JULY 1989

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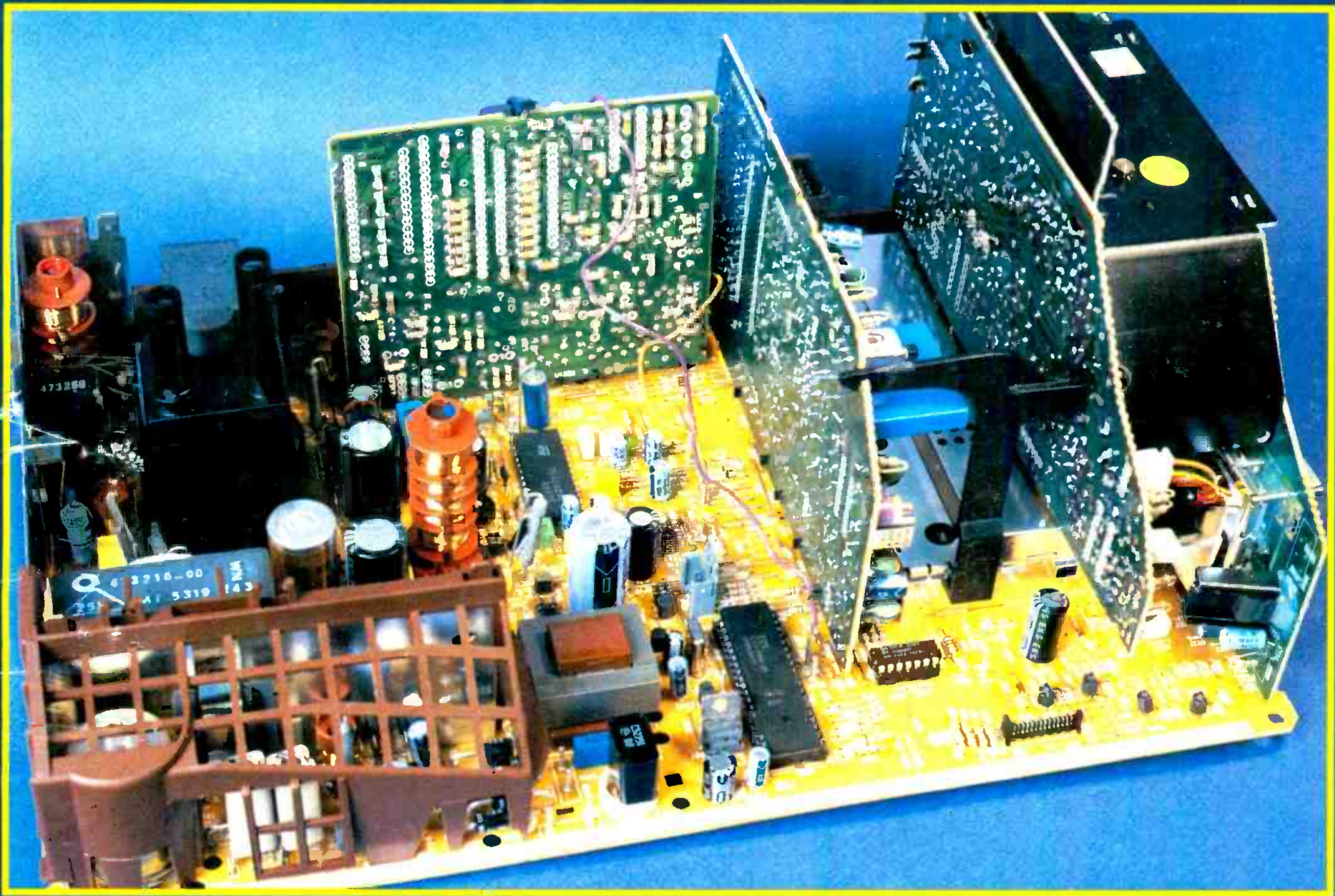
TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS



Inside the Ferguson ICC5 Chassis

Satellite TV Receiver Systems

Field Servicing Aids • DX-TV

Digital Audio Coding Principles

How to Avoid Customer Problems

VCR Clinic • TV Fault Finding

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TELEVISION

July 1989

Vol. 39, No. 9
Issue 465

On sale June 21st

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., King's Reach Tower, Stamford Street, London SE1 9LS.

INDEXES
Indexes to Vols. 36 and 37 are available at 80p each from the Editorial Office (address above).

SUBSCRIPTIONS
An annual subscription costs £20 in the UK, £24 overseas (by surface mail). Send orders with payment to Quadrant Subscription Services Ltd., Oakfield House, Perrymount Road, Haywards Heath, Sussex, RH16 3DH.

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QUERIES
We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television,* but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. Correspondents should enclose a stamped addressed envelope. Requests for advice on dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Service Bureau". Send to the address given above (see "correspondence").

this month

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HITACHI 6383531	0.70
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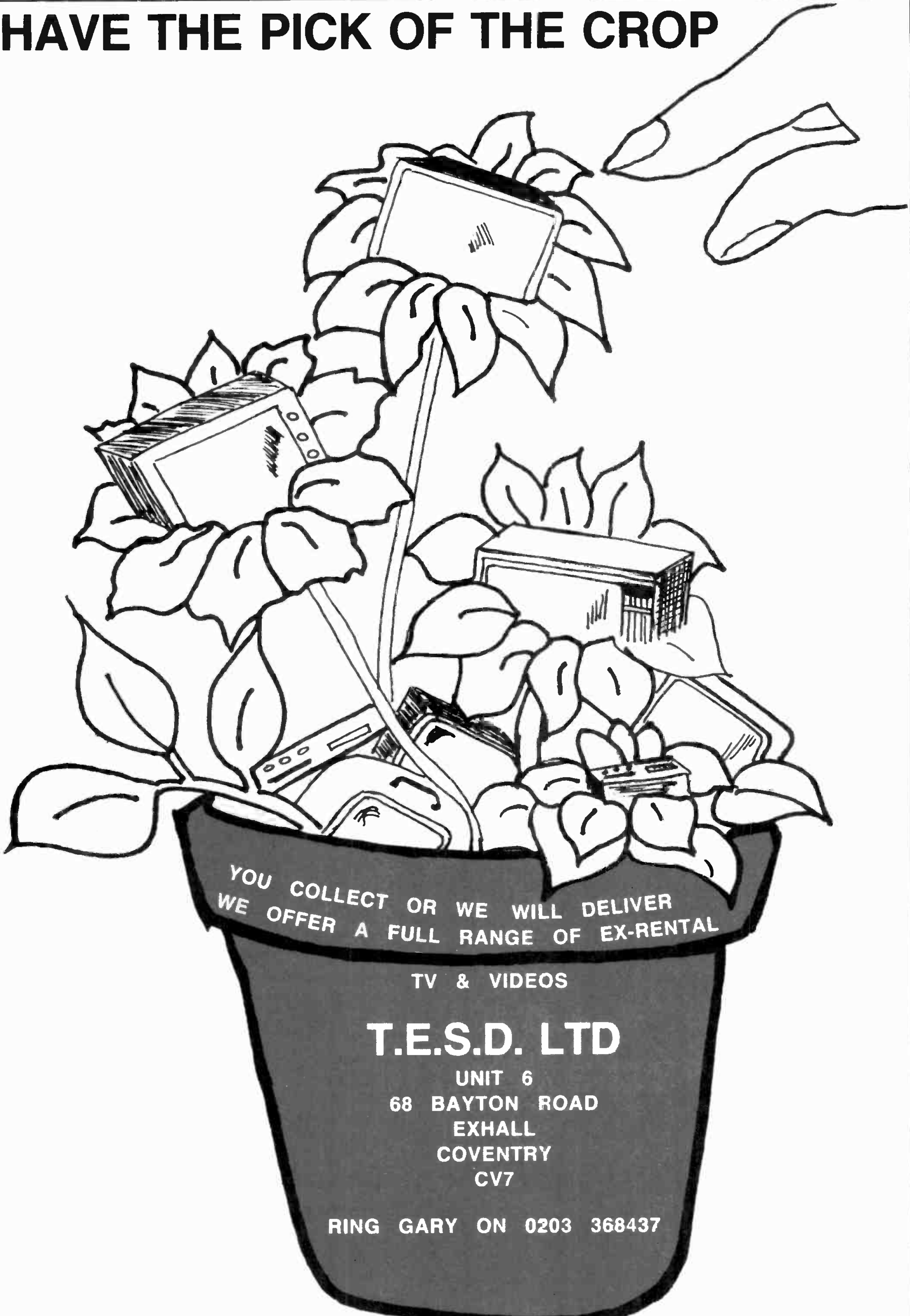

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TDA2525	2.95

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TDA2581	2.00
TDA2582	1.95
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TDA2655B	5.95
TDA3190	1.95
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TDA3540	2.95
TDA3541	2.95
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TBA3650	4.75
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TDA3652	2.95
TDA3653AQ	4.95
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TDA4500	3.95
TDA4503	4.65
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TDA4600/2D	3.30
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TDA8180	6.95
TDA8190	2.80
TDA9503	2.95
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UPC1181H	1.70
UPC1182H	1.70
UPC1185H	2.50
UPC1230H	4.35
UPC1365C	4.20
UPC1378H	3.70
UPC1382	4.35
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Z80ACPU	1.75

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16 Pin Dil-Dil	.16
18 Pin Dil-Dil	.18
24 Pin Dil-Dil	.25
28 Pin Dil-Dil	.30
40 Pin Dil-Dil	.40

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DECCA 100	8.30
FERGUSON 1690/1	9.95
FERGUSON 1790/1	7.95
FERGUSON TX9	23.50
FERGUSON TX90(14")	19.75
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Fidelity CTV140	1.50
Fidelity CTV14R	2.95
Fidelity CTV14S	2.95
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Philips G11	1.35
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Philips KT3	1.50
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TYPE	PRICE
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BC147	.10
BC148	.10
BC307	.12
BC327	.11
BC328	.12
BC337	.11
BC338	.12
BC360	.35
BC546	.10
BC547	.10
BC548	.10
BC557	.10
BC558	.10
BC639	.25
BC640	.25
BD131	.50
BD132	.50
BD222	.50
BD225	.50
BD237	.40
BD238	.40
BD278A	.70
BD437	.40
BD438	.40
BD677	.65
BD701	.95
BD707	.95
BD807	.95
BF337	.28
BF338	.30
BF422	.35
BF423	.35
BF458	.35
BF460	.95
BF470	.50
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BF871	.80
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BU205	1.40
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BU208D	1.95
BU326A	1.45
BU407	1.25
BU407D	1.50
BU426A	1.35
BU500	1.95
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7824	.70

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Capstan Motor (VT33E)	29.95
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Reel Idler (Genuine)	1.25
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Ferguson 3V59	11.95
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Philips VR6462	6.50
Philips VR6467	6.50
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Philips VR6542	6.50
Philips VR6560	6.50
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Panasonic NV370	1.95
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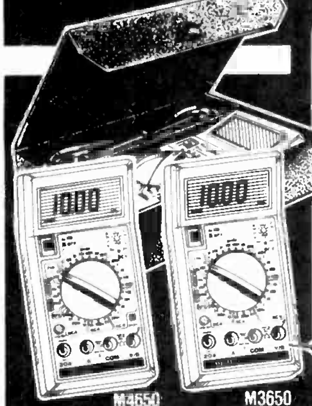

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BD180	6	neon indicators in panel mounting holders with lens
BD193	6	5 amp 3 pin flush mounting sockets makes a low cost disco panel – need cable clips
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3½in FLOPPY DISC DRIVE – DOUBLE SIDED, DOUBLE DENSITY, 80 TRACK. Shugart compatible, has 34 way IDC connector and will interface with almost any computer. Made by the famous Japanese NEC Company. Price £59.50 plus £3 insured post.

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OUR ALADDIN'S CAVE. You may be a new reader and not know that we have a shop at 12 Boundary Road, Hove, where you can go and have a browse around at our assortment of 'goodies'. Unfortunately, because of staff shortages, we cannot be open on Saturdays yet, so the hours are 9.30am to 5.00pm, Monday to Friday. We of course still serve callers at 250 but request that you bring a completed order form as 250 is really the mail order depot.

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FOIL CAPACITORS. Axial ended .33uf m1,000v. 4 for £1. Our ref BD672.

4 CORE TINSEL COPPER LEAD. As fitted to telephones, terminating with flat BT plug. 2 for £1. Our ref BD639.

EHT TRANSFORMER. 8kv 3mA. £10. Our ref 10P56.

DOUBLE MICRODRIVES. We are pleased to advise you that the Double Microdrives which we were offering at about this time last year as being suitable for the 'QL', 'OPD' and several other computers are again available, same price as before namely £5. Our ref 5P113.

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PHONE LEADS. 3 metres long, correctly colour coded, one end has flat plug which fits standard BT socket, other end has tag connectors. 2 for £1. Our ref BD639.

SUB-MINI TOGGLE SWITCH. Body size 8mm × 4mm × 7mm SBDT with chrome dolly fixing nuts. 4 for £1.00. Order ref BD649.

VERY POWERFUL MAGNETS. Although only less than 1in long and not much thicker than a pencil these are very difficult to pull apart. Could be used to operate embedded reed switches, etc. Price 50p each, 2 for £1.00. Our ref BD642.

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SOFTWARE FOR REMAKING. Just arrived. Large quantity of maily games. All are on normal tape spool in cassette holders and should be suitable for wiping out and re-making into games or programmes of your own design. We offer 5 different for £2 or 100 asserted for £20. Important note: We cannot say which titles you will get nor accept orders for specified titles or 'so many, all different', etc., so only order if you can take them as they come. Order ref 5 for £2 is 2P224, 100 assorted is 20P10.

VERY USEFUL MAGNETS. Flat, about 1in long, ½in wide and ¼in thick. These are polarised on their faces which makes them ideal to operate reed switches in doors and windows or to hold papers or labels, etc., to metal cabinets, or even to keep cupboard doors firmly closed. Very powerful. 6 for £1. Our ref BD274(a).

3 CORE FLEX BARGAIN No. 1 – Core size 5mm so ideal for long extension leads carrying up to 5 amps or short leads up to 10 amps. 15mm for £2. Order Ref. 2P189.

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CAPACITOR BARGAIN – axial ended – 4700uf @ 25v Jap made. Normally 50p each, but you will get 4 for £1. Ref. 613.

SPRING LOADED TEST PRODS – heavy duty, made by the famous Bulgin company. Very good quality. Price four for £1. Ref. BD597.

SOLAR POWERED NI-CAD CHARGER 4 NI-CAD batteries AA (HP7) charged in eight hours or two in only 4 hours. It is complete, boxed ready to use unit. Price £6. Our Ref. 6P3.

FREE POWER! Can be yours if you use our solar cells – sturdily made modules with new system bubble magnifiers to concentrate the light and so eliminate the need for actual sunshine – they work just as well in bright light. Voltage input is .45 – you join in series to get desired voltage – and in parallel for more amps. **Module A** gives 100mA. Price £1. Our Ref. BD631. **Module C** gives 400mA. Price £2. Our ref 2P199. **Module D** gives 700mA. Price £6. Our Ref. 6P3.

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13A PLUGS. Good British make complete with fuse, parcel of 5 for £2. Order Ref. 2P186.

13A ADAPTERS – Takes 2 13A plugs, packet of 3 for £2. Order Ref. 2P187.

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SINGLE SCREENED FLEX 7.02 copper conductors, pvc insulated then with copper screen, finally outer insulation. In fact quite normal screened flex. 10m for £1. Our ref BD668.

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3 VOLT MOTOR. Very low current so should be very suitable for working with solar cells. £1 each. Our ref BD681.

MINI SPEAKERS to use instead of headphones with your personal stereo – simply plug in to earphone socket. Excellent sound quality, only £4 per pair. Our ref 4P34.

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INNER EAR STEREO HEADPHONES. Ideal for lady listeners as they will not mess up your hair do! Come complete in a neat carrying case. Price £3. Our ref 3P56.

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DISPLAY 16 CHARACTER 2 LINE. As used in telephone answering and similar machines. Screen size 85mm × 36mm × 9.3mm. Alpha-numeric, dot matrix module with integral CMOS micro processor. LCD display. Made by the EPSON Company, reference 16027AR. Price £10. Our ref 10P50.

TELEVISION

Trade Turnaround and the Long-term View

One is so used to reading of the UK's trade deficit in TV/video equipment that the latest figures issued by BREMA, for the first quarter of this year, come as something of a shock, recording as they do a surplus. It's the first time that there has been a surplus in VCR imports/exports. The surplus is only small, at £2·6m, but is significant nonetheless. There has been a CTV surplus before in recent times – a slight £400,000 surplus was recorded in 1987 – but the first quarter surplus of £13·4m seems to indicate that a definite shift could have taken place.

Whilst the current weak domestic market in the face of high interest rates has helped to produce this outcome, the fact is that the deficit has been falling for several years as production in the UK has built up. We have to thank our foreign investors of course for this happy development – Sony who was I think the first Japanese company to start CTV production in the UK, Matsushita/Panasonic, Toshiba, Hitachi, Mitsubishi, Sanyo, Tatung, Orion, Sharp and GoldStar. Indigenous industry has simply faded from the scene. What is it that enables foreign firms to do in the UK what indigenous UK firms failed to do? It's not difficult to answer this question – and there's no one left to offend in doing so. Survival in the consumer electronics market requires continuous investment and a commitment to achieving market share on a world-wide scale. Failure in this respect has not simply been due to our local breed of entrepreneurs. It has as much been due to the essentially short-term basis on which performance is assessed in the UK, by both the financial institutions and businesses themselves. The financial institutions must take the major portion of the blame for this state of affairs: businesses do not deliberately adopt policies that ensure their early demise, although traditionally the temptation to make your pile then pull out and invest it in racehorses or property – often much more profitable – has always been a strong one.

This criticism of the financial institutions is not aimed at the banks, who can operate only within the context of accepted ways of doing business and valuing opportunities. There have been many criticisms of the failure of banks to provide long-term financing and support. But this is not what banks are for, and it is dangerous for banks to become too closely involved in the affairs of their business customers. Capital markets exist for the purpose of providing investment funds, and this is where the problem has lain.

Here again the criticism has to be muted. There is no logic in investing in concerns that fail to deliver healthy profits or look unlikely to do so, especially when there are other more advantageous opportunities. Japanese firms do benefit from closer links with banks (also lower interest rates), but then in many cases the major firms own their own banking facilities, neatly solving the problem. There remains however an important factor: what is seen as the major object of industry – production or making profits? Ideally the aim should be to maximise both, but it seems that the Japanese business philosophy is far more concerned with building up the market share required to guarantee continued production, taking the periods of slack demand as they come without undue concern. It's as though our Japanese competitors had a naturally longer-term view of their activities, and so far their ability to concentrate on long-term objectives has proved highly successful – despite product failures and occasional market setbacks. In fact setbacks seem to act as a stimulus to activity. Despite a lengthy period when the yen was over-valued, Japanese concerns, already considered to be ultra efficient, managed to further improve their productivity and product quality. We have to be thankful that they have been prepared to bring their abilities to the UK in setting up production here.

That said, it's depressing that the once important indigenous UK TV industry has petered out. Does it matter whether UK plants are foreign or indigenously owned? Not so far as employment and the trade balance are concerned. In this respect foreign investment is welcome. The disadvantage is that very little design work is now undertaken in the UK, so the know-how is elsewhere. This applies to the component industry as well. Whereas once the valves for TV, then the transistors and chips, were designed in the UK, with setmakers contributing their own ideas and working out final chassis designs, virtually all this work is now done abroad. Editing this magazine makes one particularly conscious of this situation: whereas once you could easily get hold of whatever design information you wanted and often chat to an engineer involved simply by picking up the telephone, now we all too frequently have to approach an oriental firm, more in hope than expecting that what's wanted can be made available. If all the oriental design reports are in Japanese, it's little wonder that information is becoming increasingly hard to come by. Not only is the situation fast approaching where there will be no indigenous design know-how, but we'll have no idea what goes on in those chips and how a system works, being left simply to check voltages and hope for the best.

Some developments have continued – Nicam and MAC for example – and these offer scope for design work, but they look like being a sort of last fling for the UK's TV industry. If the transmission side of broadcasting is privatised, as seems likely before long, one wonders whether there will any longer be a place for the engineering activities traditionally carried out by the BBC and the IBA.

Returning briefly to those trade figures, unfortunately the overall result is still a deficit due to heavy reliance on imports in the audio side of the business. It seems that Japanese firms have for some reason seen the UK as a suitable site mainly for TV production. We can still hope for an overall surplus at some point in the not too distant future however.

EDITOR
John A. Reddihough

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CORRECTION
The correct transistor for use in the satellite TV filter unit described in the August 1988 issue, page 752, is the BFX85 (not BFX88 as specified).

HELD OVER
Due to production problems with this issue Part 6 of Steve Beeching's Camcorder Servicing series has had to be held over. We have also had to hold over several letters.

COVER PHOTO
This month's cover photograph shows the new Ferguson ICC5 chassis. See article on pages 676-682.

