through with ease. There were a few dead spots in a large, Thirties house that had solid brick internal walls, particularly when linking from a back first- or second-floor room to the living room at the front on the ground floor. I'm told that there is a possible mod to overcome this should it be required - with too much sensitivity you run the risk of interaction between devices operating in adjacent houses. In practice this is, I gather, not too big a problem. Apart from this the device worked very well.

## Powermax

This extender uses the same sort of repeater unit as the Clipper, but the remote control IR receiver/RF converter consists of a second mains-powered dome (no aerial) which is placed in the room from which control is to be exercised. The test one went on the bedroom dressing table. While command transmission is now confined to one room, there's the advantage of an unencumbered handset - and as many of these can be used as you like,
the codes from each being faithfully replicated in the living room. So this system lends itself to such things as remote control of a $\mathrm{Hi}-\mathrm{Fi}$ system with extension speakers in addition to the role previously described. You can zap radio stations, control the volume and navigate around CDs.
This system also worked well for me, with no transmission problems, the link being point-to-point rather than mobile.

## Conclusions

In the workshop, which is a lively environment from the equipment and interference point of view, I didn't come across any bad effects with either system - no radio reception nasties, and no interaction between remote commands. I was unable to get inside any of these modules to explore their secrets!
One of our customers discovered a perhaps unique application. A keen videographer, he has a camcorder and auto-editor in his den and uses a Powermax to relay the latter's IR commands to an S-VHS VCR in the living room. He can thus produce an edited master tape from afar, saving the need to buy a second deck or carry the first one to and fro!
These useful and ingenious systems are worth their price to the sorts of households that have a use for them, and are a good sideline for dealers and workshops involved with TV, video and satellite sales, installation and repairs.
The list price of each of these extender systems is $£ 49.95$, but they are typically offered for sale at about the $£ 40$ mark - both figures include VAT. Trade discounts are available from distributors such as Willow Vale, also from the importer Celtel Ltd., PO Box 135, Basingstoke, Hants RG25 2HZ - phone 01256364 324, fax 01256818064.


## Book Review

Old Television by Andrew Emmerson, published by Shire Publications Ltd., Cromwell.House, Church Street, Princes Risborough, Bucks HP27 9AA (telephone 01844344 301, fax 01844347 080) at £2.95. 32 pages.


This entertaining and well-illustrated little book tells the story of early TV from the period of Baird's initial experiments in the mid-Twenties to the start of colour television in the UK in 1969. So its main concern is with the 405 -line era and the early dualstandard days. Throughout there's much on the sets of the time, without going into circuit technicalities. Rather, the book is intended, as it says in the introduction, as a handy guide to television in general, and to viewing television in particular.
In the chapter headed "the culture of the first television generation" we get a fascinating account of TV's impact on home life in the Fifties and Sixties. This is followed by information on channels, stations and idents. To conclude, the book tells you about the vintage-TV hobby, where you can get to see early TV sets and other equipment, and provides a list of societies and sources of information.
While I appreciate that Andy had limited space in which to cover what is quite a large subject, I do feel that he - and others in the UK - have been a little unfair to the achievements of pioneers in the USA in the early days, by RCA in particular. Vladimir Zworykin had filed a patent application for an electronic camera tube - the key to practical television - in 1923, while working for Westinghouse. His research continued for
several years. In the early Thirties EMI, working along similar lines in the UK, patented the first practical electronic camera tube. This was the Emitron, in 1932. Zworykin had joined RCA in 1929 however, and had by 1931 taken the development of his iconoscope tube an important stage further. A practical iconoscope tube was announced by RCA in June 1933. That same year RCA demonstrated a complete, all-electronic TV system, with transmissions from the company's W2XBS transmitter atop the Empire State Building. The standard was 240 lines with 24 sequential frames per second. By June 1936 RCA was using 343 lines with 30 interlaced fields per second. In the same year the US Radio Manufacturers' Association proposed a 441-line system, which was successfully developed by Philco with a demonstration on February 11th 1937.
Yes, EMI and the BBC got there first, in 1936, with a regular 405 -line TV broadcasting service. But had it not been for the Depression and bickering over standards, TV broadcasting in the USA would have started earlier than it did (in 1939). Really, it was neck and neck.
Others - Telefunken in Germany for example - were pretty far advanced by the mid-Thirties. And it's important to appreciate that Prof. Boris Rosing (Zworykin was a pupil of his) gave the first demonstration of a crude TV system, with a mirror-drum scanner and a CRT for the display, in St. Petersburg in 1907.
But enough of this! If you are interested in TV's impact during its early years you will find Andy's book a good read.
J.A.R.