Satellite TV – What goes with What

John Breeds

Many dubious claims are being made about some of the satellite TV equipment at present on offer, while with other equipment the specifications may be left deliberately vague. Claims I've come across include "future proof", "MAC extendible" and "fully compatible". What could they mean? Let's consider the possibilities and try to dispel some of the confusion.

Future Proof

Future proof could simply mean that a dish is motorised and can thus track the satellite arc, i.e. it would be able to point at satellites launched in the future. This seems to me to be a misleading use of the phrase however. A more accurate use would be to indicate that a satellite TV receiver can be adapted with a device to descramble any of the present programmes should their pictures be scrambled in the future — as is intended with Sky Movies for example. Used in this way the phrase simply means that the receiver has a baseband video output socket into which a descrambler can be plugged. But even this is not as simple as it sounds, since there are already several different scrambling standards, implying the need for several descramblers. Filmnet uses the Satpak system, Sky Movies is to use VideoCrypt, Premiere uses Save, BSB will use Eurocypher, while some of the German and W.H. Smith channels will work on Eurocrypt — and there are at least two versions of this one.

Consider how all the descrambling boxes required could be connected together while retaining the facility to record one channel while viewing another. It's mind-boggling to say the least! Perhaps there's a market for a box to enable you to switch all the other boxes in and out — see Fig. 1.

MAC Extendible

Perhaps the most common misconceptions relate to MAC. This standard often seems to be identified with BSB while PAL is related to the Astra transmissions, which is not a wholly accurate way of looking at things. While BSB is to use MAC, other channels from other satellites are either already using it or propose to use it. For example W.H. Smith has declared that its Screensport and Lifestyle channels, transmitted from Astra, will switch from PAL to D-MAC later this year. When German programmers start to use Astra's four remaining transponders they will initially use PAL but may switch to D2-MAC next year.

A D-MAC decoder (which will also be able to decode D2-MAC signals) could be plugged into the baseband output of a PAL receiver, providing RGB plus sync and audio outputs for feeding into a TV set's scart connector. In this way the set will produce those crisp, clear pictures, free from cross-colour effects, that are synonymous with MAC. But — and this is an important point — if the MAC decoder's video output is plugged into a VCR for record/playback purposes the TV display will revert to PAL. You thus lose the advantages of the MAC system. This applies whether you use the VCR's video or u.h.f. input socket.

MAC extendible means that a PAL receiver can be used with an additional MAC decoder to receive and reproduce signals transmitted in MAC form. The receiver does this by providing a baseband video input to the MAC decoder. What the MAC decoder cannot do on its own is to descramble encrypted MAC transmissions. For this you would need an additional MAC descrambler box. Such boxes will eventually be obtainable for many of the channels that are MAC coded and scrambled. But not for those from BSB!

Part of the contractual agreement between BSB and its officially appointed manufacturers — Ferguson, Philips, Salora and Tatung — states that the ACMs (access control modules) needed and the D-MAC chip sets will not be made available to any other manufacturer for the next three years. This limitation will not apply to manufacturers who wish to produce TV sets with built-in satellite tuners however.

So be careful how you interpret the phrase MAC extendible — it doesn't mean BSB extendible. If you wish to extend your system to include BSB you'll have to obtain a completely new package. Forget about trying to convert an existing polar mount dish for BSB, because it won't be worth the expense and hassle. Although the dish itself would be suitable for the BSB signals, the remainder of the package would not be compatible: a 12GHz LNB instead of an 11·5GHz LNB is required for BSB along with a feedhorn suitable for circular instead of linear polarisation, and the receiver would have to have an

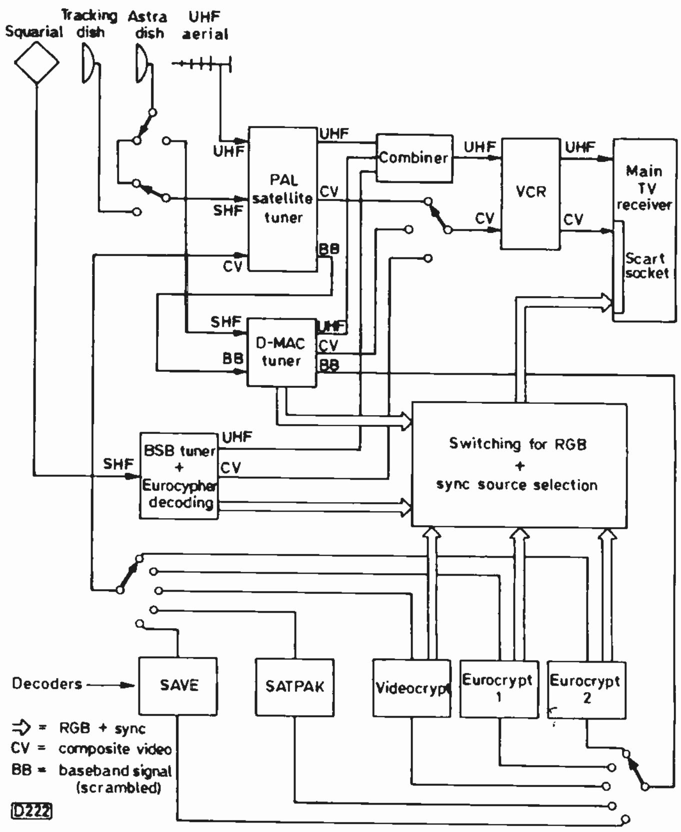


Fig. 1: A possible switching arrangement for satellite TV receivers, descramblers and a VCR.

addressable integral Eurocypher system (not just any old MAC receiver).

Compatibility

Finally what about "fully compatible"? This is another misnomer. Let's start with compatibility between the receiver and the dish, or rather the polariser/LNB. The polariser's job with signals from the low- or medium-power satellites is to cater for vertical or horizontal polarisation. Polarisers come in many forms and the way in which they work is often misunderstood. It's even common to use the wrong word as the generic name, i.e. polarotor instead of polariser. The word Polarotor is a proprietary brand name owned by the US company Chaparral Communications Inc. Using it instead of polariser is akin to calling a vacuum cleaner a Hoover!

Some polarisers are of the mechanical type, employing a servo motor to rotate a resonant pick-up probe. The servo motor requires continuous voltage pulses which are provided by the receiver. Now as we all know any piece of mechanical equipment can fail. There's no mechanical movement with a magnetic type polariser, which is also less expensive than the mechanical type. Thus the use of mechanical polarisers is being overtaken by the magnetic type.

Magnetic polarisers are current driven instead of being driven by voltage pulses. With some magnetic polarisers the vertical or horizontal mode is selected by applying either zero current or 70mA. Others work on the basis of plus/minus current, i.e. 35mA in one direction for the vertical mode, 35mA in the opposite direction for the horizontal mode.

An alternative way of handling vertical/horizontal polarity selection is to use an LNB which has its own built-in V/H switch. This arrangement is used by the Marconi LNBs supplied with Amstrad systems. The V/H type LNB is activated by a voltage level shift, which again calls for a suitable receiver.

The point about all this is that the receiver must be able to supply the appropriate form of polariser/LNB control. Clearly a particular satellite TV receiver is not suitable for use with a polariser that uses an incompatible operating principle.

The significance of incompatibility between a receiver and a polariser may not at first be apparent. But consider the situation where a customer moves house, leaves his dish behind, and finds another dish installed at the house to which he moves. This will soon become as commonplace as leaving behind a u.h.f. Yagi aerial. The question of course is whether the new receiver/polariser arrangement will be compatible? This is potentially a very real complication which is bound to cause a lot of irritation and unnecessary discontent.

Until now most installers and retailers who have dabbled in the satellite TV business have relied upon manufacturers to supply a complete system. Recent evidence suggests that retailers might swing towards obtaining items from different sources, either in an attempt to get the price down or to meet customers' individual requirements.

Unless you know exactly which piece of equipment matches which it would be wiser to buy a complete system. Detailed knowledge of a system's limitations will enable you to avoid potentially expensive/embarrassing situations. Manufacturers are working towards compatibility, but in the meantime there are plenty of potential problems and it's up to us to get wise to possible technical pitfalls. If we don't we'll run the risk of losing our enthusiasm and faith in what we're trying to sell to a largely unsuspecting public.

Notes on the Luxor Mk II Tuner

Nick Beer

The Salora/Luxor Mark II satellite TV tuner, Model 9570, was originally designed and sold for reception from the Eutelsat and Intelsat low-power satellites. In the situation that followed the launch of the Astra satellite in February it was put on sale as part of a system that included a 60cm prime-focus dish and servo motor polariser to meet the demand until a purpose-designed unit became available. We've had one or two faults and there have been a couple of modifications to improve its performance with the Astra satellite.

Faults

A common fault is inability to set one of the a.f. subcarriers, or one drifting or intermittently disappearing. This is caused by dry-joints on the preset resistors PA05-10 (500kΩ) on the back panel.

Another common complaint is of mains transformer hum. Adding damping between the transformer and the surface on which it is resonating usually provides a cure. We had one transformer that was excessively noisy and had to be replaced.

The first unit we unboxed had no sound — when tuned there was at best no noise and the picture developed hum. This was caused by the audio detector PCB, or submodule as it's called, not being pushed home into its edge plug and socket adequately.

The signal strength meter in one unit stuck at about 1 no matter what the conditions. We found that the LM358 chip I01 on the tuner interface board was faulty. Incidentally the pin numbers are not marked on the circuit diagram. Pin 1 is the output, pin 2 the inverting input (−) and pin 3 the non-inverting input (+).

We've had to return to one or two because the settings of the polarisation presets PA03-4 have drifted. This may well be due to the polariser motor of course.

Modifications

The "raw video" output is clamped and shouldn't be. Remove DA02 and fit a 47kΩ resistor in its place.

To improve the sound carrier-to-noise ratio remove the damping resistor R2 in the modulator. Then peak R8 and R9 for best audio level.

To improve the overall bandwidth with tuner type SXT006 add a 2·2kΩ resistor across pins 6 and 9 of ICT1 within the unit.

Finally we've had complaints that the receiver's video output is rather flat. Adjusting P04 on the tuner interface PCB will provide some improvement.

Teletopics

SATELLITE TV LATEST

Delays in the development of receiving equipment have led BSB to decide to postpone the start of its satellite TV service until the new year. It's understood that the main problem has been in the design of the ITT 2285 VLSI processor chip that will handle Eurocypher descrambling and subscriber access control. The development of complex new chips is a notoriously lengthy business. There has also been delay in arranging for manufacture of the squarials: there are two alternative designs but no contracts for the production of either had been placed at the time of writing.

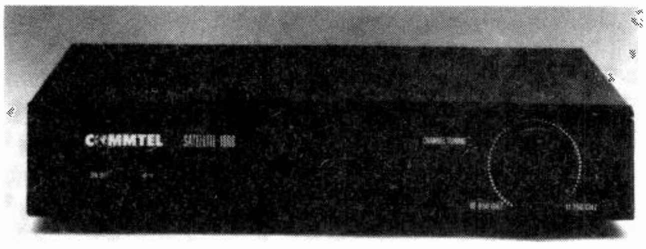
Sky Television has announced that those who subscribe to the Sky Movie service will be given a free decoder. Scrambling of the channel is due to begin in the autumn. Retailers have suggested that the prospect of having to buy a decoder has been inhibiting dish/receiver sales. Now that the decoder is no longer an issue sales of receiving equipment are expected to rise from the present level of 12-15,000 installations a month.

Today newspaper is giving away to readers 10,000 dish/receiver combinations worth approximately £2m. The equipment is being made available through Dixons stores. Readers of *Today* had to collect eight tokens from the paper and send them in. Installation will have to be paid for and Dixons will be offering its SatCare service.

Sky Television has withdrawn from the joint venture to broadcast a Disney Channel as part of its services. A \$1·5bn law suit against the Walt Disney Company was filed in Los Angeles, making various allegations related to the start of the proposed joint service. The action has since been withdrawn by agreement between the parties. The Disney Channel may yet go ahead on Astra, but not as a joint venture. Sky Television has plans for a classic films/arts channel to replace the Disney Channel.

Agreement has been reached between Sky Television and Maxwell Cable TV to carry Sky Movies on the latter's networks in place of the Premiere Channel. This will make Sky Movies available to some 50,000 extra viewers. MCTV is the UK's largest cable operator, with interests in narrow and wideband cable networks. The agreement is for five years initially and MCTV will be adding as many Sky channels as the capacity of its individual networks will allow. Premiere has announced that its pay TV service is to end on July 31st. The Premiere Partnership is being dissolved and is in the meantime seeking a buyer for its services.

Sky Television has commissioned Research Services Ltd. to carry out telephone audience surveys of satellite TV receiver owners. The first survey shows that Sky is popular with satellite TV viewers, accounting for 51 per cent of their viewing time. Sky Television viewers are considerably younger than the national population and households are of above average size.



The Commtel CR1000 satellite TV receiver offers rotary tuning over the band 10·95-11.75GHz.

The IBA received applications from three concerns, BSB Ltd., ITC Entertainment Ltd., and Starstream Ltd., for the fourth and fifth UK DBS channels. BSB, which has the franchise for the first three channels, has applied for both. It hopes to operate one as a film-only channel and the other as a general interest/news/sports channel. Present arrangements would be varied to include a pop music channel. ITC has applied for a channel to provide a general entertainment service. Starstream wants to provide twelve hours of programming daily for children, on a shared channel.

Goodmans has launched a satellite TV receiver system, Model GSR200, to sell at around £250. Features include full infra-red remote control, a twenty channel memory and parental lock. It comes pretuned to the Astra channels. Commtel Electronics plc of Fengate, Peterborough PE1 5XB has announced the CR1000 satellite TV receiver and dish, with rotary tuning over 10·95-11·75GHz and single button selection of vertical/horizontal polarisation. Low-cost satellite TV receiving systems are being offered to the trade by Zeta Services – the equipment is being assembled in Poland using UK components. There have been reports of problems with a plastic cap used to cover the LNB in Amstrad systems. Only a few early LNBs are involved and replacement caps are being offered to installers and dealers. The problem has been cracks due to incorrect chemical formulation.

The Spanish government is expected to announce shortly contracts for the country's Hispasat system, which is due to start broadcasting in 1992.

TV/VIDEO TRADE SURPLUS

The latest figures from the British Radio and Electronic Equipment Manufacturers' Association show that UK production of colour TV sets and VCRs achieved a positive trade balance during the first quarter of 1989. The surplus was £13·4m for CTVs and £2·6m for VCRs, not a great deal but certainly a change after the heavy deficits we've become used to. It's the first time that there has ever been a positive VCR trade balance. We have Japanese and other overseas firms to thank for this course. Their increasing investment in UK plant over several years, as recorded in these pages, has at last turned the balance of trade round. But not unfortunately for the overall consumer electronics sector. When audio products and component imports are taken into account the consumer electronics sector still remains in overall deficit.

PHILIPS' POLYGON GUN CRTs

A major advance being introduced with the latest Philips c.r.t.s is the polygon gun, so named because of the shape of its central aperture. The new gun solves a problem that's been present since unitised gun designs were generally adopted over a decade ago – the problem of minimising aberrations and associated effects in the electron-lens system to produce a sharp, clean electron spot. With the polygon gun the three circular apertures of the conventional gun are replaced by an oval ridge that forms, in effect, a larger electron-optical lens surrounding three apertures whose profiles are precisely configured to compensate for the non-radially symmetric electric field. The larger electron-optical lens (between the second and third anodes) provides the dual benefits of reduced spherical

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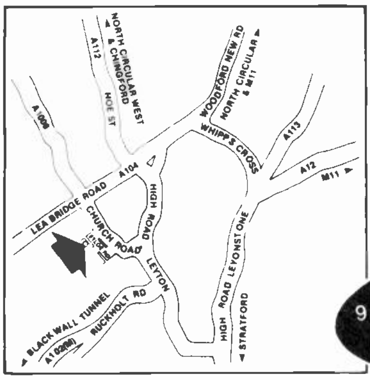

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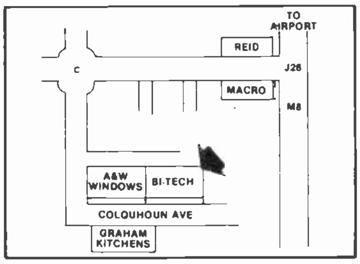

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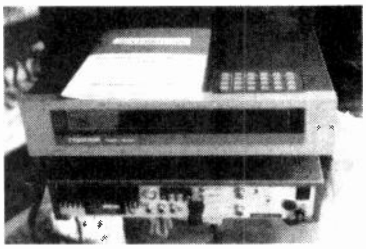

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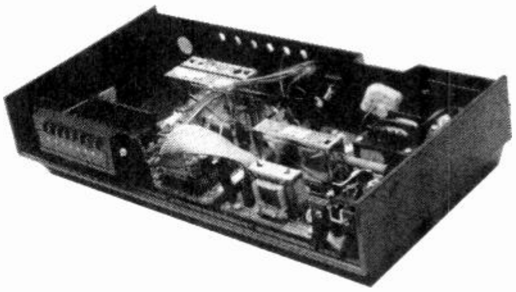

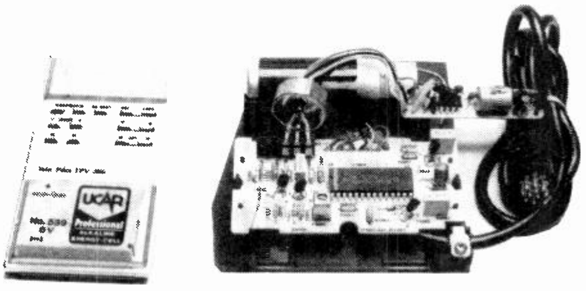

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aberration and lower magnification, resulting in a sharper spot at the screen. In addition it allows a somewhat wider electron beam to be used, reducing space-charge repulsion effects and thus further increasing the sharpness of the spot.

The benefit of the polygon gun can be demonstrated by considering its use in a 33in. tube with a 29·1mm neck diameter. For proper beam landing at the screen, the screen/mask geometry dictates that the three electron beams should be 6·5mm apart as they pass through the lens. Theoretically, this should be the maximum attainable lens diameter. Mechanical constraints dictate a minimum distance of around 1mm between the apertures, so that in practice the lenses can be no larger than 5·5mm. Use of the polygon gun in the same tube gives an effective lens diameter of around 7·1mm.

The new gun is being introduced in the complete range of Philips' colour monitor tubes and will be gradually introduced into the TV picture tube range, starting with the 33in. tube.

PANASONIC UK's MOVE

Panasonic (UK) Ltd. has completed its move from Slough to Bracknell, Berks. The new address is Panasonic House, Willoughby Road, Bracknell, Berks RG12 4FP. There are several telephone numbers to note. The general one is 0344 862 444. Spares orders should be on 0344 860 133. For dealer servicing queries the following numbers apply: 0344 853 502 for domestic VCRs; 0344 853 503 for TV sets and microwave ovens; 0344 853 511 for audio equipment (including car) and vacuum cleaners; 0344 853 509/510 for Technics products; 0344 853 501 for industrial video equipment, cameras and camcorders. There are other numbers for things like printers, typewriters and telephone equipment. The customer liaison number (use, guarantees etc.) is 0344 853 943.

CAMCORDER TARIFF INCREASE?

Manufacturers of camcorders have complained to the European Commission over a proposal to increase the tariff on imports (there is no camcorder production in the EC) from 4·9 to 14 per cent, the level applied to VCRs. The argument is about customs classification – since camcorders nowadays incorporate a TV tuner, the Commission contends that they should be rated in the same way as VCRs. Some two million camcorders worth around $2bn were sold in W. Europe last year.

HD-TV LATEST

The Japanese Broadcasting Corporation NHK is due to start hour-long daily HD-TV transmissions via the BS2 satellite, the aim being to establish a full service by the time of the Barcelona Olympics in 1992.

The West German post and telecommunications minister Christian Schwarz-Schilling has formally proposed to the US commerce secretary Robert Mosbacher that a joint European-US programme should be started to develop an HD-TV system. Quite how this could work since Europe is committed to MAC while the USA is committed to an NTSC-compatible system is not clear. The American Electronics Association has proposed to Congress that at least $1·35bn in federal aid should be provided for the development of a US HD-TV system – the US industry suggests that the worldwide market for HD-TV equipment could be around $40bn a year by 2010. Mr. Mosbacher is opposed to large-scale government funding however, favouring tax brakes, anti-trust waivers to encouratge industry collaboration plus some research aid.

The first annual European conference and exhibition on HD-TV is to be held at the London Tara Hotel on September 18-19th 1989. It's being organised by Meckler Ltd., Grosvenor Gardens House, Grosvenor Gardens, London SW1 0BS (telephone 01-931 9985).

NEW VIDEO EQUIPMENT

The latest addition to the Sony Watchman range is the tea caddy-shaped FD500B. It has a 4·5in TV screen at the front and the speaker is built into the top. In addition to monochrome TV the FD500B incorporates an a.m./f.m. radio receiver. The weight is 3kg and the suggested price £130.

Philips is introducing a new VCR feature called POP – picture-outside-picture: Model VR6880 has on its fascia a 3in. LCD screen that can be used to monitor a recording or TV broadcast. The screen is mounted on a flap that can be tilted up to 45°. A small monitor speaker is also incorporated. Features of the VR6880 include on-screen displays which can be superimposed on the LCD picture. One use suggested for POP is for camcorder editing. The suggested price is £599.

Grundig's latest VCR, Model VS680, offers S-VHS, numerous digital effects, hi-fi sound, Nicam stereo plus the ability to record subtitles and teletext pages. It incorporates a text and graphics generator, a digital stroboscope with adjustable picture speeds and a still picture memory store which can recall a still picture at a later date. There seem to be few possible features that haven't been included in this machine, which has a suggested price of £1,299·95.

JVC's latest VCR, Model HR520, can record teletext subtitles but you need to purchase an optional Fastext adaptor to use this feature. The suggested price without the adaptor is under £400.

Toshiba plans to launch a CD-V combi player later this year. Three new CD-V players are to be introduced by Philips. The CDV487 is a clip player for 8 and 12cm CD and CD-V discs, with a suggested price of £400. It has an autochange facility that enables up to six discs to be loaded. Models CDV786 at £499 and CDV495 at £600 are both combi players but since they don't include analogue sound circuitry they can't play the older LaserVision discs. The CDV495 features Philips' favourite-track selection system and trick play facilities for use with active-play video discs. Philips report that in the first few months after the launch of the CD-V system over 80,000 discs were sold.

TERRESTRIAL MICROWAVE TV

The DTI's Radiocommunications Division has issued a discussion document on the choice of the frequency band that could be used for terrestrial microwave TV in the UK and has asked for comments from potential users and industry. These would be taken into account before firm proposals for legislation are put forward. Several bands have been under consideration (2·5, 12, 27-29 and 40GHz). The 2·5GHz band has been ruled out because of existing pressures, uncertainties over possible future international developments and the limited amount of spectrum space that could be made available. The 27-29GHz band has also been ruled out since the 40GHz band has similar characteristics and the significant advantages of larger amounts of spectrum space, no existing users and the fact that it is, in part, internationally designated for broadcasting. This leaves under active consideration the 12GHz (12·1-12·5GHz – the lower half of the band is to be used for the DBS service) and 40GHz (40·5-42·5GHz) bands.

The 40GHz band is considered to be in many ways the more attractive option as there are no existing or proposed users and sufficient spectrum space for 20-30 TV channels could readily be made available. The main problem is that the service area of a transmitter would be very limited, perhaps 2·5 miles in diameter. Thus the feasibility of using the band to provide continuous coverage of large areas is questionable. The basic technology has been developed but there are doubts as to whether the cost of receivers could be reduced sufficiently to be competitive with lower frequency systems and whether they could be made available to the public within a suitable time scale. There is in a nearby band additional spectrum space that could later be used to expand a service.

The 12GHz band would offer fewer channels – in theory five-six nationwide channels could be established, or maybe nearly twice this number if new technology under development (the use of a.m. instead of f.m.) proves to be successful. The problem with a.m. is that likely transmitter power levels would be unrealistic, giving transmitter service areas scarcely greater than at 40GHz. With conventional f.m. the transmitter service areas would be 10-20 miles in diameter. There are two other disadvantages to the use of this band: existing users, and limited security of tenure – DBS has priority and there are uncertainties about future international developments, including various proposals for multichannel DBS satellites with pan-European beams. If the government decided to apply for additional DBS channels it would be faced with a conflict between satellite and terrestrial use since there appears to be little chance that the band could accommodate both uses. Consumer receiving equipment is already widely available, but there could be considerable overlap problems with local franchise areas and even within nominal service areas 20-30 per cent of households might be unable to achieve the necessary line-of-sight between the transmitter and receiving aerials.

IN BRIEF

Plans to introduce a sixth u.h.f. channel have been abandoned, mainly on the grounds that the service would be available to only seventeen per cent of the population if the present four-channel network was to be kept intact . . . Philips, Matsushita and Sony have joined forces to promote and market a common CD-I (interactive compact disc) standard . . . The loss-making Telemontecarlo station has been sold but no announcement of the new owner has been made . . . SCS Components of 218 Portland Road, Hove, East Sussex BN3 5QT has published its first mail order catalogue, featuring a wide range of components, cables, connectors etc. For further details telephone 0273 770 191 . . . An out-of-print book service is being run by L.A. Foulkes of 13 Pantbach Road, Birchgrove, Cardiff CF4 1TU, telephone 0222 627 703. The firm will carry out a search and deals with books on all subjects, including fiction and non-fiction.

Field Servicing Aids

Malcolm Burrell

Once the field service engineer has leapt into his vehicle to depart for the arduous day ahead he's his own boss, but is probably subject to more psychological stress than many would assume. He must if possible complete the initial task then deal with perhaps ten or more calls, each of which may confront him with one or more unknown problems. For example, a lady insisted that her new colour portable should produce the wonderful simulated picture shown in the glossy brochure using just its built-in loop aerial. Another insisted that there was something fundamentally wrong with her video that it should again have succumbed to the collection of toys which her little boy would *never* poke into the tape aperture — "and by the way, who's gonna pay for the ruined tape?" Then there was a traffic jam on the bypass on the way to a dead, ticking Hitachi set. This would have to go back to the workshop with the knowledge that the manager had sold all the serviceable stock and it would be necessary to rummage around for a working replacement before enduring a repeat journey!

Despite all the hassle there are some ways in which the engineer can improve his day, his performance and his psychological state. By carrying a few potential solutions to problems in his toolcase for example.

Extra Equipment

Ninety percent of poor reception problems are caused by an inadequate receiving aerial system. Faults range from old cable or bodged connections to defective amplifiers or the use of set-top hardware. If you simply blame the aerial system on the basis of past experience you are treading on dangerous ground unless you can back your diagnosis — and occasionally you might be wrong.

In many cases a signal strength meter can provide confirmation that the system has low gain, at the same time convincing the customer. Beware of false readings caused by ghosting however. This is a case where the experienced engineer will be able to rely on his judgement in assessing the screen and meter displays. Commercial signal strength meters can be costly. An alternative is to spend a little time making up a kit (e.g. the Manor Supplies one) or devising a useful tool on the basis of a surplus tuner/i.f. panel.

Another solution is to use a small but robust monochrome portable. You often find them at boot sales or one may be lurking in a corner of the workshop with a damaged case. It can reside unobtrusively in the vehicle for occasional use as a means of checking or demonstrating that an aerial system is faulty. If you give the set an overhaul you could build in a signal strength meter. Beware of the customer who will argue about even a slight discrepancy in picture quality between his own set and the test receiver!

It's a good idea to keep in the vehicle copies of the leaflets published by the BBC and the IBA giving advice on reception problems. You can usually obtain a few copies free of charge from the respective Engineering Information departments. They will provide a useful, professional confirmation of any advice you may offer.

While we all sadly miss the regular use of transmitters as expensive pattern generators, you can again obtain kits at reasonable prices — look for example at the Manor Supplies advertisements. There's a tendency to use such equipment only infrequently in the field, but it's comforting to know that you have such a generator to hand. It can be used to prove to any doubting customer the potential of his receiver. You can incorporate a cheap r.f. modulator with sound capability that can be used, for example, with a suitably-adapted surplus personal stereo unit. This will enable prerecorded tapes to be used when tackling obscure audio problems like "lispy newsreaders".

Safe Repairs

Engineers can be held legally responsible for damage or injury caused by inadequate repairs. But what is meant by "adequate?" It's generally considered to be acceptable to fit a rebuilt c.r.t. or universal type rectifier tray that doesn't carry BEAB approval provided the repair is carried out by an engineer with the competence to judge an unsafe situation. The method of implementing a safe repair is largely a matter of skill combined with common sense!

Hints and Tips

Electrical discharge from a pinhole in a rectifier tray or line output transformer calls for replacement of the offending device. Repair dodges are sometimes attempted but are not advisable, on safety grounds. Leads and connectors from defective trays can however be salvaged for use as replacements, provided no joins are required.

The combination of damp and dirt on the bowl of a c.r.t. often results in brushing and flashovers. The area should be thoroughly cleaned then lightly coated with a water repellent spray such as WD140. Finish with a smear of silicone grease to promote a seal between the e.h.t. cap and the c.r.t. glass.

Water repellent spray can also be useful for treating noisy controls. Potentiometers can sometimes be dismantled and the metal contact surfaces lubricated with a graphite-based oil or silicone grease — the usual cause of problems is oxidation, not the carbon track. If you are ever caught without switch cleaner grab a small receptacle and get a few drops of nice dirty engine oil from the dipstick. Keep it clear of high-voltage paths however.

Despite the fact that even the largest toolcase seems to lack space for a soldering iron holder it's well worth having one. The soldering iron is used so frequently it's almost inevitable that your first indication of a mishap will one day be the odour of smouldering carpet! Construct a holder within the toolcase — it can consist of a piece of tubing bolted to a large heatsink. You'll not regret the slight loss of storage space.

If you can find a fast-acting adhesive that reliably joins different materials, keep a tube in the toolcase for those occasions when it's necessary to secure a broken lug or some loose trim. Since the field service engineer spends so much time on his knees you may well also need it as a first-aid repair to the soles of your shoes!

While most modern TV sets don't accumulate the amount of dust that was common with valve receivers you nevertheless tend to end up with dirty hands. Some baby wipes in the glove compartment come in handy for removing excessive grime. They are particularly refreshing in hot, sticky weather.

next month in TELEVISION

● SERVICING SALORA COLOUR RECEIVERS
Salora colour receivers can cause problems for those not familiar with this manufacturer's sets because of the unusual circuitry used, in particular the Ipsalo combined power supply/line output arrangement. Next month Nick Beer and Ian Bowden start a new series dealing with Salora chassis from the F up to the latest models, with notes on unusual features and fault guide lists.

● SATELLITE TV SERVICING AID
One of the problems that faces those who service satellite TV receiving equipment is incompatibility between various tuners and aerial systems. What do you do when confronted with a tuner that doesn't match your dish/head unit? – it's hardly practical to have all common dish arrangements available. The simple device described, devised by D.J. Stephenson, enables a Marconi or Grundig head unit to be interfaced with almost any make of receiver.

● VCR HEAD WEAR
There's considerable difference between the video head life obtained with different VCR makes and models. This article lists the factors that affect head life and provides data on various makes, based on research carried out by MCES and others. One thing to make sure of is that the back tension is correct.

● ONE-FOR-ALL REMOTE CONTROL
Universal infra-red remote control units enable one device to control several items of equipment. The One-for-All unit goes about this in a new way – via computer programming, with all relevant codes stored in memory. Eugene Trundle reviews this new device.

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VCR Clinic

Reports from Philip Blundell, Eng. Tech., Eugene Trundle, Ian Bowden, Nick Beer and Joe Cieszynski

Sanyo VHR-D500E

This was our first fault in the special effects department of a machine with digital trick-effects circuitry! The reported symptom was that the digitally-derived pictures were intermittently bright green. In equipment which generates colour pictures in any way, green images usually mean absence of the B – Y and R – Y (or U and V) signals. And so it was in this case.

During digital encoding for memorisation, IC402 on board DM5 of the digital module quantises R – Y and B – Y alternately. An intermittent open-circuit in the minuscule choke L404 was lifting the entire chip circuit off the analogue ground line to produce the fault. **E.T.**

Finlux VR1010/Philips VR6462

There was an unusual fault on this machine, the symptoms being no tuning pattern signal, no playback signals and no E-E signals. The deck worked mechanically. Voltage checks revealed that the +12b supply was excessive, and we found that diode D6148 in its unusual stabiliser circuit was leaky. **E.T.**

Sony CCDV7/8, Pioneer VE-M800

These machines have the same basic mechanism and cabinet shell. If you get one that won't eject, with the tape tangled inside, check for a distorted or bent cassette cradle. What sometimes happens is that the left side of the cradle is too high, so that the splines in the take-up spool are not gripped: the turntable rotates, but the tape spool doesn't. Unlike some makes of camcorder, I find that a little careful bending back works – but replacement is better. **E.T.**

Panasonic NV333

No playback sound was the problem with this machine. There was a buzz when the audio head connections were touched, but it wasn't very loud. Signal injection (with the same finger) showed that the playback switch/amplifier transistor T4006 was failing to come on, due to insufficient base current. R4015 had risen in value from 33kΩ to 330kΩ, which threw us until we double checked the ohmmeter range. **E.T.**

Sony SLC9

We've had two of these excellent Betamax machines in recently, both with the same fault. The machine will accept a cassette but fails to load the tape — instead the eject light flashes. If you thread the tape manually everything works fine until you press the eject button, whereupon the tape unthreads but the cassette fails to eject, once more accompanied by the eject LED flashing. The cause of these symptoms lies with the unload-end switch, just in front of the cassette. It will need adjustment or replacement. **E.T.**

Mitsubishi HS302

Another dealer had fitted a new cassette bulb but rewind was now poor and the take-up spool didn't rotate in play. We found that the spools were catching on the cassette box: the clip that holds the wires down, by the cassette bulb, had been fitted incorrectly – as a result the wires prevented the housing from going right down. **P.B.**

Philips VR6467 etc

Quite a common fault with this range of machines is the cassette lift lever 276 jumping out of its slot in the rack slider 278. If this occurs check the lift itself for broken or missing parts. Otherwise replace the rack, lift lever and cassette-in switch COD1. If the lift begins to operate before the cassette is fully home in the tray the cassette will not lower and the gears will jump. **P.B.**

Ferguson 3V23/JVC HR7700

The playback colour had Hanover bars. Comparison with the conditions in another machine showed that in the faulty one the signal at TP203 was much larger. The associated adjustments R224/L203 had little effect and it turned out to be the delay line DL201 that was faulty. **P.B.**

Philips VR6180

The sound would cut out intermittently when this machine had been playing for half an hour. If you left it playing the machine would eventually stop and eject the tape. A dose of freezer and hairdryer heat isolated the fault to IC7140 (type MUP8051H1-2-D3). **P.B.**

Grundig VS340

If the machine intermittently fails to play or leaves a loop of tape hanging out of the cassette on eject, suspect the capstan motor of having a dead spot. **P.B.**

Akai VS1

There was no vision in the E-E and playback modes. Loss of the playback signal was due to loss of the 12V PB supply because fuse SF5 had blown. Absence of the E-E signal was the result of loss of tuning memory as one of the tags had corroded off the ni-cad battery – these machines give a blank raster when not tuned in, not snow. **P.B.**

Panasonic NV-G40 (G Mechanism)

The reported fault with this machine was that it wouldn't play. It would just about fast wind if it was started by hand. The cause of the trouble was insufficient torque from the DD capstan motor.

The only incorrect voltage around the motor driver chip IC2501 was at pin 19 which is some form of current limit input from IC2102. With the machine just in the "on" state this voltage should be 0·75V – the manual doesn't tell you this, I checked with another machine. In fact 0·14V was present. If pin 19 was disconnected from the PCB land the voltage rose and the motor worked correctly except that full torque was applied as soon as fast wind was selected, instead of the usual slow start.

Three resistors are connected to this land, 33kΩ and 680kΩ which go to pins 19 and 22 respectively of IC2102 and a 5·6kΩ chip resistor (R2506) which is connected to chassis. This latter resistor gave a reading of 800Ω in circuit but was found to measure 5·6kΩ when removed. The resistance from the land to chassis was checked, producing a reading of several megohms. We cleaned the PCB in the area where the resistor is connected and after refitting it the machine worked perfectly. For two weeks that is, after which it failed again.

The cause this time was the same – a low resistance reading across R2506. We found that merely touching the tip of the soldering iron on to the land that connects the two i.c.s would clear the fault and that the leakage was on the component side of the double-sided PCB. **I.B.**

Panasonic NV730

The on, off and the two week bars in the display were permanently on. The cause was simple – the metallised plastic screening card fitted at the front right of the machine to cover some of the ribbon cables that connect the display PCB had been pushed too far forward and was touching one of the exposed legs which stick out of the top of the fluorescent display tube, earthing it.

The problem with another of these machines was tape tangling. It had been in the workshop about six months ago, when the reel idler had been replaced for the same fault. We gave it a test run which lasted for several days before the fault appeared. This revealed that there was no voltage drive to the reel motor in any mode. A look at the circuit diagram suggested to us that Q1504, a regulator transistor that supplies the voltage to the motor switching circuitry, could be responsible for the trouble. On investigation we found that all three connections were dry-jointed. It's mounted on the right-angled heatsink at the rear right-hand corner. **I.B.**

Sony CCDV8

The complaint was of a flashing picture coupled with a clicking noise. When the camcorder was switched on with the lens cap fitted there was no problem. With the lens cap removed the picture would be lost every few seconds. These oscillations would increase in frequency if the lens was pointed at a brighter subject. The trouble was due to the fact that the iris was oscillating from fully closed to fully open. The cause was simple enough – a poor connection at pin 4 of connector CN703 on board AW-2. This is the iris brake drive: without this "negative feedback" the iris control circuit starts to oscillate. **I.B.**

Ferguson 3V23/JVC HR7700

The symptom here was a common one: black tearing to the right of black-to-white transitions while any tape was being played. This can be due to a number of things, the most common cause being worn heads. Fitting replacement heads made no difference however, neither did adjusting the Q and damp controls associated with the f.m. preamplifier. When I attempted to set up the playback limiters as per the manual I discovered that the "limiter balance 2" control had no effect at all. After carrying out a few further tests I decided to order a replacement for the chip that contains the suspect limiter (IC4, type HA11703). Fitting this enabled the fault to be cleared. **J.C.**

Panasonic NV-G21

This fault could theoretically occur with any machine that uses the G mechanism. There was a knocking noise in play, record, fast forward, rewind and search. The cause was the pulley at the bottom of the capstan motor rotor/flywheel – it drives the loading and reel mechanism via the timing belt and was running eccentrically. There's considerable tension in this belt and the noise didn't occur with the motor running off load.

Another of these machines had a white line at the bottom of its own recordings and would intermittently roll and mute the sound. The audio/control head was at the wrong height, the control head section erasing part of the video track. **N.B.**

Ferguson 3C03

As with the majority of modern camcorders this model has a built-in diagnostic system. It came in with the record, pause, stop and fast forward LEDs alight. According to the manual this indicates loss of one of the 5V rails. In fact the 5V supplies were present and what we had was a syscon fault. The best approach seemed to be to check around the syscon microcomputer chip IC401, where we found that there was no voltage at pin 32. This is connected to pin 4 of IC401 and a check here revealed signs of life. The cause of the trouble was a break in a through-the-board link. These are impossible to repair, the only solution being to bridge the break with a lead from one side of the board to the other. **N.B.**

Panasonic NV2000

This old top loader came to me with a note on the card saying that there was no capstan lock in the playback mode: there was no mention of the hum that obliterated the sound and vision in the E-E mode! A check on the power supply revealed that D1011 (10E1) and its reservoir capacitor C1009 (1,000μF, not 100μF as the sheet says) were both leaky – the electrolytic was getting decidedly warm. The effects of this were hum on the 12V supply to the r.f. converter and the demodulator circuits and on the 18V supply to the capstan servo circuit. This fault highlights the need to check all symptoms before you plunge in. **N.B.**

Sony SLF1

The cassette lid wouldn't stay latched down. On examination I found that the latching assembly, on the left-hand side of the mechanism viewed from the front, was being held in the "carriage down" state. The lacing mechanism appeared to be displaced so I wound the loading motor to where I thought it should be and the lid then closed. When the machine was switched on again the mechanism returned to its previous state – unlacing continued for too long. Maybe the unlace end sensing switch? It was o.k. but following this path I soon came to Q611 and Q613 which had both exploded. These are the unlacing end sense switching transistors on the syscon PCB. A lot of heat had presumably been involved as there were numerous dry-joints. **N.B.**

Panasonic NV-G25

The display worked correctly but several of the unused portions were partially illuminated. We found that the voltage drop across the digitron's heater was correct but the actual feed voltage was high. The cause was traced to the supply's stabilising zener diode D7502 (7·5V) which was virtually short-circuit. **N.B.**

Letters

SPARES DISTRIBUTORS

The current situation regarding Philips' spares ought to be aired in public. The company has put its spares business out to wholesalers and no longer supplies non-account holders. This is a perfectly sensible policy but unfortunately the result, at present, is chaos. The basic idea is that a dealer who requires parts for any Philips product sends his order to one of the main appointed distributors, i.e. HRS, Chas Hyde, CPC, Willow Vale or SEME. I have recently tried to obtain several parts for Philips equipment and have had a great deal of trouble. According to Philips, any part can be supplied to a distributor within 48 hours. The word from the distributors is somewhat different – seven to ten days seems to be average for non-stock items. This leaves the poor dealer with an irate customer – or several of them. It's time that Philips and its distributors got their act together.

I've dealt with most of the well-known component distributors at one time or another. Perhaps the following unbiased comments on the services provided may be of interest. Here goes, anyway.

I've dealt with HRS for some time. In the early days stock was hard to come by, but there have been improvements since the move to Garretts Green. First I get what I order, secondly they can tell you straight away the stock situation and thirdly they are not always out of stock. The range and variety of stock held, including audio and visual products, is very good. Availability is good, accounting good (except for credit notes) and the catalogue excellent. Generally a very good company. A helpful rep.