# DX and Satellite Reception 

# DX and satellite TV news and reception. A phase-shift system for interference cancellation. The 1998-2000 edition of the World Satellite Yearly reviewed. Roger Bunney reports 

Some Sporadic E reception during late April suggests that the 1998 season will be an improvement on last year. At 0745 on the 23rd I saw a weak, slow-fading PM5544 test pattern on ch. 4, with the aerial pointing to the SE. Its identification was too fuzzy to discern, and the signal faded out after fifteen minutes. A slow-fading tropo-type signal in Band I is characteristic of very long single-hop


Fig. 1: Todd Emslie's nulling system for inferference cancellation.


Fig. 2: The phase-shift circuit. T is a $1: 4$ (75/300 $)$ transformer. VR1 and VR2 are both 5 ks linear pofentiomefers. C1 and C2 are $0.01 \mu F$. The components should be housed in a small metal box.

SpE reception. Peter Schubert (Rainham) noted weak SpE activity on chs. E3/R2 on April 26/27th. Then a strong SpE opening occurred on May lst, with TVE (Spain) ch. E4 received in the early evening - a bullfight of course! Only days now to the proper start of the season!

Todd Emslie (NSW, Australia) has written about recent reception highlights there. F2 layer reception from the States across the Pacific has improved, reaching as high as 36 MHz . F2 back-scatter has been noted, giving New Zeland ch. 1 $(44.25 \mathrm{MHz})$ from the NE in midApril. Highlights of the past season include Thailand ch. E3 and China ch. R1 on March 25th, also Japanese beacons/radio amateurs at 50 MHz . Last December Hawaii Khon-TV ch. A2 was received in both Christchurch NZ and Victoria Australia.

Like many other DXers, Todd suffers from interference problems. He has designed an effective but extremely simple nulling circuit that covers from $40-220 \mathrm{MHz}$ ! Details will be found later in this column.

## Satellite Sightings

Eutelsat II F4 at $7^{\circ} \mathrm{E}$ has ever fewer analogue news circuits. But perhaps the most unusual sighting for me this month was from II F4 on April 23rd. When checking this satellite I received, at 2315 BST onwards, $11 \cdot 145 \mathrm{GHz}$ horizontal, colour bars plus the idents "Newsforce DSNG4" and "Alftah Broadcast Chad". Thinking it might be a latebreaking news story I stayed tuned. But all that appeared during the
next hour were more colour bars plus inserts of, I presume, the local TV programme - revolutionary dancing plus waving of a red flag. Newsforce pioneered digital satellite newsgathering, and the signal would have been a European analogue redistribution. Unusually, this was clear analogue: even sound in syncs hadn't been used.

The mid-summer World Cup and Tour de France transmissions will be distributed across Europe using EBU digital capacity, with MPEG-2 coding. The full EBU/Eurovision network, with 55 transmit/receive stations in 48 countries, is to go digital by September. The number of EBU TV channels will be increased from thirteen to over twenty. So there will be more to see - if you have a digital receiver.

A serious Spanish coach crash was heavily featured via Intelsat K on April 26th, with the local test patterns of TV Valencia and Canal Sur.

Several SNG evening magazine programme inserts for BBC regional services are still uplinked in analogue form. The BBC's Northern Ireland truck (UKIl 20 DGSP) was in early April feeding news material and live reports for several news programmes via the 12.608 GHz horizontal transporter aboard Telecom 2C at $3^{\circ} \mathrm{E}$. This was during the talks on and the eventual peace deal in the Province.

John Womersley (Bradford) has bought a Nokia 9602 digital receiver and writes in some detail on its operation. There are many grey imports with which Nokia will not guarantee reception. Certain 9200
and 9500 receivers now on the market contain v. 2.0 software, similar to Model 9602. It enables you to avoid going into red menus for access to certain tuning options. More on red menus via the internet at
www.eurosat.com/digital/dbox.hmtl
or
www.xs.4all.nl/~satje/dbox/secret.html
Many digital feeds are available via Sirius- 2 at $5^{\circ} \mathrm{E}$. The following provides sports offerings:
12.346 GHz with S/R 3332, VPID

33, APID 32, FED $3 / 4$ and PCR 33.
John uses a Im dish, a universal LNB, a Global A/B switcher, a Pace MSS300 analogue receiver and his Nokia 9602.