Chas Hyde gave me my first account and I've dealt with this firm since 1983. The range and variety of stock held is good, availablility is excellent and the accounting good. The catalogue is poor however – descriptions in some cases non-existent and no pictures at all of certain items (this applies to general spares). Main Philips dealer, helpful rep, generally an excellent firm to deal with.

I find that CPC's unique ordering system could be improved, also the level of stock, back ordering and speed of delivery. The firm has a good range of products however. Particularly useful is the range of Hinari and Mastercare parts, but I never seem to be lucky in phoning up when they've got what I want. Amstrad spares are a nightmare. If you require any part not listed it can take months. You can't go direct to Amstrad unless you are an Amstrad account customer and the part is for equipment under guarantee. If you back order parts that are listed you'll be charged postage even though your original order was large enough to avoid this. The accounting system is a mystery and awkward. If you order on say August 28th the invoice will be sent under separate cover and may not arrive until September. Naturally it will go into September's invoices for payment in October. But CPC will have put it into August's invoices and will stop your account in September, thereby causing endless confusion and inconvenience at my end. Sending the invoice with the goods would prevent this. Moral: don't order from CPC near the end of the month. Range and variety of goods stocked is very good but the availability is questionable. Catalogue is good. No rep.

SEME has always been very good to me and given me truly remarkable service. It is in my opinion the best, with technical advice on products available (account holders only I'm told). There's a reasonable range of product – if only they could supply more manufacturers' genuine spares I'd be happy indeed, but they don't. They do supply NEC, Fidelity and some GEC spares amongst others. So, range and variety fair, availability excellent, accounting excellent, likewise the catalogue. A friendly, helpful rep who is welcome any time. An excellent company to deal with.

I don't hold a full account with Willow Vale and go to this firm only for Grundig spares, which come promptly. The problem I find with this firm is the huge reams of paper covered in writing – it's not easy to tell which part is the invoice and which is rubbish. The catalogue is untidy and doesn't give prices. I can never find the separate price guide and the Sharp catalogue is hard to follow. But perhaps it's just me.

I have occasionally tried Wizard and Ampmace but it seems that these companies carry only a limited range of stock.

The above comments are based on my own experience which, I quite accept, may not be typical. No malice intended: I write in the genuine hope that these comments will result in better service. If I've offended anyone, I apologise.

Martin R. Blake,
Proprietor, Martin Blake Video Services,
Wrexham, Clwyd.

PVC AND HEAT

There are two reasons why the tip (May) for removing hardened PVC wire covering is a bad idea. (1) Heating PVC in an uncontrolled way with a soldering iron produces quite toxic fumes. (2) The end of the PVC remaining on the wire contains corrosive agents that will eat through fine wires in particular.

If heat must be applied, use a temperature-controlled hot-air gun.

Alan C. Pickwick, M.Sc., A.M.B.C.S., F.R.A.S.,
Sale, Cheshire.

HELP WANTED

I've been unable to solve a matching problem between a Spectrum Plus-2 128K computer and a Goodmans CTV14X colour portable – the picture breaks up in a similar manner to tuner or modulator drift, requiring frequent adjustment to the receiver's fine tuning. Replacing the computer's modulator has made no difference, while the TV set works well off air and with a VCR. This suggests that the trouble lies in the computer – but what? Colour dropout also occurs. Do any computer users have the answer?

Ray Crockit, Anglezarke, Thrumster,
Wick, Caithness KW1 5TX.

Could anyone help me to obtain service sheets for two computer monitors? The first is a Nabu VC4404 (formerly Vilker-Craig) – it's a monochrome terminal with on-board processing for transmitting RS232, Model no. 70-400-01078-8. The second monitor was produced by Zenith Radio Corporation, Model no. ZVM-123-6, chassis 12ZM12X. It's a 12in. monitor that accepts composite video.

John Hamnett, 39 Artillery Court, Wadeson Road,
Ardwick, Manchester M13 9TX.

Can anyone supply a mains transformer for the B and O 2600-3200 series hybrid CTV chassis? While this part is understandably no longer available from B and O I would dearly like to restore the set to its former glory – the picture was excellent. A second-hand transformer from a set kept for spares would do fine.
Steve Ormonroyd, 3 Harold Road,
Lowestoft, Suffolk NR33 0EF.
0502 572 966.

SPARES MANUFACTURE

My early years were spent in the motor trade, dealing with the products of Lucas, CAV, Rotax, Sims and the US firms Declo Remy and Hyatt. In those days many firms made replacement parts, not copies, for the original manufacturers' equipment. Sometimes these replacement parts were better than the originals. I suggest that the answer to the spares problem mentioned by R.T. Blyth (June) would be for enterprising firms to do this for the radio and TV trade. It's already done for triplers of course, and a few years ago Alderson James produced tuner controls. In the early days of television there was also a universal line output transformer. Copies may cause legal problems, but surely where an original manufacturer refuses to supply parts others should be allowed to do so?
K.J. Treeby,
Plymouth, Devon.

EHT ARCING

I must complain once more about the suggestion that sealant be used to cure e.h.t. arcing (TV Fault Finding, May). It must be stressed that the practice of sealing up an existing e.h.t. discharge is dangerous and should never be adopted.
G.R. Darby, Proprietor Monitech,
Earls Barton, Northampton.

SPARES, FEEDHORNS, ETC

With reference to Paul Hardy's comments on spares (TV Fault Finding, May), this is a perennial problem. Nearly all manufacturers now guarantee to supply spares for only a limited period – in the case of colour TV sets this is usually between six and eight years. I feel that after this time they should offer all spares to an approved distributor. As Paul Hardy's case shows, many spares are required beyond the typical spares availability period. Maybe however the eight-year period will become long enough: c.r.t. replacement generally writes a set off, and the life of the average modern c.r.t. is pathetic.

I gather than the editor (sorry, J.A.R.) was responsible for the caption on page 502 (May) which includes the comment that offset dish LNBs have a flared feedhorn without scalar rings. While this is true of the Grundig dish shown it's not true of all offset dishes. The original Skyscan system K1, with 1·2 or 1·5m offset dishes, had a flared feedhorn with scalar rings. Conversely, not all prime-focus units have scalar rings. The Salora prime-focus 1·8m dish had just a straight feedhorn.

Many service engineers will see a lot of sense in Malcolm Burrell's comments (Letters, May). Technology for technology's sake is the only way to describe some of the totally obscure and virtually useless features in modern TV, video and audio equipment – and, I'm sure, in other fields as well. They are there to make the product more "attractive" and to convince the customer that he can't possibly do without it. The public falls for this but probably seldom makes use of anything other than the basic features of equipment.

Here are a few additions to Graham Richards' list of useful tips.

(1) I've on many occasions used my Weller gun to degauss a c.r.t. But it can't replace the trusty old RBM coil or Willow Vale rod as it doesn't remove "the stubborn stains"!

(2) If you're looking for a good multi-purpose power supply, try taking one from the Sony C7 VCR and encasing it. It's a switched-mode power supply and provides an excellent alternative to commercial units. Many of these VCRs are now being scrapped: the power supply is self-contained and the mains switch can easily be reused.

(3) The 2SC1942 transistor mentioned is also used in many of the earlier Hitachi models in the chopper and/or line output positions and regularly fails. The exact device is available ex-panel from Sendz Components at a very reasonable £1 or so. I've used many from this source and they have proved very successful.

Finally, what a shock to read that Les Lawry-Johns is selling up. It is indeed a sad day for us all, readers old and new alike. Les has for so many years echoed the emotions of every engineer and has kept us entertained – some of his tales have been worthy of a TV script in their wit and natural comedy. I hope, as I'm sure everyone will, that once the pressures of work have been lifted he'll enjoy better health in his retirement – we all know that this is one of the most stressful jobs going. I hope he will continue to write for us and wish him and his family all the best for the future.

Nick Beer,
Bideford, N. Devon.

Long-distance Television

Roger Bunney

April was a gloomy month with little reception of any consequence. Sporadic E conditions were poor, with not even the usual mid-April opening. F2 conditions are still suffering from the aftermath of the auroral disruption on March 13th. Meteor scatter has been similarly quiet. At the time of writing the only improvement has been in tropospheric conditions: high pressure with warm weather provided a tropospheric lift in early May, but the only benefit was some reception of Band III/u.h.f. Benelux stations in central southern England. The SpE log, such as it is, follows:

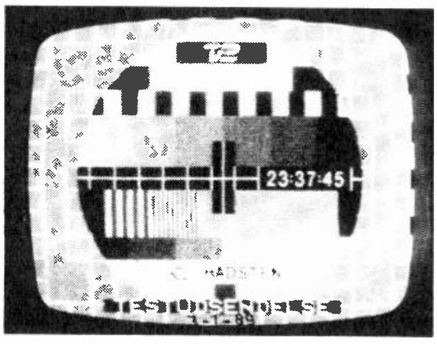
5/4/89 TVE (Spain) ch. E2.
6/4/89 TVE E2; NRK (Norway) E2.
7/4/89 TVE E2.
9/4/89 ARD (W. Germany) E4; RAI (Italy) IA; TVE E2, 4; RTP (Portugal) E3.
12/4/89 TVE E2; TVP (Poland) R1.
15/4/89 TVE E2, 3; NRK E2; RUV (Iceland) E4.
19/4/89 TVE E2, 4.
21/4/89 TVE E2.
25/4/89 CST (Czecholslovakia) R1.
27/4/89 ARD E2; JRT (Yugoslavia) E4.
29/4/89 TVE E2.

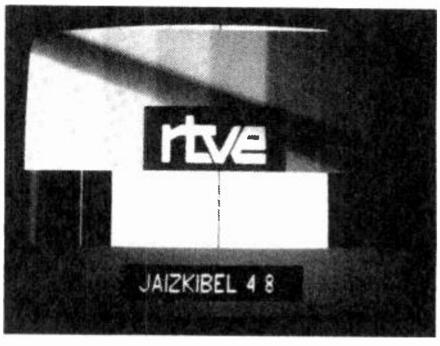
A minor aurora was noted by Iain Menzies in Aberdeen on the 7th. On the following day Tim Anderson (St. Leonards, E. Sussex) received GBC (Ghana) ch. E2 by what is assumed to have been transequatorial skip. A weak FUBK-type test pattern with prominent black/white checkered squares around the edges was noted at 1710, followed by a coloured news announcer, programmes and a logo, the signals ending at 1820 BST. Picture quality was P2-P3 at best, with the aerial pointing south towards Ghana/Nigeria. Tropospheric conditions improved on the 19th, giving Benelux/French reception; RTL (Luxembourg) and NRK ch. E11 were seen in central UK. Ryn Muntjewerff (Holland) has received confirmation from an Eastern contact that his F2 reception on March 5th was of the Malaysian TV3 network.

George Gaskin has sent in details of the Spanish signals currently receivable in Gibraltar. The ECO/Galavision satellite TV signals on ch. 46 originate from a low-power relay at Los Barrios to the north. Canal Sur is available on chs. E41 and E46. GBC now screens live BBC news at 1800 and 2100 BST — recorded ITN news had previously been used.

A press release from the DTI states that ideas of a sixth terrestrial u.h.f. channel in the UK have been abandoned. Amongst the reasons given are that only seventeen per cent of the population would have been able to receive the service.

My thanks to Iain Menzies (Aberdeen), Roger Fussell (Torpoint), Bill Cotterill (Tipton), Tim Anderson (St.





Left: A C band (4GHz) signal from RTM (Morocco) received via the Intelsat 53°W craft's Northern Hemispherical beam by Ian Waller in Lincoln using a 6ft dish and a new Gardiner 35°K LNB. Centre: The Danish ch. E26 Hadsten TV2 transmitter received on test by Ryn Muntjewerff (Holland). Right: RTVE/ETB ch. 48 test pattern received in Gibraltar by George Gaskin.

Leonards), Peter Schubert (Rainham) and Simon Hamer (Powys) for sending in reception reports.

News Items

Denmark: The Danish PM5534 test pattern has been seen carrying the identifications "DR" in red in the upper part and "Danmarks Radio" in black letters on the lower white square. There's a new ch. E35 TV2 outlet at Nibe, with 600kW e.r.p.

West Germany: The Flensburg NDR relay transmissions on ch. E11 have apparently been moved to chs. E12 and E59. The ch. E4 transmissions will eventually be moved to Band III/u.h.f.

Greece: There is hope that the EPT-3 network will be extended rapidly throughout the country. The first station was Thessaloniki ch. E39.

France: The Antenne-2 network is now using both Antiope and Ceefax teletext.

Kuwait: A new TV transmission tower to be built at Kuwait City will be the tallest man-made structure in the Gulf, reaching to some 372m. Construction has started.

Zimbabwe: A five-year programme has started to extend radio and TV across the country and improve reception in many areas.

Israel: An Arabic Educational TV service has been established by Israeli TV. It will share time with Hebrew Educational TV during the 0900-1600 Monday-Saturday slot.

New Zealand: The TV3 commercial TV service will come into operation this November, with coverage of 70 per cent of the population initially, rising to 95 per cent by the end of 1990. NBC and TV3 have signed an agreement giving TV3 access to all NBC news, sport and entertainment programme material.

Australia: A subscription channel, the first in the country, starts in Sydney this month, providing six hours of programming daily for hospitals and medical institutions.

UK: The DTI has abolished a wide range of licences covering low-power devices, e.g. garage door openers, children's walkie-talkie units, radio microphones and low-power microwave devices. There could well be increased interference in Band I from 49MHz equipment — it's already becoming common for "co-channel" interference to occur and some "low-power" alarms can be received at over half a mile.

Satellite TV

PamAmSat at 45°W has carried several additional services on its 11·56GHz (horizontal) transponder during the month (April). CNBC (Consumer News and Business Channel, apparently Canadian) was transmitted towards the end of the month and the whole output of Fox TV WNEW-5 New York has been seen.

Astra (19·2°E) may carry a new Dutch cable TV channel known as RTN (Radio Televisie Nederland) starting this autumn.

The Conseil Superieur de l'Audiovisuel (CSA) has now allocated the channels on TDF-1 at 19°W. One channel will carry Antenne-2/France Regions 3/Sport 2/3 operating for 24 hours a day. This channel will be scrambled, charging £9 per month. Another channel will be run on a joint basis by two consortia, one "Channel Enfants" providing a 14·5 hours a day service for children up to 14 years of age, the other "Euromusique" providing 4·5 hours a day of pop offerings. Two channels have been allocated to the Canal Plus group. One will duplicate the terrestrial service (a different programme may later be carried by the terrestrial transmitters), the second will provide a similar programme with German language sound. These will both operate for 20 hours a day, mainly scrambled at £15 per month. A further channel, "La Sept", will be a combined French/German arts service which will build up to provide 10·5 hours of unscrambled programmes daily. The CSA has insisted that a single decoder should be used for all the scrambled services, so scrambling will not start until the end of the year or early 1990. The FR3 service will also carry two existing stereo radio programmes, France-Inter and France-Musique, also the external radio service RFI.

The 11·56GHz carrier transmitted by Gorizont at 14°W is no longer in use. A new satellite at 16°W will take over at this frequency with higher power.

Sale or Swap

Maurice Hillier, near Southampton, has for sale at £40, or swap for a Telecom 12·5-12·7GHz LNB, an SPC 10·9-11·75GHz LNB with a typical noise figure of 1·85dB. It has an N output socket. You can contact him on Romsey (0794) 40830.

Stephen W. Batrop, 68 Victoria Road, Bude, Cornwall EX25 8RH (0288 55253) has for sale a couple of vintage items. First a Murphy Radio TV pattern generator type II with power supply A, covering 40-70MHz with switched internal or external a.m. It's not known whether this is in working order. Secondly a round 15in. Mazda CRM152B c.r.t. which is still in the original box and as far as known is unused. It requires a 2V, 1·4A heater supply and 12kV e.h.t.

Inside the Ferguson ICC5 Chassis

J. LeJeune

The Ferguson ICC5 chassis is the first one that shows the influence of its French owner Thomson. It was designed by Thomson but has clearly been customised by Ferguson – nothing is left, for example, of its multi-standard origin. The UK built receiver is single standard (PAL system I), u.h.f. only. Two different versions of the basic chassis are available, one version having a different i.f. and demodulator system to cater for Nicam 728 stereo sound. You might find that the chassis is vaguely familiar – it's been used in its full Continental version in NordMende and Telefunken receivers of recent manufacture.

The standard UK vision i.f. (39·5MHz) has been adopted. The tuner and i.f. sections are arranged within a can that lies flat on the chassis, the quality of the screening being very high. This should be helpful for viewers in areas where there are high r.f. fields produced by radio amateurs, emergency services and radiotherapy equipment. Processing of the luminance and chrominance signals is carried out on a daughter board. This is one of three, which give the chassis a degree of flexibility. The other two daughter boards are for teletext and on-screen graphics and for the audio circuitry. Fig. 1 shows the general arrangement of the electronics in the ICC5 chassis.

Microcomputer Control

The receiver's heart is its dedicated microcomputer chip IR01. This is a 40-pin device made for Ferguson (type FERG05) and is similar to the ITT 2070 central control unit (CCU) chip. The main functions provided by IR01 are as follows: IR remote control decoding; display LED drive; audio muting; d.c. volume control; teletext and on-screen graphics control; programme selection; adjustment of brightness, contrast and saturation. The teletext decoder is of the Fastext variety. Facilities such as "child lock" with a personal identification number and a unique "burnt-in" serial number are also provided. This latter item must be one of the reasons for Ferguson's advice that the ICC5 chassis will not be available through its "advance replacement" scheme.

The central control processor IR01 controls all the receiver functions via four bus systems which are referred to as IM, I2C, tuning and Thomson. All the operations within IR01 are synchronised by a 4MHz clock. The IM bus takes care of channel selection and the analogue control adjustments, the I2C bus is mainly concerned with teletext and graphics, while the tuning bus adjusts the frequency of the tuner's local oscillator via the phase-locked loop system in IT20 (TD6316AP). Finally, the Thomson bus is mainly concerned with the HA11498 video processing chip IV21, controlling its internal switching for video source and type selection. There are few front controls on the cabinet – just on/off, volume up/down and sequential programme selection up/down. Heavy reliance is thus placed on remote control.

Chassis Features

Much of the circuitry is conventional and should pose no problems for the service engineer. Other features may be strange to eyes accustomed to Ferguson's previous chassis. Mains isolation is provided by the chopper transformer LP04 and the drive coupling transformer LP32. The input to the chopper's driver stage is provided at line rate by the TEA2029C "power processor" chip IL14 which incorporates the sync circuitry and the line and field generator circuits – it also provides sandcastle and a.g.c. gating pulse outputs and contains a safety trip. The mains input range catered for is a generous 180-264V a.c. It enters the receiver through a two-stage filter network. This is designed primarily to prevent hash generated in the receiver from being fed into the mains supply but also prevents a great deal of mains-borne interference from getting into the receiver. Notable departures from convention are the use of a thyristor as the field output device and a two-chip chroma-luminance processing system. There's naturally a scart connector, and some models have comprehensive socketry for external speakers.

The chroma-luminance processing system incorporates comprehensive switching to cater for off-air, external composite video or external RGB signals. The latter are converted to YUV (luminance plus U and V colour-difference signals) form for application to the contrast and saturation control circuits within IV21. This switching allows several video sources to be mixed – off-air TV and teletext, off-air TV and RGB from the scart connector, or teletext and external RGB and off-air TV. Correct presentation depends of course on all these signals being synchronised. After control has been applied to the YUV signals they are converted to RGB form for application to the driver and output stages.

Conventional class AB RGB output stages are used, mounted on the c.r.t. base panel. Emitter-followers are incorporated to provide beam sensing feedback. The focus and first anode controls are also mounted on the c.r.t. base panel.

The chassis is compact and robust, a nice feature being the arrangement of the picture geometry presets along the rear edge. For servicing purposes the chassis can be slid back from its position on the cabinet floor and tilted to be vertical. Tubular projections from the plastic chassis mounting frame, at the front of each side member, mate with holes in the cabinet floor to hold the assembly firmly in this position. The lead lengths are sufficient to allow for this, though care is needed (and a piece of cardboard?) to prevent short-circuits on the c.r.t. base panel. Considerable use is made of surface mounted components. The trend is towards this type of construction, the mixture of axial lead and leadless components providing a very high component density and thus a compact chassis.

Tuning

The tuner has two stages. A dual-gate MOSFET is used in the r.f. amplifier stage, which is followed by a bipolar transistor in the conventional self-oscillating mixer arrangement. Inter-stage coupling is earthy-end inductive, permitting good control of shape over the 2:1 frequency range. The local oscillator is controlled by the previously mentioned phase-locked loop in IT20 (TD6316AP).

This i.c. contains a series of divider systems, some fixed

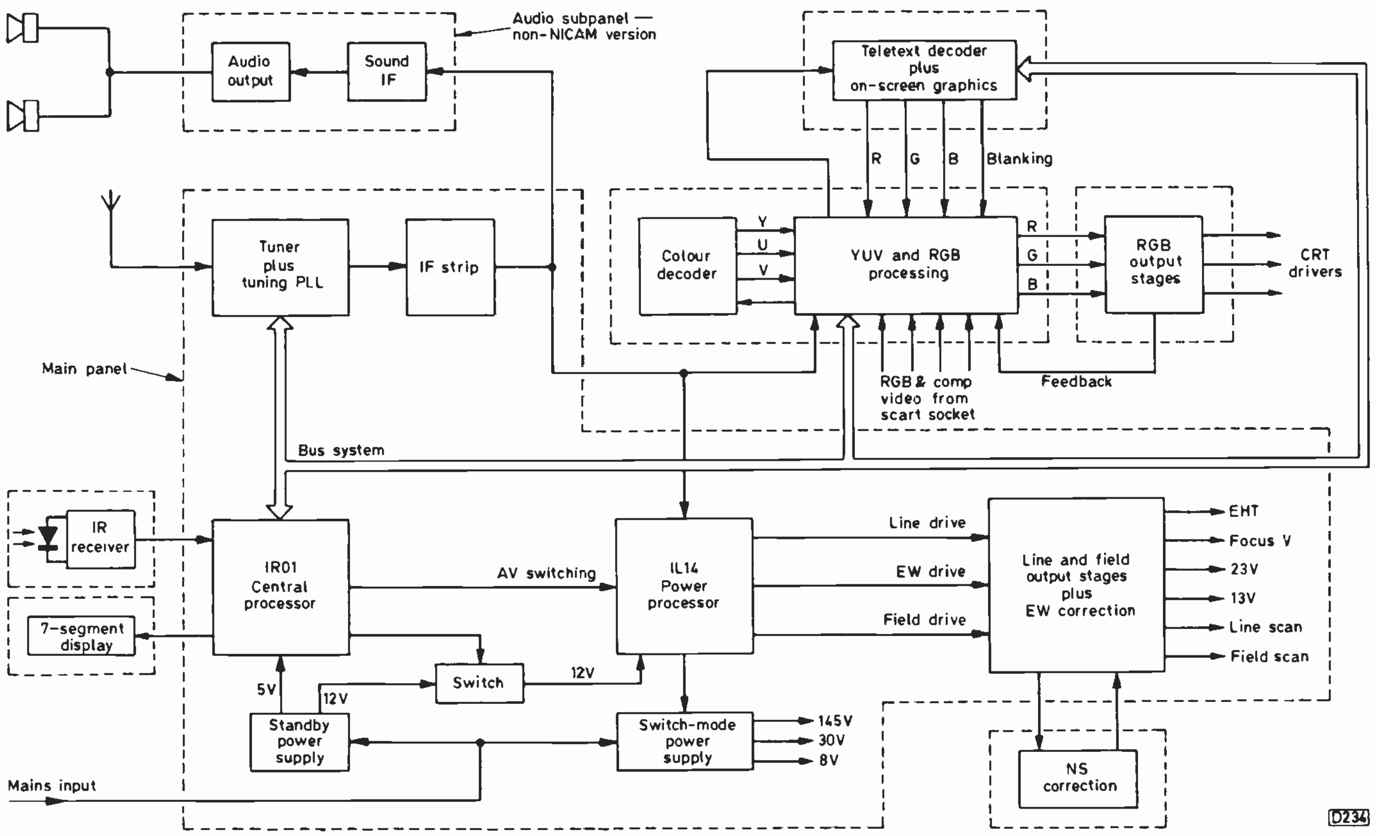


Fig. 1: Overall arrangement of the Ferguson ICC5 chassis.

ratio and others programmable via the IM bus; a frequency comparator; a serial data in/parallel data out circuit; an 18-bit latch; a digital-to-analogue converter and an analogue tuning voltage controller (see Fig. 2). It also contains a 4MHz oscillator and a divide-by-512 circuit which produces a final frequency of 7,812·5Hz. When the viewer selects a programme via the IR handset the central processor IR01 converts this command into signals on the IM bus. These set the division ratio of the programmable dividers in IT20 so that, when the tuner is on the required channel, the result of division of the local oscillator frequency by the programmable divider chain is 7,812·5Hz. A simple comparator looks at the sample and reference frequencies and generates an error voltage which is used as a.f.c. for accurate tuning of the local oscillator. This produces a necessary slight adjustment of the division ratio – the fine-tuning data.

The IM bus signals set the approximate tuning voltage for the required channel, the phase-locked loop taking care of any errors. This system does not call for the usual a.f.c. derived from the detected vision carrier. The fine

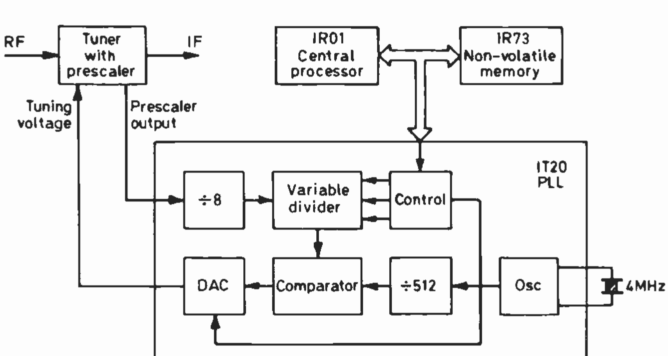


Fig. 2: The phase-locked loop tuning system which is controlled by the microcomputer chip.

tuning data is fed back to the central processor via the IM bus and is memorised. Thus as the tuner ages and tends to drift the tuning data is continually refreshed, taking care of any changes that occur in the loop.

The IF Strip

The tuner's i.f. output is filtered by a top-coupled bandpass circuit and is then amplified by a two-transistor SAWF driver stage. This stage has a high input impedance to suit the input filter and a medium output impedance to suit the SAWF. The latter has an unbalanced input. Its insertion loss is made good by the preceding amplifier/driver stage.

The SAWF's balanced output drives a conventional TDA2451 i.f. amplifier/detector chip. In addition to the internal a.g.c., which has a range of 60dB, pin 5 provides an a.g.c. output for the tuner, the crossover point being set by P136. The TDA2451's output at pin 11 is fed to the chroma-luminance subpanel and the sound subpanel.

A somewhat different arrangement is used in sets that have Nicam stereo sound capability. In these the SAWF provides separate, balanced vision and sound i.f. outputs. A TDA4443 vision i.f. amplifier/detector chip acts in the same way as the TDA2541 while a TDA4445B is added to handle the sound i.f. signal.

The set on which this article is based did not incorporate the Nicam stereo sound facilities. Its sound panel uses a conventional TBA120T chip for the intercarrier signal and a TDA2030A audio amplifier chip which provides some 6W peak power with very acceptable quality. Ceramic filters are used at the input to the TBA120T and in the quadrature detector circuit. Audio from the scart connector is fed into the TBA120T at pin 3, prior to the d.c. volume control which thus provides adjustment of the external and off-air sound signals.

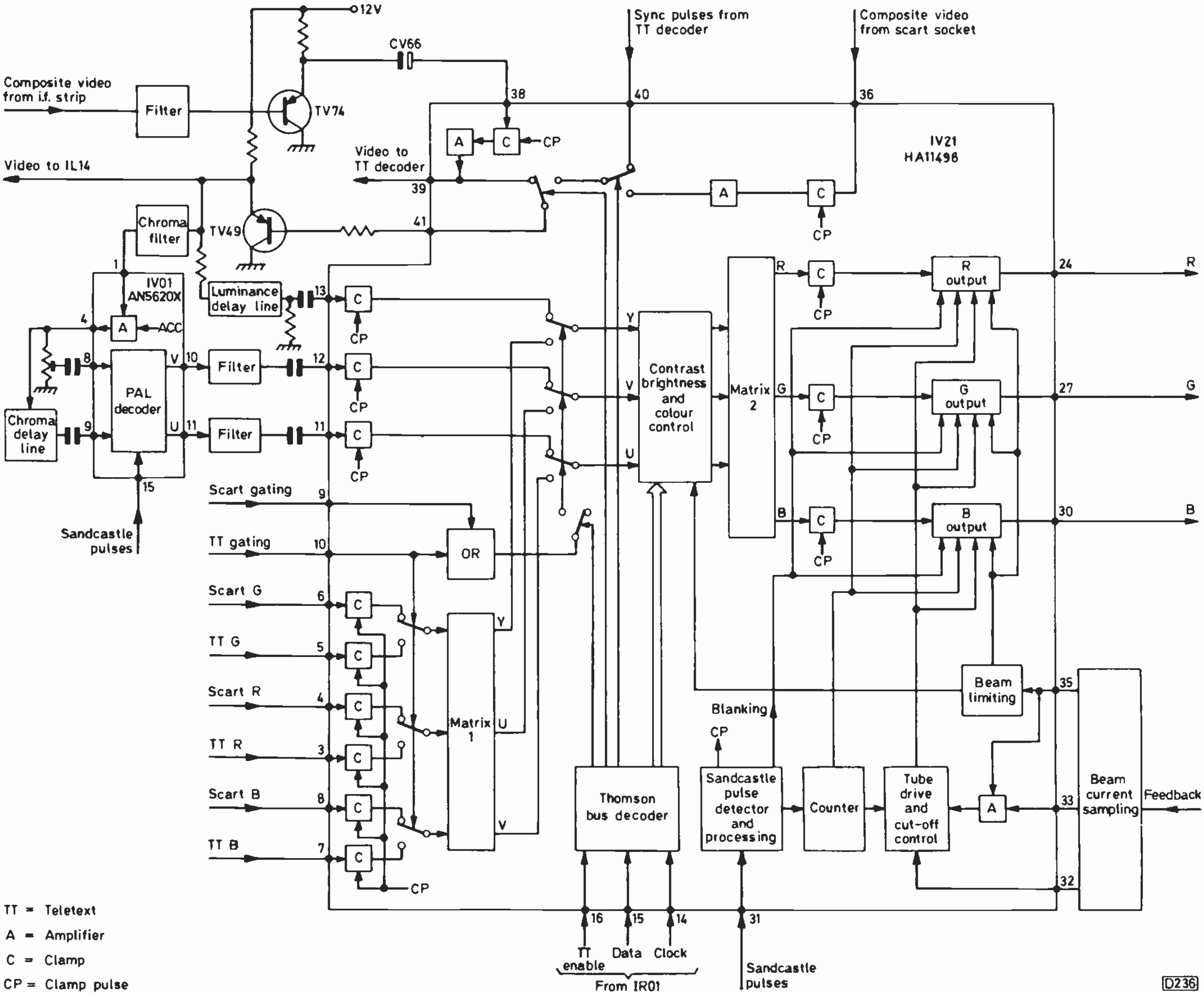


Fig. 3: Signal processing and routing/switching on the chroma/luminance subpanel.

Similarly audio is taken from the TBA120T prior to the volume control stage to feed the scart connector.

Video Circuitry

The circuitry on the chroma-luminance subpanel is shown in simplified form in Fig. 3. There are two chips, an AN5620X (IV01) and an HA11498 (IV21). IV01 is a PAL decoder chip providing U and V outputs at pins 11 and 10 respectively. IV21 provides matrixing; switching between off-air video, teletext and RGB or composite video inputs from the scart connector; control of contrast, brightness and saturation; beam limiting and black-level control; decoding of the Thomson bus signals; and RGB drive circuits.

The composite video signal from the i.f. chip is filtered, buffered by TV74 and fed via CV66 to pin 38 of IV21. After clamping, amplification and switching for off-air/external composite video selection it emerges at pin 41 where a further buffer TV49 feeds the chroma filter, the luminance delay line and the sync separator in IL14. The luminance delay line VV53 has a built-in subcarrier trap.

The delayed luminance signal re-enters IV21 at pin 13 where after clamping and switch selection of internal/external signals it's applied to the control section. The demodulated U and V colour-difference signals from IV01 are filtered and applied to pins 11 and 12 of IV21. They follow a similar path via clamps and switching to the control section. All this switching and control is determined by IR01 via the Thomson bus, which is connected to IV21 at pins 14 (clock), 15 (data) and 16 (teletext enable). Following brightness/contrast/saturation control a

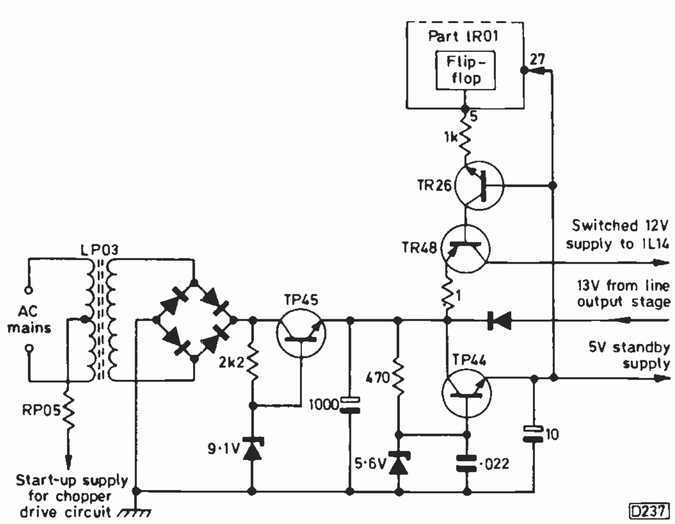


Fig. 4: The standby power supply circuit.

matrix provides RGB outputs for the driver stages. These are under the control of the beam limiting and black-level systems which operate via feedback from the RGB output stages on the c.r.t. base panel.

The class AB RGB output stages on the c.r.t. base panel are conventional – of almost the same design in fact as in the TX100 chassis. There are two potentiometers, PV50 in the red output stage and PV70 in the blue output stage, for peak white adjustment.

Power Supply Circuits

The main power supply in the ICC5 chassis is a switch-mode circuit of the shunt type, with mains isolation. There's also a standby power supply which consists of a mains transformer and bridge rectifier feeding two static regulators that deliver 5V and 13V supplies when the main power supply is shut down by a command via the IM bus. With the mains power switch in the off position the entire receiver is disconnected from the mains supply.

Fig. 4 shows the standby supply circuit and its switched-12V arrangement. On receipt of an on command from the remote control handset the flip-flop behind pin 5 of IR01 switches to produce a low output. Provided the standby 5V supply is present TR26 and TP48 switch on, providing a 12V supply for the sync/timebase generator/chopper drive chip IL14. Failure of the 5V will mean a dead set.

Fig. 5 shows the chopper circuit. The drive from IL14 is coupled to the base of TP11 by the pulse transformer LP32, which is part of the mains isolation barrier. TP16 and TP19 form a complementary-symmetry driver stage for the chopper transistor TP24. Bridge rectifier DP06-9 produces approximately 330V across CP03. This supply feeds the primary winding of the chopper transformer LP04. Three windings on the secondary side provide 145V, 22V (via a tap), 30V and 8V supplies.

During start-up the driver stages draw power from the centre-tap in the primary winding of mains transformer LP03, DP08 and DP09 acting as rectifiers to provide a d.c. supply. Once the chopper circuit has come into operation the supply for the drivers is provided by DP26/CP26 and the associated winding on the chopper transformer. At switch-on IL14 provides drive pulses with a very small mark-space ratio. Over a short period of time IL14 progressively increases the mark-space ratio, thus smoothly increasing the output from the chopper circuit to the correct operating level. This soft-start feature ensures that no component is over-stressed during the start-up stage.

TP14/15 form an excess current trip. In the event of the chopper transistor passing excess current the voltage developed across RP21 and RP25 will switch TP15 on, linking the base of TP14 to the power supply chassis line so that it too conducts, the two transistors latching on. The chopper drive is removed since the bases of TP16 and TP19 are connected to chassis via DP16 and TP15.

The Power Processor Chip

Fig. 6 shows a simplified block diagram of the power processor chip IL14 which provides field, line and chopper drives, a field sawtooth output for the EW modulator circuit, the super-sandcastle pulses and an interchannel sound muting output (also an a.g.c. gating pulse output which is not used). Composite video is fed into the sync separator section at pin 27. The separated line sync pulses are used to control a 500kHz oscillator (line frequency × 32) via a phase-locked loop. Line and field sync reference signals are generated by division of the output from the 500kHz clock oscillator, the field sync pulses providing a reset for the field divider chain (vertical timing). The chip contains line- and field-frequency sawtooth oscillators.

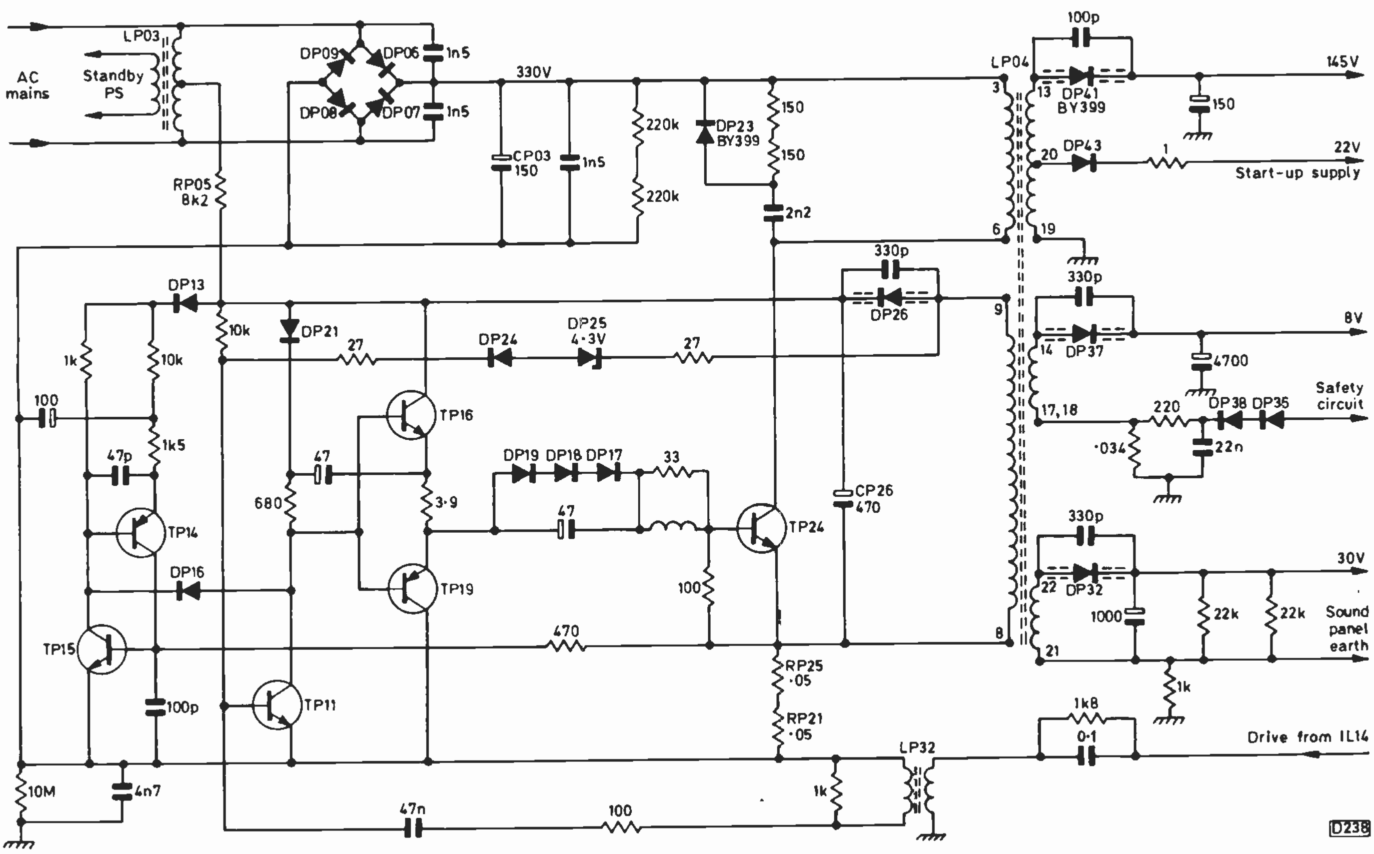


Fig. 5: The chopper circuit.

The off-air line sync pulses and the divided-by-32 output from the 500kHz oscillator are compared in phase detector 1, which controls the 500kHz oscillator. Thus all the outputs from the dividers are synchronised to the incoming line sync pulses. This phase detector has time-constant switching, operated by a voltage supplied to pin 23 by the central processor chip IR01 – programme selectors 8, 9 and 10 are reserved for AV use. The chip also switches to the AV time-constant when there is no or a very noisy video signal.

The second phase detector compares the timing of the divided down output from the 500kHz oscillator with line output transformer derived pulses which are fed in at pin 12, arriving at the phase detector via the sandcastle pulse generator circuit. The output from this detector is applied to the line drive pulse generator circuit. This enables the start of the scan and thus the horizontal picture position to be set. There is also a d.c. input from the line shift control, giving manual adjustment of the picture within the raster. During normal operation the line drive pulse generator stage produces from the output of the sawtooth line oscillator a constant 26μsec wide pulse which is passed via the output stage to pin 10. At start up however the pulse width is narrower, giving a soft-start action to prevent overloading the line output transistor.

The output from the sawtooth line oscillator is also applied to the chopper drive modulator and the field drive modulator. For chopper pulse width modulation the modulator stage is under the control of an operational amplifier whose inverting input is taken to the slider of the set h.t. control. As previously mentioned, the mark-space ratio of the chopper drive pulses is reduced at switch on to give a soft-start action.