Roy Carmen (Isle of Wight) noticed a Canal Fiat corporate programme via Telecom 2C in early April, at $12 \cdot 650 \mathrm{GHz}$ vertical, with Lancia and Alfa Romero cars. Interesting that the feed was clear D2-MAC.

Many Vauxhall dealers now have an 1.8 m offset dish to provide ex-factory sales information and training for engineers. A visit to your local Safeway store will also reveal dishes, and it's understood that Sainsburys is to have a corporate TV network soon. Can anyone tell us when such material is aired and in what format? I've heard that Eutelsat II F2 at $10^{\circ} \mathrm{E}$ is a favourite for corporate signals. Any information will be welcome.

## Broadcast News

Sweden: The following digital terrestrial transmitters are in operation: Horby ch. E22, Vastaras ch. E37, Stockholm ch. E59,
Norrkoping ch. E36, Uppsala ch. E40, Malmo ch. E22, Goteborg ch. E40 and Linkoping ch. E42. The plan is for each transmitter site to have six digital multiplexes providing a total of 24 channels. Each site will transmit SVT and TV4 in both analogue and digital form.
Channels above E60 will be progressively used for DTT transmissions.
Finland: The Nelonen channel now has a full teletext service.
Lithuania: The Moscow TV6 relay has been converted from SECAM to PAL. The country has adopted Central European Time: thus summer time will be GMT plus two hours, winter time GMT plus one hour.
Singapore: DTT has started on a
test basis, run by Advent TV with TCS progamming. The plan is for a full service by the end of the year.
Northern Ireland: Ulster TV,
Belfast plans to open a local digital service early next year with programme material from both sides of the border, including RTE and the new commercial channel TV3. This will be in addition to the ITV DTT package.
Burma: A TV transmitter has been opened in the East Shan State to relay government progamming to the nearby mountainous regions.
UK Radio: The Isle of Man government has made the 279 kHz long-wave frequency available for a high-power radio service with wide coverage. The transmitter power will be reduced at night to avoid co-channel interference. United Christian Broadcasters, The Isle of Man International Broadcasting Company and an old favourite, Radio Caroline, have expressed interest.

## Nulling System

Todd Emslie's nulling system, mentioned earlier, is shown in Fig. 1. Fig. 2 shows the phase-shift circuit. The idea is to cancel interference by adding the signal from the DX aerial to that, after phase shifting, from the interference aerial. The phase-shift circuit uses a 70/300 2 transformer, two capacitors and two $5 \mathrm{k} \Omega$ linear potentiometers. It should be followed by a preamplifier then an in-line 0 20 dB variable attenuator - the latter can be obtained from Cirkit, stock no. $10-01520$, at $£ 3.94$. An amplifier is also used in the feed from the DX aerial. A wideband ferrite combiner such as the Antiference CS1000 or Tratec ES02 is used to add the two signal feeds: do not use a resistive combiner/splitter or the cheapie ferrite splitters from the Far East.

After connecting the units, adjust the attenuator so that the levels of the interfering signal inputs to the combiner are roughly equal. Then adjust the phasing and balance potentiometers - a $360^{\circ}$ phase shift can be obtained. The interference will be reduced or will disappear.

Todd reckons that the system reduces an $\mathrm{S} 9+20 \mathrm{~dB}$ ABN-2 ( $64 \cdot 24 \mathrm{MHz}$ ) interfering signal from a transmitter five miles away to an S1-2ish signal level. This enables him to receive MS pings and other weak signals in the same channel. The system is wideband, working from Band I through to 220 MHz .


The Merlin Communications logo, received via Sirius2 at $5^{\circ} \mathrm{E}$.

## Sarellite News

Because of the problems with
PanAmSat's PAS-6 satellite at
$43^{\circ} \mathrm{W}$ a replacement, PAS-6B, will
be launched later this year to main-
tain and expand services to
South/Central America. It's being
manufactured by Hughes and will


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A Spanish test card received via Intelsat $K$ at $21.5^{\circ} \mathrm{W}$.
have 32 high-power Ku-band transponders. Although PAS-6 was launched less than a year ago, problems with its solar panels have led to reduced power output. Because of this a decreased load programme has been initiated. PAS-6 and PAS3 , both at $43^{\circ} \mathrm{W}$, will maintain services until PAS-6B arrives.

The Greek government has proposed a single digital system with free access for both state and commercial broadcasters provided a common digital encryption standard is adopted.

The Sky Scottish channel from Glasgow closed on May 31st. Viewer figures were minimal. The channel had broadcast from 18002000 via Astra and local cable systems.

AsiaSat-3S is to be launched next spring, after which it should be in service within a month. The earlier AsiaSat-3 failed to go into orbit.

It might be an idea to hold off buying that new digital satellite receiver. Philips is to introduce a second-generation MPEG IRD chipset early next year. It's claimed to be faster and to have a lower power consumption - the three ICs will operate at down to 1.8 V . At a cost of $\$ 15$ for the chips, complete receivers could be on sale for about $\$ 200$.

Intelsat waved goodbye to an old friend, 502 , which was shifted out of orbit on April 14th, ending a record seventeen years' service. It
was launched in December 1980 and was the oldest in the Intelsat fleet. The new 709 is to take up position at $50^{\circ} \mathrm{W}$, offering DTH services to Brazil with +50 dBW ku-band transponders. There has been an Intelsat shuffle as follows: 804 to $64^{\circ} \mathrm{E}$; 801 to $31.5^{\circ} \mathrm{W}$; 506 to $29.5^{\circ} \mathrm{W}$; 511 to $29.5^{\circ} \mathrm{W}$ for cable distribution. 805 will go into service at $55.5^{\circ} \mathrm{W}$, where 512 is to be de-orbited.

Intelsat has formed a spin-off company, called New Skies Satellites NV, which will be free to operate without the cumbersome Intelsat control (see Teletopics last month). The new company will operate 513 at $177^{\circ} \mathrm{W}, \mathrm{KTV}$ at $95^{\circ} \mathrm{E}, 703$ at $57^{\circ} \mathrm{E}, 803$ at $21.5^{\circ} \mathrm{W}$, Intelsat K at $21.5^{\circ} \mathrm{W}$ and 806 at $40.5^{\circ} \mathrm{W}$.

Eutelsat has confirmed that Europesat-1 will enter service at $29^{\circ} \mathrm{E}$ in mid-2000. The 36transponder satellite will provide DTH TV, multimedia and corporate services. Its design will enable it to operate alongside the Astra craft at $28.2^{\circ} \mathrm{E}$. A frequency-sharing plan is being arranged between the two satellite organisations.

## 1998-2000 World Satellite Yearly, 5th edition, by Dr. Frank Baylin. Published by Baylin Publications at $£ 59$.

This substantial book has over 550 pages ( $10.7 \times 8.4 \mathrm{in}$.) packed with information on satellite theory and practice, diagrams, footprints, addresses - in fact it's a complete reference guide to the technology and situation as at mid-1998.

The format is basically the same as in the earlier, successful editions. It starts with coverage of satellite basics - dishes, equipment, how and why satellites work in orbit etc. Scrambling and the MAC variants are well documented, but greater emphasis is now naturally placed on digital compression. Also pirate hacking: the subsection on page T-162 raises the question "Digital Television - The Next Target?" There is also an interesting section on marine satellite systems.

The main purpose of the book however is to gather together a mass of reference information, in particular downlink footprints etc., for every satellite now active (now being spring 1998) or expected to come into operation during the anticipated life of the book. So there's a massive section that provides details of who is using which transponder on which bird. There follows an equatorial trip west-
wards around the Clarke Belt from $180^{\circ} \mathrm{E}$, pausing at each satellite to describe the craft's background, i.e. operator, launch date etc., then the details of the craft itself - construction, on-board loading, electronics, downlink frequencies and transponder powers, beacons and so on. There's a very detailed listing of transponder uplinks and downlinks, with frequencies, bandwidths, performance data, powers and other information.

Equally important are the satellite footprint maps, showing the main target regions and EIRP contours. For the enthusiast this provides an indication of reception possibility at a given location. AMOS-1 at $4^{\circ} \mathrm{W}$ for example would, via its European beam, have an EIRP of about 29dBW in South Hampshire, an indication of why it's a difficult signal to receive! The final satellite listed is Intelsat at $177^{\circ} \mathrm{W}$, completing the course to $180^{\circ} \mathrm{E}$. The book ends with an extensive listing of manufacturers' and companies' addresses and contact details.