The field drive system is a bit more elaborate. A field-frequency sawtooth oscillator controlled by the vertical timing circuit provides, at pin 3, an output for the EW correction circuit in the TDA4950 chip IG01. This output is also shaped and fed back to pin 2, one of the inputs of another operational amplifier, together with a feedback waveform from the field output stage. The sawtooth output from this operational amplifier is fed, along with the output from the sawtooth line oscillator, to the field drive modulator circuit. The result of mixing these two signals is a pulse-width modulated output, i.e. the output from the field drive modulator consists of line-frequency pulses modulated at field rate. At the beginning of the field scan the pulses are narrow. They gradually increase in width during the field scan. Those familiar with the old Philips G11 chassis will recognise this as class D drive. We shall see how it's used shortly.

Interchannel sound muting is based on detecting the presence of off-air sync pulses. Pin 24 goes low when a video signal is present, rising to 6·7V in the absence of a video signal to activate the sound muting system.

The TDA2029C incorporates a safety circuit which shuts down the line, field and chopper drive outputs in the event of excessive output voltages in the line output or chopper circuits. Voltage sensing is at pin 28, which is normally at 0V and rises to about 6V in the trip condition.

Line Deflection

The line driver and output stages follow conventional practice. A BU508A or S2000A3 acts as the line output transistor (TL31). Taps and windings on the line output transformer provide 200V, 23V and 13V lines and the c.r.t.'s heater supply. The diode-split winding provides the e.h.t. and the input to the combined focus/first anode control unit on the c.r.t. base panel. A further winding provides current for the thyristor field output stage.

Field Deflection

Field scanning is controlled by an ESM740G thyristor, DL21, whose gate is coupled via RL21 to IL14's field output pin 4, which as we have seen produces a pulse-width modulated output. The arrangement is shown in Fig. 7.

The reason for using a winding on the line output transformer as a load for DL21 is the need to be able to switch it off. As you will doubtless know, a thyristor can be switched on by applying a positive-going pulse to its gate but will switch off only when the voltage across it is reduced to zero. The line flyback pulses picked up by winding 4-11 of the line output transformer switch DL22 on, with the result that DL21 is switched off once per line.

The pulse-width modulation applied to DL21's gate switches it on once per line at a progressively earlier point as the field scan progresses. Since the impedance of the field scan coils at line frequency is large they have an integrating effect on the field scan current. In this way the steadily increasing current pulses are smoothed to produce a ramp. Current flows from chassis via DL21, LL32, winding 4-11 on the line output transformer, RL50, the field scan coils and RF17 to the 23V supply.

During the field flyback period DL21 remains cut off and DL22 acts as a clamp. The voltage developed across CL54 rises to some 200V and the direction of current through the scan coils is reversed.

RF17 is included to provide a feedback signal which is tapped from the height control and fed back to pin 2 of IL14.

EW Correction

A conventional diode modulator arrangement is used for EW correction, with the driver and waveform shaping circuitry incorporated in a TDA4950 chip (IG01). Fig. 8 shows the circuitry here. The field-frequency sawtooth waveform fed into pin 1 is converted to a parabolic waveform by the first stage, a Miller integrator. PG02 adjusts the tilt of the parabolic waveform to provide keystone correction. Overall feedback is applied to pin 7 to control the gain of the internal circuitry, PG08 adjusting the degree of pincushion correction provided. An anti-breathing input from the earthy end of the e.h.t. circuit is also applied to pin 7. The other input to the operational amplifier, at pin 8, is fed with a sawtooth waveform derived from a 50V peak-to-peak pulse obtained from the line output transformer. This signal is in anti-phase to the line scan, and as PG12 sets its amplitude this preset operates as a width control.

NS Correction

With Super-Planar tubes additional S correction plus pincushion and "gullwing" (or moustache) correction are required. These are provided by the NS correction circuitry on board NS5000M.

Text and Graphics

Most receivers that incorporate the ICC5 chassis also have Fastext and on-screen graphics. A set of three chips

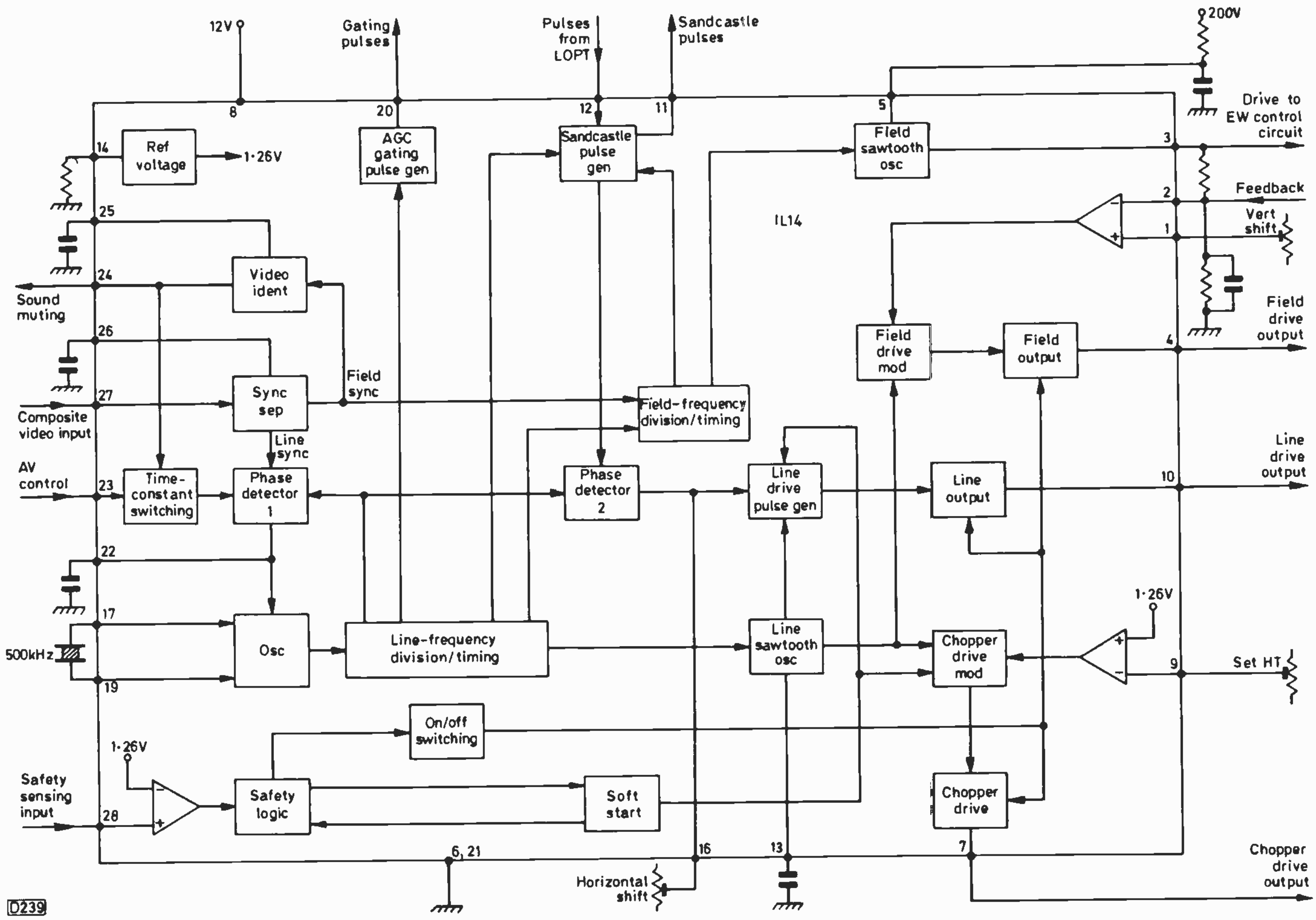


Fig. 6: Simplified block diagram of the TEA2029C power processor chip.

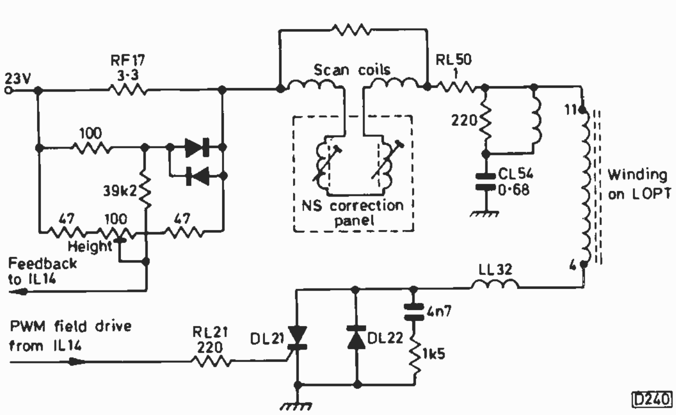


Fig. 7: The field deflection circuit.

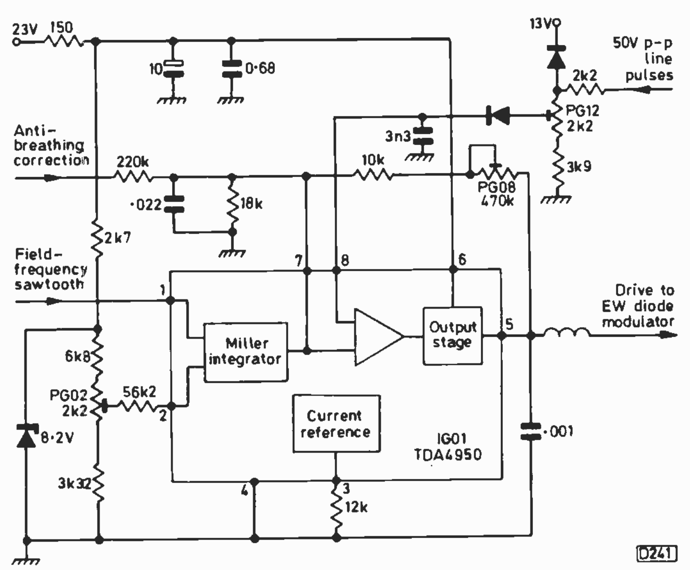


Fig. 8: Circuitry around the TDA4950 chip which controls the EW diode modulator.

provides the Fastext facilities, with a 4-page memory. The SAA5231 text acquisition chip IV03 feeds an SAA5243 device (IV02) which is described as a computer-controlled teletext chip – it's controlled by IR01 via the I2C bus. Captured pages of data are transferred to IV01, a static RAM (μPD4364C/15L). IV02 contains a character generator which provides RGB text signals plus blanking suitable for text-only, mixed or subtitle operation. The teletext panel also contains two custom-built chips, IV05 and IV06, which provide synchronised RGB graphics for user-control information, station identification and the point-of-sale message.

In Conclusion

Much has been fitted into this compact chassis by clever use of conventional and MELF (metal-ended leadless-frame, i.e. surface mounted) components. Some might query the return of plug-in modules, but the plug and socketry is of a high standard and will permit a degree of panel jockeying in the event of a bout of technofear. The performance provided by the chassis should win many admirers. It's an interesting change from established UK and Japanese designs.

Amstrad's Satellite TV Receiver

Ian Martin

Following Steve Beeching's interesting article (May) on his Grundig satellite TV receiver installation I thought that readers might be interested in my experiences with the Amstrad SRX200. From the point of view of cost and features this package is very attractive, suggesting that it might well become the most popular budget system. As I'd no hands-on experience with satellite TV systems it seemed the best way of finding out about the technology of installation and operation.

As the weeks went by awaiting delivery (I gather that supplies are now more readily available) misgivings began to set in: would the dish/LNB combination be adequate, would the receiver meet the quoted specification, would the mechanical construction be robust or flimsy? At last the day arrived and the system was collected from the supplier, in two cartons. A small one contained the receiver, remote control unit, batteries, instructions and r.f. lead. A large thin carton contained the LNB and dish in flat-pack form. As I was to instal the system myself I also had to purchase the cable and connectors to link the LNB to the receiver and the wall fixing bolts and plugs – these would normally be taken care of by the contracted installer.

Inspection

First inspection revealed that the receiver is of a high standard of build and finish, the internal PCB being made by Orion or some equally competent Japanese manufacturer. The semiconductor devices are from Motorola and a variety of other suppliers – no sign of any cheap chip set here! I'll leave out mention of the user controls as these are described in the many advertisements and reviews elsewhere. The tuning system is of the search and memorise type and comes already set up for the sixteen Astra channels. It's easy to use but is limited if you like to explore the frequencies between the specified channels. The a.f.c. is very powerful – more on this later.

The back panel sports connectors for u.h.f. in and out, an F connector for the input from the LNB, left- and right-hand channel phono audio output sockets and a scart connector which is wired for audio and video but not RGB outputs. An unusual miniature D connector is fitted for a MAC or subscription decoder (not yet available) which I assume will sit in the recess on top of the unit.

Installation

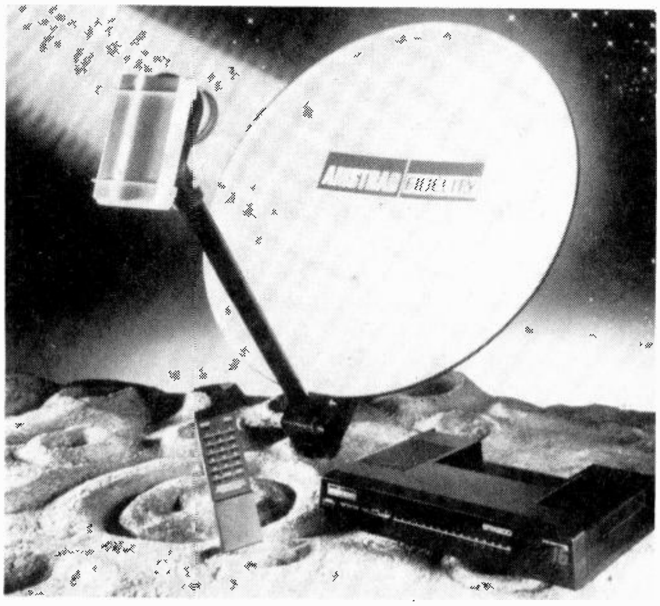
The manual is generally good and is seemingly aimed at the home installer, with all the stages of dish assembly and connection outlined. I did however find it easier to assemble the bracket first, fitting the dish to the bracket last, rather than the way round suggested in the text. Some time is required to sort out which nuts and bolts are which before you start as they all come in one pack. Incidentally the dish is held on to the bracket by means of six self-tapping screws – due to the light weight of the dish this seems to be perfectly adequate.

We'd already decided where to put the dish, a clear view to the south east being available. In the absence of a compass magnetic south was found by floating a magnetised needle in a bowl of water – does anyone else remember Ladybird's "Magnets, Bulbs and Batteries" book from junior school?!

With the dish attached to the wall mount, the elevation was preset to the local value using the protractor embossed on the mounting bracket – a map showing all 0·5° elevation lines across the UK is included in the manual. The dish was then pivoted slowly eastwards while observing a monitor placed on top of a convenient bay window. A strong signal quickly appeared on channel 8 (Sky Television). Once the approximate positon was set, fine adjustment was carried out using the weaker channel 6. I was unable to receive any horizontally polarised (odd numbered) channels however due to a fault in the LNB. After a considerable amount of hassle, partly due to a shortage of LNBs and partly due to the dealer trying to disclaim any responsibility for self-installed systems, a replacement LNB was obtained from SatCare. This solved the problem and brought in MTV on channel 15 and all the odd numbered channels.

Results Obtained

The receiver was found to perform very well, with excellent video response and stereo audio. Teletext signals come through clearly, indicating good i.f. characteristics. One major problem came to light after about one hour's use however: sparklies began to appear, particularly on channels 1 and 9. They eventually became very severe and appeared to be lining up! It transpired that the receiver was slowly tuning up the band, the a.f.c. pulling in the next channel up. This was verified by selection of the "recall" function, which shows on the LED display the actual frequency being received. Channels 1 and 9 are particularly affected because of the adjacent channels 3 and 11. At one stage a watchable channel 3 D-MAC signal could be seen floating over channel 1. By this time other units in a friend's shop were displaying the same



The Amstrad SRX200 satellite TV receiver system.

effect, and a call to Amstrad's Technical Department provided a simple cure – readjust the receiver's a.f.c. offset control VR101 when the receiver is warm, then rememorise the channel. This problem apparently affects some early units.

Conclusion

In general I'm very happy with reception and the system's features. Self-installation doesn't save much money as the cost of cable, clips, masonry drills etc. adds up. As I'm located in South Wales the field strength of the Astra signal is relatively high. I've seen letters in other magazines from users farther north however complaining that sparklies mar reception, though this may well be due to the a.f.c. offset problem or bad dish alignment. The construction of the dish mount should allow a larger lightweight dish to be fitted if necessary. Perhaps someone will make a DX kit!

Over all then a good value product that delivers excellent performance at low cost. It seems to be a good introduction to the world of satellite TV.

How to Avoid Customer Problems

Dave Mackrill

From time to time in his articles Les Lawry-Johns has mentioned problems with awkward customers. It's a sad fact of life that our customers can cause us far more trouble than their TV sets or VCRs do — if we let them. While our magazine covers many aspects of electronic servicing, little has been written about dealing with the general public.

Soon after I started in business, some years ago, it became obvious that this could be the most difficult part of the trade and that a very definite and careful approach was needed since, without precautions, some customers would waste no time in taking advantage. To minimise possible problems I've adopted the following approach.

(1) When a customer phones or calls with a repair I always quote my charges. So much for the first quarter of an hour, then at the rate of so much per hour, plus parts. Or for a VCR a set service/overhaul charge plus parts, then extra for additional time if a prolonged repair is needed. I charge extra for collection and delivery of equipment and mention this if appropriate.

I never make any promises about when a repair is likely to be ready, merely saying that I'll repair the equipment as soon as possible. I find it better not to commit myself, just in case. Most people appreciate this approach, as there is nothing worse than having a repair promised for a certain time or date then finding that for some reason it's not ready.

I've lost one or two potential customers by making the above conditions clear, but consider myself better off without them.

I ask all prospective callers to make a definite appointment and give them an hour, that is I might tell them I'll be here between three and four and will wait in specially if I know they'll be coming.

(2) I keep a book by the phone and note down names, addresses, phone numbers, details of equipment and fault symptoms. This information is taken from all phone callers and visitors. It's also useful to note the time they intend to come or the time they expect you to visit them.

It's a good idea to ask all customers whether their TV set/VCR has been working correctly up to now. In the past I've been asked to repair equipment that's been given to someone and has had at least six separate faults. One example was a hybrid colour TV receiver that appeared to have spent at least six months in a garden shed.

It's best to make it clear that you repair only normal breakdowns. All sorts of things can come to light if you question a customer carefully. For example: "We gave it to George round the corner to look at — he understands videos because he mends cuckoo clocks in his spare time. He's cleaned and oiled it for us."

(3) I keep a diary in which I write details of all faults and work done plus any comments I make to customers about charges, repair completion, estimates or any details relating to their equipment. A careful note is made of any appointments made by the customer or by myself.

(4) I also keep a customer index. When a job is brought in or a call-out repair is completed I transfer the details from my "book by the phone" into this, including equipment serial numbers but not actual fault details.

(5) An account book is kept showing who paid what for what type of repair and the date. This also shows my outgoings on a daily basis.

(6) When a job has been completed I make out a bill on a proper headed form with the customer's name and address, details of the repaired item and date, plus a report on all the work done and the components replaced. I then telephone the owner, briefly explain the repair and quote the price. I ask them to make an appointment to collect the equipment, as described earlier, or tell them when I can deliver it to within an hour.

I then always ask "will you be paying cash?" Even if they say yes I go on to explain that I can accept cheques only up to the £50 limit accompanied by a current banker's cheque guarantee card for the same account. I do this even when I've agreed to deliver the set. There's nothing worse than installing a large colour TV set only to find that the customer can't pay for the repair. A favourite ploy is "we'll drop the money in to you".

(7) If a customer refuses to collect equipment and pay for the repair or doesn't keep an appointment and doesn't contact me I wait 24 hours then send out a recorded delivery letter on my headed paper, showing my name and address, the date, the customer's name and address and details of their equipment. The letter states:

Dear Mr./Mrs. . . .

This is to inform you of your obligation to collect the above goods and settle the attached repair invoice. In accordance with my terms of business equipment left for repair and remaining uncollected for a period of three calendar months is normally sold to defray the costs incurred. If the goods are still uncollected by . . . (date three calendar months later) they will be sold or scrapped on . . . (date as before plus one day) or as soon as possible afterwards.

Please note that storage will be charged at the rate of £5 per month.

Yours faithfully,

So instead of being stuck with the item indefinitely, unable to sell it or even to use it for spares, at least I know that I can legally dispose of it after three months. The full details can be obtained from any local Citizen's Advice Bureau by phone.

(8) Keep carbon copies of all letters and bills sent to customers. If given permission to dispose of a customer's property I note the exact words, time and date in my diary.

(9) I also keep a record of awkward customers and those who waste my time by not keeping appointments. If they ever contact me again I'm able to tell them politely that I'm unable to help them.