No reference book of this magnitude could be 100 per cent accurate of course, even at the time of publication. Whilst
preparing this review Intelsat has announced an orbital reshuffle, and there have been announcements from Eutelsat and PanAmSat. NileSat-101, at $7^{\circ} \mathrm{W}$ from early May to provide services for North Africa and the Middle East, is not listed. But these are quibbles.

In conclusion, this massive reference work is an essential item for the bookshelf of anyone, professional or enthusiast, concerned with satellite use and reception. But, because of its size and comprehensiveness, it is not cheap - if you are in the trade however it's an allowable expense to offset against tax. The book can be obtained by post from Swift Television Publications, 17 Pittsfield, Cricklade, Wilts SN6 6AN (phone 01793750620 , fax 01793752 399) at £65 inclusive of postage and packing. The price when supplied to European addresses is $£ 70$, and by airmail anywhere else in the world $£ 80$. Those in London may find the book at the Modern Book Company, Praed Street, Paddington, or Foyles in Charing Cross Road. Baylin Publications can be contacted by phone/fax at 01189414468.

#  it could be You! 

With ever more new, innovative technology being introduced in consumer electronics equipment, new blood coming into the industry is vital to its continuing success. Panasonic, an industry leader, has decided that now is the time to reward the best of the new technicians.

In conjunction with City \& Guilds and Retra, Panasonic has launched an award scheme for the Top Ten results from this year's final examinations for City @ Guilds 2240 (part 3) in TV and VTR servicing. The only rule is that you must be 25 years or under at the time of sitting the examinations.
Panasonic is arranging a competition to find the first, second and third top technicians out of the ten finalists. All ten will, with a guest or partner, be invited to spend a day as guests of Panasonic at Bracknell, with a luncheon, presentation of certificates and over £2,500 worth of Panasonic products for the finalists (first prize worth $£ 1,000$ ).
In recognition of the support provided by employers for their trainees, Panasonic is to present to each of the ten finalists' employers an inscribed plate proclaiming the achievement of the organisation in the field of training.
The top three finalists will then be taken to a luxury hotel in Cardiff for an evening as special guests of Panasonic. On the following day there will be a fascinating tour of the Panasonic European TV factory in Cardiff and a lunch.
All in all this will be a super event fully endorsed and supported by Retra.


So, all you young technicians, make that extra bit of effort for those all-important final examinations this year. You could be Panasonic Young Technician of 1998 !


## Reports from

Nick Beer and
David Woodnott

## Hitachi VCMIE

I'd not had one of these twist-andshoot models for repair before. They clearly suffer from the sur-face-mounted electrolytic capacitor problem. This particular one recorded perfectly when twisted into the camera mode. In the untwisted VCR mode however it would intermittently either refuse to carry out any deck functions, or the buttons would select the wrong functions, or the machine would permanently be in the rewind or another mode.
The control switches appear to be connected to a resistive ladder network. An examination revealed that some of the through-the-board links in front of the connector (PG802) to the switches had become corroded. The answer lay on the other side of the PCB: C234 ( $100 \mu \mathrm{~F}, 6.3 \mathrm{~V}$ ) and $\mathrm{C} 244(47 \mu \mathrm{~F}, 6 \mathrm{~V})$ were leaking.
There were leaky electrolytics in other areas as well. N.B.

## Panasonic NVM10B

This full-sized camcorder was dead. It was no surprise to find that the $0.025 \Omega$ fusible resistor R1051 (part no. VSF0059) was open-circuit, but the short that could be measured between its business end and chassis had a rather unusual cause. Much lifting of chokes to isolate circuit areas confirmed that the cause of the problem was somewhere in the middle of the power supply. The chopper transistor was OK, but the transformer had a short-circuit between its primary winding and chassis. It's T1001, part no. ELL10R010. A

## Camcorner

replacement transformer and fusible resistor restored normal operation. N.B.

## Panasonic NVMC30B

This one arrived with a tape stuck in the mechanism and a note to say that it would remain powered up for only a few seconds. It's not an uncommon fault with this model, the cause usually being faulty regulator transistors in the power supply. In this case however the power supply was OK. Inspection of the unit at power up, with the tape still loaded, revealed that the drum didn't rotate. In fact it was completely jammed! We removed, cleaned and refitted the drum, after which all was well. Dirt of some sort must have made the drum stick. D.C.W.