(10) A couple of years ago I invested in a telephone answering machine. Now, if the phone rings at an unsocial hour I don't need to answer it in case it's a friend or relative. I can up the volume and listen to the incoming message and then pick up the receiver if I wish.

If you make a habit of keeping careful records as described in this article you'll find that you won't have too many problems and will not be caught out by people phoning to say "you mended my telly six weeks ago and it's the same again". You can consult your books and quickly find out whether:

(a) It wasn't you who repaired the equipment, but probably Smashem and Bodgem down the road.

(b) It was six months ago.

(c) The symptoms were different.

(d) Also which components were replaced and the repair charge.

Fortunately these precautions are not necessary with the majority of customers. But you need to be prepared and ready to protect yourself. The best of luck to you all!

Test Report: Rover MC10SAT Analyser

Eugene Trundle

Some time ago I reviewed in these pages a panoramic monitor which combined the functions of a field strength meter, a v.h.f./u.h.f. spectrum analyser and a picture/sound monitor. A similar but very much more sophisticated instrument is now available, the Italian Rover Model MC10SAT. I've spent many hours exploring its features and performance. It amounts to a portable laboratory for the analysis and measurement of all the characteristics of TV and radio signals in the ranges 41-300MHz, 470-870MHz and 950-1,750MHz, covering the broadcast Bands I, II, III, IV and V plus the output range of satellite TV head units.

Facilities are also provided for high-frequency counting; reflectometer tests on coaxial cable; audio/visual monitoring; terrestrial and satellite signal demodulation; VSWR/RL and filter testing by sweep generation; use with teletext decoders, MAC decoders etc. via a multipin socket; and tuner substitution in distribution systems and receiver fault-finding.

Because the instrument is required to give accurate readout figures for both the frequency and level of the signal carriers being checked it contains two internal "rock" references: a stable and accurate crystal in a frequency synthesis tuning circuit and a calibrated wideband noise generator whose output level is constant to within 1·5dB at 50dB/μV over the band 35-1,000MHz. A comparison of the signal under test with these references gives quantitative and accurate readings, as we'll see.

This quite large and heavy instrument (it's got a handle though!) is mains powered but includes two 3Ah accumulators that give about one and a quarter hours' cordless operation after a twelve-hour charge. The front panel is dominated by a 6in. monochrome TV screen on which all spectrum measurement and checks of picture quality and level are made. Frequency and channel are shown by digital displays, push-button selected. Channels are readily stored in sixteen non-volatile memories.

Below the c.r.t. screen are the terminals and controls for the satellite TV receiver and a switchable 90dB attenuator (10dB steps) for r.f. carrier strength measurement. The spectrum analyser and function controls are grouped together. Volume, brightness and contrast controls are provided for the TV receiver and display functions.

The instrument comes in a heavy protective cover with side pouches for the accessories. Further details are given in the specification, Table 1, which is necessarily abridged – the original covers six pages of the operator's manual! We'll run through the instrument's various functions, providing notes on the results obtained and comments based on my test runs.

Field Strength Meter

The instrument operates as a monochrome TV receiver with frequency-synthesis tuning that covers Bands I/II/III/IV/V. In this mode normal vision and sound signals can be received and checked for quality by keying in standard channel numbers. Non-broadcast channels, e.g. from a VCR, computer or satellite TV tuner's modulator, are catered for by means of plus/minus shift buttons that give a 62·5kHz offset per stab. The frequency thus tuned in is read out in MHz via a three-digit display, with an accuracy of plus/minus one digit. Baseband audio and video signals are available for external use, and there's a facility that enables the display's line scanning to be delayed so that the sync pulses and nearby signals can be examined at screen centre.

A horizontal white line is present at the bottom of the picture display, its extent indicating the signal strength on a scale calibrated from 20-40dBμV. Use of the attenuator switches enables this electronic pointer to be brought to screen centre for easy readout of the carrier level, which is then the sum of the attenuator setting and the indication. If you want you can easily convert the dBμV figure to

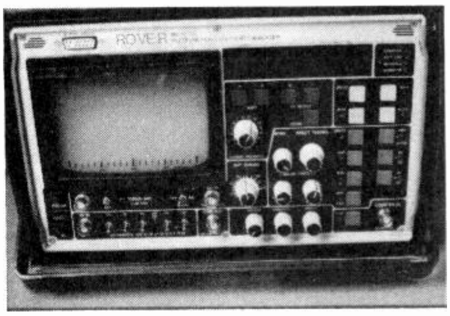


Fig. 1: The Rover MC10SAT's front panel layout.

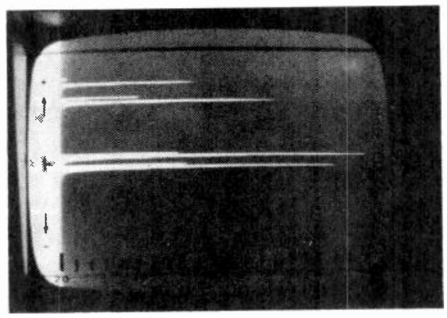


Fig. 2: Display of the u.h.f. band showing the Heathfield TV carriers on chs. 49, 52, 64 and 67. At higher gain settings carriers from relays etc. are visible as stray pick-up.

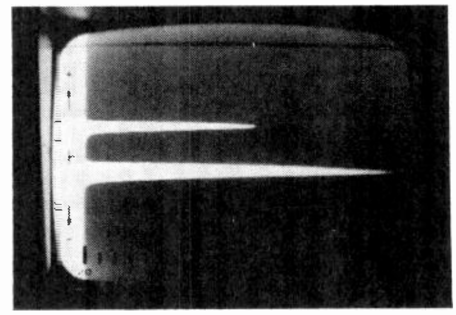


Fig. 3: The zoom and expansion controls enable the carriers of a single u.h.f. TV channel to be examined.

mV, based on the factor 60dBμV = 1mV – a conversion chart is included with the instrument.

The accuracy of this field strength indication can be quickly checked at any time by switching in the CNG (calibrated noise generator) whose known level provides a reference point. I checked all the local terrestrial broadcasts here and found that they ranged from 63dBμV (2·4mV) to 77dBμV (7mV). These high levels are partly due to an excellent aerial and distribution amplifier and partly to the boost given to the carriers in the through-amplifiers of the satellite TV tuner and VCR, varying between 2-4dB across the u.h.f. band – also checked with the MC10SAT. Whilst at it I took the opportunity to check the accuracy of the various in-line attenuators lying in the tool box.

An audible signal strength indication is provided by a tone generator whose note increases with carrier level. I found that I could easily align aerials and dishes for maximum signal with my eyes closed!

RF Spectrum Analyser

The same "pointer and scale" system of signal strength indication is available with the panoramic display function we'll consider next, this time with the added bonus that the *relative* levels of all the carriers available in each band are shown.

The instrument's ability to sweep any band and display the shape, position and amplitude of all the carriers present is perhaps its most useful feature. Fig. 2 shows the display obtained in this mode, in this case with the black line at the bottom of the screen representing channel 21 while the black line at the top represents channel 68. Spectrum tuning and span (position and zoom) controls enable the whole band or any part of it to be observed – Fig. 3 shows the display with a single transmission occupying much of the screen.

Simultaneous display of everything going on in a band is very useful for assessing aerial and distribution system bandwidth and for identifying sources of interference, not to mention DX-TV carriers. I also found that selection and adjustment of notch and bandpass filters in situ is made very easy in this mode. While examining the input to my own TV set I could see the minuscule carriers of a distant group A transmitter sitting below the outputs from the VCR (2·8mV on ch. 35) and the satellite TV tuner (2·4mV on ch. 38) – the last two nicely separated and readily identifiable by their twin sound carriers 6MHz above and below the vision carrier.

To read the exact frequency of any signal in this sweep display a black electronic cursor can be laid over the carrier, after which the cursor frequency can be read out via the digital display. If required the figure can be keyed into the frequency-synthesis tuning system, after which a touch on the MEAS key will bring up the picture (and sound) at that point in the band. By this means I identified a satellite TV tuner as being the source of a whopping 479·5MHz i.f. leakage signal at around ch. 22.

Out of interest I looked at a sweep of Band I, which in this case includes the v.h.f. radio broadcast spectrum. Up came three neat little 56dBμV carriers from the BBC site at Wrotham. But what were these huge signals at 102·5 and 104·5MHz? They turned out to be the new local radio transmissions coming in off-beam at no less than 76dBμV/6mV. Wow!

Sweep Generator

Since the CNG has constant output across the whole signal spectrum the instrument can be used to check the

Table 1: Abridged specification.

Coverage: 41-870MHz at 75Ω; 0·95-1·750GHz at 62Ω.

Noise figures: 11dB at v.h.f., 13dB at u.h.f.

Measurement accuracy: 2dB minimum for indicator; 1·3dB minimum for attenuators.

Tuning capability: 100 channels via FS tuning plus offsets. 16 channels storable in non-volatile memory.

Analyser span: Adjustable between full band and one channel.

Noise generator: Output over 35-999MHz, flat to within 1·5dB.

Counter: Capability 20-999MHz, to 1,200MHz with digital shift. Input 3mV-1V.

Satellite TV tuner: Gain 0dB ±3dB, tuning resolution 50MHz.

Display tube: Monochrome with 6in. diameter, calibrated 20-40dBμV.

Power supplies: 117-220-240V, 50Hz mains, consumption 40W. 12V and 6V internal batteries, both with 3Ah capacity.

Accessories supplied: Power lead, case, DM10 satellite TV module, slide rule, RFC3 T connector, RFB02 reflectometer bridge, selection of link leads and adaptors, instruction manual, internal batteries.

resonant frequency and bandpass characteristics of all sorts of filters. Accurate indication of insertion loss, notch depth and the −3dB passband is made easy since the curve is directly displayed on the screen. Once again the cursor can be laid over any part of the curve and the corresponding frequency read from the very accurate digital display.

Since there's little interference here I don't have to get involved with r.f. filters, but I did play with a couple of ch. 37 filters and was very impressed with the effects obtained when adjusting them and the way in which they could be analysed at a stroke with the instrument in this mode.

Reflectometer

The MC10SAT has a T connector for use with coaxial cable. When a signal is fed into a cable reflections from the far end, be it open- or short-circuit, give rise to a standing-wave pattern at the input – due to reinforcement and cancellation by the reflected signals. This effect depends on cable length and not on frequency. Hence the provision of the reflectometer mode.

The CNG's output is applied to the cable and the resulting signal spectrum is displayed. You select a suitable frequency (at u.h.f. for short runs, a Band I signal for long cables) and manually position cursors at successive maxima on the standing-wave pattern displayed on the screen. Cursor frequency readings are then available via the digital display for mental subtraction. Now I'm not very good at arithmetic, but I've got a calculator! The resulting frequency is lined up on a slide rule supplied and the cable length is read off the other scale.

It works! A two metre flylead produced a slide rule reading of 1·98mm and I found that there was 72m of satellite TV cable left on the 100m drum I'd borrowed. I owe him for 28m then! As a final test of this fascinating measurement system I cruelly drove a nail through a redundant downlead on the outside wall. The analyser and slide rule said it was 4·4m away; 4·5m was measured between the plug and the nail. Very impressive, and very useful for tracing hidden faults and damage. The slide rule has separate scales for two commonly used types of cable.

Frequency Counter

A stroke on the CNT key gives accurate readout of input frequencies between 20-999MHz. The count is based on the same high-stability crystal used for the FS tuning system, with an accuracy of ±1 count.

I used this counter mode, with a pick-up loop at the end of a cable, to check local oscillator frequencies in tuners and converters and to verify output frequencies from an old (with valves!) signal generator – the outputs had drifted somewhat during the generator's 25-year life. While trying to recalibrate it I got a shock from a valveholder, so I left it as it was.

Tunable Front-end

I.F. input and output connectors are present at the rear of the instrument, enabling it to be used to check tuners, SAW filters and i.f. amplifiers in TV sets and VCRs. The 38·9MHz i.f. used in the Rover is no handicap when applied to 39·5MHz equipment – it merely moves the r.f. tuning point slightly. UK versions of the analyser have 6MHz sound spacing. I didn't get the opportunity to try this mode, but the ability to measure carrier levels and introduce attenuation sounds useful.

This mode also enables the instrument to be used as a temporary front-end for a TV transponder, to change channel instantaneously, or during commissioning to check the best channel to relay.

Universal Satellite TV Receiver

The instrument has a completely independent satellite TV receiver with its own input and output terminals, complete with a switchable d.c. output for an LNB. Continuous tuning over the range 950-1,750MHz is possible, working with a BNC input socket (for which I had to make an F-socket adaptor). The satellite TV tuner's output is presented as a 134MHz i.f. signal with a 50MHz bandwidth. This output can be fed to the regular r.f. input socket used in all the tests previously described.

Thus you don't get an accurate readout of the input from the LNB (you don't need this) but you can accurately measure the signal strength as described above – the satellite TV tuner merely changes the signal frequency, with 0dB gain. Of more importance, the carrier-to-noise (C/N) ratio can be determined with reasonable accuracy, indicating the signal margins for reception in rain and under other impaired conditions. I found here at home that the signal level from Astra (via a 60cm offset dish and 1·5dB LNB) was around 64dBμV (1·6mV) and the C/N ratio around 13dB.

You can display the satellite TV picture on the screen in this mode, but it's not very good with the a.m. detector! Much more interesting is the spectrum analyser mode, which enables you to scan and display the 50MHz (centred on 134MHz) i.f. output from the satellite TV tuner. Now the Astra channel width is 26MHz. The channels are about 15MHz apart, with alternate polarisation. Thus about three channels can be simultaneously displayed in the spectrum analyser mode, and a fascinating sight it makes. Because of the extra superhet process involved, the satellite TV bands are displayed with the lower frequency carriers at the top of the screen. Manipulation of the tuning and span controls lets you see the f.m. vision carrier in detail, the sound carriers (more than one with some transmissions) and the effect of polarisation.

My satellite TV tuner has preset tweakers for polariser skew, and by using the MC10SAT with this display I was able to adjust the (magnetic) polarisation current to maximise the wanted carrier and null out the two adjacent carriers. Switching up a channel on the satellite TV box shifted the polarisation to suppress the middle carrier in the display, enabling me to peak the other preset. I then sealed them because I can't keep the Rover wonder machine! Turning the "spect tuning" knob winds all the available satellite channels down the screen in sequence – a total of eleven, alternatively this way and that, on this particular day here.

Satellite TV Demodulator Box

The i.f. amplifier and detector used in the basic chassis are intended for handling terrestrial a.m. vision signals, so subjective picture quality cannot be assessed in the normal "MEAS" mode. A satellite TV demodulator box is supplied with the instrument however – it hooks into the multiway socket on the front panel. The reason for adopting this modular approach is the wide variety of modulation, encoding and encryption systems in use with and proposed for use with the satellite TV services. Descramblers and MAC decoders will be made available to suit the latest transmissions. A teletext decoder module is also envisaged.

The satellite TV demodulator module supplied, type DM10, is suitable for f.m. transmissions (e.g. Astra). Its baseband output is fed into the instrument's monitor section so that monochrome pictures and monaural sound can be reproduced. This gives you complete TVRO capability which can be used while carrying out dish alignment. The DM10 module has a sensitivity adjustment with a range of 40dB and an audio subcarrier adjustment covering 4·5-8·5MHz – this is the key to finding hidden radio transmissions, stereo and alternate language carriers and a wide variety of buzzes, roars and squeaks.

Monitor Use

The small picture tube (the e.h.t. regulation is not too good) and loudspeaker (not hi-fi, but it conveys the message) can be used as a monitor for baseband signals. The 6in. c.r.t.'s definition is quite good, but I didn't use this mode for lack of a 15-pin connector of the right pattern . . .

In General

A look inside the instrument revealed a mother board with five daughter boards and a standard of construction that looks fit to last. The machine is quite weighty with its batteries – portable here means that it's got a handle rather than that it's light! The instruction manual is reasonably comprehensive and not too difficult to understand, though it contains one or two monumental misprints to exercise your brain. The manual's most frustrating feature is the need to flick over pages to see the text and illustrations, though this becomes less of a drawback as you become familiar with the use of the instrument.

Operation is simplified by the local grouping of the controls and connectors. The instrument's flashing readouts and winking LEDs are impressive indeed. It's the best toy (not meant in any disparaging sense) I've had to play with for many a month, but I wouldn't regard it as a roof-top instrument, particularly in bad weather.

Conclusion

This instrument well deserves its "mobile laboratory" tag and worked very well for me. It's stable, accurate and well designed, and has provision for updating – an essential feature in these days of rapid change and evolution in the broadcast and communications fields. As far as I can see it's capable of analysing any sort of signal that falls within its wide operational range, be the signal from a conventional aerial, a dish, an MATV/CATV system or a local source. In fact it's a very good tool for those concerned with cable systems and networks, interference tracing, commercial and broadcast signal links, DX-TV, technical education and research/design.

It's not the sort of instrument that you could afford to issue for each van, but a large, self-respecting communications or aerial/dish installation company should have one to call upon at HQ.

The Rover MC10SAT costs around £1,875 plus VAT and is available from J.G. Communications, 76 Malvern Way, Hastings, East Sussex TN34 3PX (telephone number 0424 441 010).