## Sanyo VMD6P

A faulty AV socket is quite a common problem with these popular, middle-aged camcorders. The sock et is available at modest cost from CHS. Sometimes however you find that the printed circuit has been damaged by excessive AV connector wriggling. So a new PCB has to be obtained. This is also available from CHS, though not at quite such a modest price.

We've on occasions found that some audio circuit setting up is required after fitting a replacement board. The usual symptom is low or distorted sound. Information on this is included in the relevant service manual. D.C.W.

## Sony CCDTR305E

The customer said that this newish camcorder had operated intermittently for some time but had now ceased to do anything at all. There was a tape, which couldn't be ejected, in the mechanism. An initial inspection showed that the unit would power up in the VTR mode but not in the camera mode. No functions worked however.
When the RM95 remote unit was connected the VTR functions could be operated by the buttons, but there was no camera mode as the CAM/VTR switch is in the main body of the camcorder. A replace-
ment Switch Block Control, as Sony call the complete control-button assembly, was required. This cured all the symptoms - albeit at a price. D.C.W.

## Sharp VLE3OH

This early Viewcam model has been generally reliable. Until recently we've not seen many of them. This one came in for a general service. There is nothing much to report, except for something that those with little experience of these machines (like us!) should note.
After its service the unit was put on test and performed well. As we didn't have the customer's AV connector, we were able to check the results only by looking at the LCD screen and by using another camcorder to play back a tape, which was OK.
The unit soon came back however, with a report to say that while it now worked well there were no outputs via the AV connector. We had failed to notice a peculiarity with the connectors used in this model. The ribbon cable connectors used by most manufacturers have a grip system that, when released, enables the cable to be removed. Refitting is the reverse procedure. With the Sharp version, as used in this model, it's possible for the whole section to come away at the cable end when the grip is released. This is of no consequence if the grip is not removed from the cable. If it should fall off, as it must have done in this case, it can be refitted incorrectly. This might not be noticed the connector can appear to be correctly recoupled to the PCB socket. When it's incorrectly fitted however a section of the plastic grip partinsulates the ribbon cable end from the connecting pins on the PCB.

This was where we had made our mistake with the AV connector. It was simple to rectify once we realised that this reversed connection is possible. It can obviously occur with any of the other similar connectors, causing various symptoms - thankfully none fatal, as the worst that can happen is an opencircuit. We live and learn! D.C.W.

## Answer to Test Case 427 - see page 631 -

There were false trails and chicken-and-egg theories with the Daewoo set - but no field scanning! Those who remember the AN5521 field drive/output chip used in older Panasonic sets, and probably some other makes and designs, may recall that it wouldn't produce a ramp to drive the field scan coils unless it had some feedback from the output side of the circuit. This made fault diagnosis very difficult, as a fault anywhere in the field feedback loop removed the output. The hapless technician could be sent round in circles.
It seems that the field generator section of the TDA8362 chip has the same irksome characteristic. Unless the conditions at its feedback pin 41 are correct, it won't produce a field drive output at pin 43. Pin 41 expects to receive a sawtooth waveform from the height control potentiometer VR301, which is at the earthy side of the field deflection current path. A $2 \cdot 2 \mathrm{nF}$ capacitor, C302, is connected between pin 41 and chassis. This was the cause of the trouble - it was leaky.
As IC designers sit at their drawing boards - computer terminals nowadays no doubt - thinking up wondrous feedback, driver and output arrangements, all long-tail pairs and so on, it would be nice if they could manage to spare a thought for bemused technicians like Techocrat, who have to deal with the problems when things go wrong.

## NEXT MONTH IN TELEVISION

## Digital Satellite Receiver Design

Chris Carter describes the SGS-Thomson design for a lowcost digital satellite TV receiver.

## Low-ohms Meter Extender

There are many situations where it's helpful to be able to measure low resistances reliably. Alan Willcox has devised a simple meter range add-on unit that extends a digital meter's resolution down to $0.01 \Omega$ ( $0.001 \Omega$ is possible).

## Servicing the Mitsubishi EE3 Chassis

John Coombes on how to tackle faults experienced with this CTV chassis.

## CabSat '98 Report

This year's Cable and Satellite Show was particularly significant, with digital TV equipment being displayed and demonstrated. George Cole reports.

## How the Internet Helps

Is the operation of the internet still a bit obscure to you? If so, Peter Marlow's description of the system and how it can help you could be valuable reading.

## Toshiba Service Briefs

Latest know-how from Toshiba Technical on the company's CTVs and VCRs.

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