ECONOMIC DEVICES PO BOX 15, WOLVERHAMPTON, WV2 4AZ

15/80H	2.72
15/85R	3.28
17052	5.61
17053	5.61
17074	9.30
17089	3.45
17127	2.50
17376	1.58
1N4001	0.04
1N4002	0.06
1N4003	0.06
1N4004	0.05
1N4005	0.05
1N4006	0.08
1N4007	0.07
1N4148	0.03
1N4448	0.05
1N5401	0.11
1N5402	0.13
1N5403	0.18
1N5404	0.15
1N5408	0.14
1N914	0.04
1S1555	0.31
1S44	0.10
1S921	0.10
2N2219A	0.37
2N3053	0.35
2N3054	0.99
2N3055	0.79
2N3442	1.16
2N3702	0.14
2N3703	0.18
2N3705	0.16
2N3706	0.14
2N3707	0.16
2N3711	0.11
2N3771	2.04
2N3772	1.55
2N3773	2.20
2N3819	0.40
2N3823	1.17
2N3904	0.15
2N3906	0.62
2N4101	1.33
2N4240	2.00
2N4444	0.90
2N5293	0.50
2N5294	0.50
2N5296	0.48
2N5297	0.50
2N5298	0.61
2N6109	1.58
2N6130	0.85
2N6133	1.25
2N6180	0.73
2N6292	1.65
2SA1006	1.50
2SA1011	1.65
2SA1015	0.49
2SA1012	1.25
2SA1020Y	0.80
2SA1027R	0.45
2SA473	0.75
2SA766S	4.95
2SC1173Y	1.25
2SC1474	1.25
2SC1509	1.35
2SA1095	3.00
2SA1103	6.00
2SA329	0.40
2SA489	1.17
2SA490	1.32
2SA493	2.25
2SA562	0.57
2SA564	0.62
2SA614	4.88
2SA628	0.37
2SA639S	1.75
2SA659	0.49
2SA673	1.50
2SA684	1.20
2SA697	0.80
2SA699	1.25
2SA715	0.95
2SA748	1.95
2SA817	0.18
2SA835	2.50
2SA836	0.89
2SA844	0.65
2SA872	0.59
2SA884	2.15
2SA937R	0.97
2SA940	2.23
2SA940-2	2.14
2SA950	0.72
2SA951	1.75
2SA966-Y	0.85
2SA999	0.75
2SB774	0.65
2SB185	1.13
2SB375	3.87
2SB400	0.40
2SB405	1.03
2SB511	2.65
2SB54	1.39
2SB546	0.56
2SB56	2.80
2SB618A	2.22
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2SB643	0.50
2SB669	3.67
2SB681	3.96
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2SB774	0.65
2SB819	1.13
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2SC1104	3.98
2SC1106	4.54
2SC1114	3.25
2SC1116	4.95
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2SC1129	1.65
2SC1131	0.64
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2SC1162	0.55
2SC1172	2.22
2SC1195	6.09
2SC1213	0.89
2SC1226	1.46
2SC1292	0.90
2SC1306	1.98
2SC1317	0.50
2SC1364	0.49
2SC1383	1.20
2SC1391	2.45
2SC1398	0.75
2SC1413A	5.00
2SC1446	1.25
2SC1447	2.07
2SC1475	0.60
2SC1505	1.00
2SC1514	1.37
2SC1573Q	1.63
2SC1583	0.34
2SC1617	3.89
2SC1678	1.98
2SC1741	1.25
2SC1810	1.70
2SC1815	0.20
2SC1826	0.67
2SC1829	2.25
2SC1875	4.50
2SC1893	3.02
2SC1906	0.98
2SC1921	1.37
2SC1923	0.30
2SC1929	2.25
2SC1942	1.98
2SC1959	0.26
2SC1957	0.95
2SC1953	1.93
2SC1962	1.93
2SC1969	1.78
2SC1983	3.28
2SC1985	1.55
2SC2009	0.34
2SC2029	2.33
2SC2028	2.11
2SC2063	0.99
2SC2078	3.39
2SC2073	1.54
2SC2085-Q	1.65
2SC2091	1.30
2SC2141	2.44
2SC2166	0.87
2SC2216	0.69
2SC2233	1.20
2SC2236	1.69
2SC2278	1.14
2SC2314	0.87
2SC2335+Kit	7.00
2SC2551	1.26
2SC2565	3.84
2SC2570	0.80
2SC2577	1.60
2SC2578	6.75
2SC2671	0.91
2SC288A	1.85
2SC3153	6.50
2SC372	1.40
2SC373	1.16
2SC383	1.33
2SC388	1.27
2SC394V	0.81
2SC403C	0.60
2SC458	0.34
2SC495	0.92
2SC515A	1.85
2SC535	0.79
2SC536	0.10
2SC537	0.54
2SC605L	1.16
2SC620	1.46
2SC643A	1.54
2SC668	0.67
2SC681	4.40
2SC682	1.88
2SC684	1.65
2SC693	0.63
2SC710	1.15
2SC711A	0.50
2SC717	1.28
2SC734	1.43
2SC783	3.98
2SC790Y	1.85
2SC828	0.28
2SC867A	3.04
2SC876	0.96
2SC930	0.54
2SC935	4.13
2SC940	4.68
2SD1128	2.90
2SD1138	0.94
2SD1273	1.30
2SD1453	1.33
2SD152K	2.64
2SD198	3.87
2SD234	0.47
2SD235	0.60
2SD24	2.29
2SD257	1.98
2SD292	4.09
2SD313	2.65
2SD325D	2.26
2SD350	3.05
2SD353	7.50
2SD389	2.41
2SD401	1.40
2SD414	1.98
2SD471	2.13
2SD560	2.95
2SD600	2.98
2SD601R	0.65
2SD613	1.03
2SD636	0.40
2SD639-R	0.72
2SD655	0.98
2SD657	2.80
2SD661A	0.80
2SD731	2.11
2SD773	0.60
2SD811	7.63
2SD823	1.98
2SD837	1.48
2SD841	2.00
2SD856	1.00
2SD857Q	1.84
2SD882	1.15
2SD894	1.75
2SD898	0.82
2SK105H	2.15
7805-T022	0.63
7808	0.45
7812-T022	0.35
7815	0.64
7905	0.80
AD140	1.06
AD143	1.93
AD145	1.60
AD161	0.30
AD162	0.45
AF114	2.47
AF115	1.24
AF118	1.20
AF127	0.65
AF139	0.40
AF178	1.45
AF179	0.55
AF180	0.55
AF181	0.53
AF186	0.53
AF239	0.53
AF279	0.88
AN115	3.98
AN155	1.89
AN206	2.58
AN208	3.55
AN210	2.28
AN211	3.25
AN214Q	2.40
AN234	5.09
AN236	3.33
AN240P	0.99
AN241	1.71
AN245	4.90
AN253	1.80
AN260	3.85
AN272	7.92
AN295	5.52
AN301	2.45
AN302	3.09
AN305	8.88
AN315	2.46
AN316	5.53
AN318	9.35
AN320	5.47
AN321	2.25
AN322	6.78
AN337	5.37
AN340P	1.53
AN355	5.98
AN362	1.50
AN370	3.95
AN5111	3.43
AN5120N	4.50
AN5132	4.42
AN5250	4.40
AN5610	7.43
AN5612	2.07
AN5613	4.20
AN5630	3.95
AN5701N	1.66
AN6250	2.95
AN6300	4.40
AN6310	4.54
AN6340	6.46
AN6341	1.42
AN6363	16.00
AN6531	1.95
AN6551	0.50
AN6552	0.68
AN6610	1.65
AN7111	1.25
AN7115	2.52
AN7145	2.80
AN7146	9.90
AN7151	2.37
AN7156	2.85
AN7158	2.34
AN7218	0.80
AN7223	4.55
AU107	5.87
AU110	5.69
AU113	6.95
AY105K	2.08
AY106	1.09
BA524	8.94
BA310	0.14
BA1310	1.98
BA1320	1.38
BA1322	3.95
BA1330	2.75
BA145	0.19
BA148	0.25
BA154	0.40
BA155	0.12
BA156	0.05
BA159	0.09
BA182	0.19
BA222	1.66
BA302	1.24
BA311	0.65
BA312	1.45
BA313	0.76
BA317	0.04
BA318	0.09
BA328	1.65
BA333	1.37
BA335	6.27
BA5102A	2.50
BA511	1.95
BA514	1.00
BA521	1.20
BA524	8.94
BA526	7.98
BA527	2.98
BA532	1.50
BA536	1.70
BA6209	3.10
BA656	1.00
BA7100	11.35
BA841A	28.98
BA843	3.96
BA854	5.76
BAV18	0.06
BAV19	0.11
BAV20	0.35
BAV21	0.12
BAW62	0.11
BAX12	0.11
BAX13	0.11
BAX16	0.08
BC107B	0.11
BC108B	0.15
BC109B	0.14
BC113	0.14
BC119	0.36
BC126	0.20
BC132	0.14
BC135	0.14
BC137	0.18
BC138	0.34
BC139	0.33
BC140	0.45
BC141	0.34
BC142	0.23
BC143	0.34
BC147	0.11
BC148B	0.13
BC148C	0.11
BC149B	0.13
BC153	0.14
BC154	0.14
BC159	0.16
BC160	0.40
BC161	0.28
BC168	0.36
BC169C	0.16
BC170	0.16
BC171	0.11
BC172B	0.27
BC173	0.17
BC174B	0.27
BC177	0.35
BC178	0.26
BC179	0.26
BC182	0.09
BC182LB	0.14
BC183LB	0.26
BC184	0.13
BC184LB	0.26
BC186	0.25
BC187	0.28
BC204	0.16
BC207	0.14
BC212B	0.26
BC213L	0.10
BC214	0.10
BC225	0.40
BC237	0.10
BC238	0.10
BC238B	0.08
BC239B	0.25
BC251A	0.31
BC294	0.50
BC300	0.35
BC301	0.23
BC302	0.53
BC303	0.30
BC307A	0.06
BC308A	0.11
BC309	0.17
BC317A	0.13
BC327	0.33
BC328	0.11
BC337	0.09
BC338	0.12
BC368	0.18
BC440	0.69
BC441	0.46
BC454	0.36
BC460	0.42
BC461	0.47
BC462	0.51
BC463	0.30
BC478	0.32
BC479	0.41
BC532	0.28
BC546	0.17
BC547	0.10
BC548	0.10
BC549	0.10
BC550	0.10
BC556	0.16
BC557	0.10
BC558	0.10
BC559	0.10
BC560C	0.14
BC635	0.34
BC636	0.20
BC637	0.24
BC639	0.36
BC640	0.24
BCX34	0.40
BD115	0.36
BD116	0.70
BD124	1.31
BD131	0.42
BD132	0.42
BD133	0.53
BD135	0.36
BD136	0.36
BD137	0.26
BD138	0.28
BD139	0.34
BD140	0.32
BD144	1.43
BD150	0.75
BD157	0.67
BD160	1.60
BD163	0.71
BD166	0.42
BD175	0.28
BD179	0.30
BD181	0.99
BD182	0.99
BD183	0.99
BD184	1.21
BD187	0.53
BD189	0.69
BD190	0.69
BD201	0.49
BD202	0.60
BD203	0.46
BD204	0.41
BD207	1.79
BD208	1.23
BD222	0.50
BD225	0.46
BD228	0.63
BD229	1.05
BD232	0.49
BD234	0.42
BD237	0.47
BD238	0.28
BD239	0.45
BD240	0.57
BD241	0.39
BD242	0.50
BD243A	0.37
BD243C	0.50
BD244	0.31
BD244C	0.72
BD245C	0.70
BD246C	0.80
BD253	1.05
BD278A	0.70
BD317	1.20
BD318	2.72
BD375	0.42
BD380	0.76
BD410	0.49
BD433	0.44
BD434	0.45
BD435	0.49
BD436	0.60
BD437	0.41
BD438	0.52
BD441	0.59
BD442	0.66
BD509	1.42
BD510	0.75
BD519	0.98
BD529	0.60
BD530	0.80
BD533	0.67
BD534	0.52
BD535	0.45
BD536	0.50
BD537	0.50
BD538	0.67
BD544B	0.83
BD677	0.40
BD679	0.57
BD680	0.52
BD681	1.48
BD696	2.47
BD699	1.85
BD700	3.70
BD707	0.60
BD709	0.60
BD710	0.80
BD809	0.80
BD810	0.69
BD879	0.74
BD895	2.18
BD901	0.99
BD902	0.65
BDW83C	0.99
BDW84C	0.99
BDX32	1.88
BDX53A	4.93
BDX53B	3.35
BDX54B	0.31
BDX62A	1.96
BDX63A	1.96
BDY20	1.21
BDY81	1.18
BF115	0.29
BF117	0.66
BF118	0.67
BF121	0.25
BF123	0.13
BF127	0.13
BF137	0.29
BF153	0.58
BF154	0.26
BF157	0.33
BF158	0.18
BF159	0.18
BF160	0.31
BF167	0.38
BF173	0.34
BF177	0.55
BF178	0.40
BF179	0.36
BF180	0.36
BF181	0.32
BF182	0.34
BF183	0.39
BF184	0.43
BF185	0.39
BF194	0.14
BF195	0.14
BF196	0.17
BF197	0.16
BF198	0.17
BF199	0.17
BF200	0.37
BF218	0.36
BF224	0.17
BF237	0.65
BF240	0.19
BF241	0.17
BF245	0.50
BF245B	0.49
BF246A	2.52
BF255	0.20
BF256	0.28
BF257	0.34
BF258	0.33
BF259	0.34
BF262	0.57
BF263	0.57
BF271	0.34
BF273	0.20
BF274	0.20
BF324	0.23
BF336	0.33
BF337	0.45
BF338	0.40
BF355	0.49
BF362	0.60
BF363	0.50
BF371	0.50
BF391	0.25
BF417	0.84
BF418	1.87
BF422	0.30
BF423	0.33
BF450	0.35
BF451	0.29
BF457	0.41
BF458	0.49
BF459	0.52
BF460	0.99
BF469	0.28
BF470	0.26
BF471	0.33
BF472	0.33
BF479	0.61
BF480	1.79
BF491	0.50
BF506	0.43
BF532	0.24
BF596	0.18
BF597	0.27
BF694	0.22
BF757	0.59
BF759	0.47
BF761	1.05
BF762	0.34
BF869	0.49
BF870	0.30
BF959	0.42
BF960	0.49
BF970	0.50
BFR39	0.44
BFR61	0.92
BFR62	0.50
BFR79	0.29
BFR81	0.29
BFR86	1.08
BFR89	1.63
BFR90A	0.85
BFX29	0.34
BFX84	0.37
BFX85	0.41
BFX86	0.36
BFX87	0.55
BFX88	0.34
BFX89	0.44
BFY50	0.30
BFY51	0.33
BFY52	0.27
BFY79	0.49
BFY90	0.42
BLY49	2.20
BR100	0.22
BR101	0.70
BR103	0.66
BR303	1.15
BRC84	2.08
BRX44	0.60
BRX49	0.34
BRY39	0.69
BSS38	0.67
BSTB0140G	4.93
BSTC0246	8.64
BSTC0233	6.12
BSTCC0143	3.07
BSTD1043	2.85
BSV57B	3.91
BSW68	0.60
BSX19	0.34
BSX20	0.19
BSY52	0.50
BSY79	0.51
BT108	1.45
BT119	1.76
BT120	2.17
BT121	2.48
BT123	1.98
BT151-800R	1.03
BTT6018	2.42
BU106	2.48
BU108	1.50
BU109	2.25
BU110	5.69
BU125	2.48
BU126	1.10
BU137	6.53
BU205	1.15
BU206	1.27
BU207	1.65
BU208	1.12
BU208/02	1.88
BU208A	1.12
BU208D	1.43
BU209	1.93
BU226	2.45
BU326A	0.99
BU406	1.49
BU406D	1.53
BU407	0.82
BU412	5.29
BU426A	1.67
BU500	1.45
BU508A	1.89
BU536	1.65
BU608	1.65
BU705	2.50
BU806	0.85
BU807	1.40
BU826A	1.95
BUW84	1.39
BUX84	0.50
BUX85	0.69
BY126	0.13
BY127	0.13
BY133	0.06
BY164	0.44
BY176	0.52
BY179	1.42
BY182	1.05
BY187	0.77
BY189	1.76
BY198	1.62
BY207	0.22
BY208	1.11
BY210-400	0.18
BY210-600	0.27
BY210-800	0.19
BY223	1.43
BY224-600	1.88
BY226	0.25
BY227	0.20
BY228	0.60
BY229-1000	1.12
BY229-600	0.92
BY255	0.13
BY295-600	1.03
BY298	0.20
BY299	0.60
BY407	0.90
BY409	1.49
BY448	1.35
BY713	0.65
BYW56	0.14
BYX55-600	0.23
BYX71-600	0.85
BYX71-350	0.62
BYY56	1.20
BZY93C30	1.86
C106D	0.37
C106M	0.76
CA3046	1.55
CA3089	0.83
CA3090AQ	3.25
CA3094	2.20
CA3131EM	2.95
CD4001	0.34
CD4002	0.27
CD4008	1.35
CD4011	0.29
CD4012	0.24
CD4013	0.33
CD4016	0.36
CD4017	0.40
CD4020	1.23
CD4021	0.39
CD4023	0.28
CD4025	0.64
CD4028	0.84
CD4040B	0.60
CD4047	1.06
CD4049	0.24
CD4052	0.64
CD4066	0.21
CD4069	0.29
CD4070	0.25
CD4081	0.14
CD4093	0.40
CD4511	1.10
CD4528	2.04
CD4556	1.47
CR02AM-8	1.70
CV12E	4.09
CX095D	3.14
CX104	8.77
CX108	12.48
CX109	7.86
CX130	8.76
CX134	11.10
CX136	11.49
CX139	11.83
CX157	5.52
CX158	5.50
CX177	8.75
CX187	5.26
CX755	12.95
CX885A	6.85
E1222	0.40
E5024	0.28
E5386	0.25
GD243	4.34
GF758	0.84
HA11215	1.75
HA11211	2.53
HA11225	4.29
HA11229	3.46
HA11235	1.75
HA11124	5.25
HA1125	4.29
HA1137W	1.38
HA1138	5.03
HA11414	5.65
HA1156	1.16
HA1160	4.79
HA1166X	6.60
HA1167	6.45
HA11706	3.61
HA11705	8.00
HA11703	4.22
HA11701	4.56
HA11710	3.45
HA11713	2.90
HA11711	2.00
HA11715	9.90
HA11714	7.76
HA11716	13.10
HA11725	18.26
HA11725MP	16.00
HA117555P	6.23
HA11781	21.15
HA1180	5.15
HA1196	7.43
HA13001	1.73
HA1306	2.26
HA13402	7.87
HA13342	2.65
HA13365	4.02
HA1366WR	1.38
HA1367	2.75
HA1368R	2.45
HA1368	2.07
HA1370	3.71
HA1374	1.80
AA117	9
HA1377	1.75
HA1389R	2.05
HA1389	2.39
HA1392	1.38
HA1394	2.37
HA1397	3.76
HA1398	2.95
HA1406	2.07
HA1452	0.85
HD14538	2.07
HD38702-A2	7.95
HD38750A53	5.77
HD38750A-7	7.25
HD38800A50	14.09
HD44801A05	12.50
HISH1010	8.59
HISH1004	6.00
HISH1002	9.50
HM6231	9.81
HM6232	10.95
HM6251	5.25
HM7103	4.85
HM9032	4.00
HM9012	3.22
HM9015	3.24
HT4207	13.25
HT4208	20.65
KA2101	1.00
KC581C	7.68
KC582C	4.85
L200CV	1.69
LA1201	0.75
LA1210	1.56
LA1230	1.44
LA1320	2.87
LA1357N	9.00
LA1363	1.05
LA1364	3.02
LA1365J	1.15
LA1385	1.53
LA1387	5.95
LA3350	1.43
LA3361	1.60
LA3390	5.52
LA4032P	2.35
LA4100	1.25
LA4101	1.30
LA4102	0.75
LA4112	0.56
LA4125	2.25
LA4138	4.98
LA4140	0.70
LA4192	1.50
LA4220	1.25
LA4420	1.72
LA4422	1.00
LA4430	1.29
LA4440	1.95
LA4445	1.80
LA4460	1.75
LA4461	1.70
LA5112N	1.18
LA7020	13.86
LA7025	11.97
LA7027	10.92
LA7040	9.20
LA7042	3.90
LA7800	1.03
LA7801	0.90
LB1274	3.61
LC7800	9.20
LD3120	1.13
LD3150	2.75
LM1017N	1.81
LM1877	3.50
LM2808	5.94
LM2877	7.45
LM317CKC	1.08
LM324N	0.98
LM339N	0.41
LM340K	11.85
LM348N	2.15
LM380N	2.80
LM567CN	1.71
LM6402/011	10.23
LM6402A093	10.15
LM748	0.69
LM8360	3.87
LM8361	3.57
LR3419	9.37
LR3471	9.37
LU1141	7.27
LU52012	5.95
LU52011	14.95
LU03112	12.37
M193	6.83
M21C	1.30
M23C	1.98
M293	6.71
M51102L	1.69
M5115P	5.24
M51203L	3.15
M51231P	3.07
M5134-9341	4.13
M51353P	5.25
M51381P	5.98
M51393AP	9.48
M51394P	12.50
M5142P	6.85
M5144P	3.77
M51513L	2.55
M51515BL	2.75
M51517L	2.90
M5192	2.20
M5194AP	5.74
M5231L	4.80
M53274P	1.33
M54532P	1.50
M54544L	1.22
M58478P	6.75
M58485P	12.75
MA06	1.07
MA8001	0.82
MA8003	1.16
MB3705	1.98
MB3712	1.85
MB3713	1.69
MB3730	2.09
MC13002	3.90
MC1310P	2.25
MC1327P	1.33
MC1330P	1.98
MC1350P	0.90
MC1351P	1.32
MC1352P	1.40
MC1357P	2.15
MC1358P	1.48
MC14493P	4.20
MC14494P	2.15
MC14497	3.46
MC14510BAL	3.75
MC14511BCP	1.10
MC14528BCP	2.15
MC1712	3.88
MC5192	19.50
MC7724CP	3.48
MCR106-5/6	1.23
MCR220/7	2.28
ME0411	0.75
ME6002	0.25
ME6102	0.28
ME8001	0.38
ME0411	0.75
MJ2501	3.30
MJ3001	1.48
MJ481	1.53
MJE2955	1.88
MJE3055	1.25
MJE340	0.49
MJE520	0.48
ML231	0.59
ML232B	3.08
ML237B	2.52
ML238	5.77
ML923	3.18
ML926	3.58
MM5314N	8.98
MM5316N	9.16
MM5318N	3.11
MM5369N	2.01
MM5387AA/N	6.23
MM5841N	6.68
MN1400VL	13.65
MN1405	7.92
MN1435VX	9.50
MP1192	5.07
MP2794	4.00
MP2812	5.07
MP8512	1.57
MPC596	2.13
MPF256C	0.60
MPS6570	0.48
MPSA42	0.35
MPSA56	0.08
MPSA92	0.45
MPSU05	0.85
MPSU10	1.55
MPSU56	0.60
MPSU60	1.33
MR818	0.33
MR854	0.50
MR914	1.20
MSM5816RS	17.35
MSM5840H	13.55
MVS460-02	0.38
NE542	2.65
NE555	0.19
NE556	0.65
NP1106	11.58
OA202	0.18
OA47	0.16
OA91	0.14
OA95	0.08
OC28	2.52
OC29	2.15
OC36	7.53
OC44	0.35
OC45	0.18
OC72	0.48
OC75	0.44
ON236	1.65
ON782	1.98
OT121	1.45
PT6042	2.45
PT8504	4.58
R1038	2.19
R1039	2.19
R2008B	1.33
R2009	1.98
R2010B	2.98
R2029	1.33
R2030	1.33
R2257	2.35
R2265	1.49
R2305	1.18
R2322	0.67
R2323	0.75
R2354A	0.64
R2354B	2.81
R2443	1.35
R2461	1.50
R2540	1.91
R2540X	3.30
R2615	0.67
RCA2060	2.00
RGP01-15	0.70
RGP10	0.30
RGP30M	0.28
RT402	1.58
RT905A	2.38
S1299	5.34
S2800D	1.84
S2802	2.90
S2818	4.05
S3702S	5.21
S40W	13.10
S6080B	9.98
SA8063	5.17
SAA1006	1.85
SAA1020	4.78
SAA1025	4.40
SAA1024	2.81
SAA1075	4.25
SAA1121	7.44
SAA1124	2.45
SAA1130	4.99
SAA1174	7.77
SAA1250	3.95
SAA1251	3.20
SAA1351	8.11
SAA3027P	2.95
SAA5000	3.25
SAA5010	4.40
SAA5012	5.90
SAA5020	5.78
SAA5030	6.33
SAA5050	7.74
SAB1009B	5.98
SAB3011	7.34
SAB3013	2.47
SAB3021	7.90
SAB3024	6.36
SAB3209	5.82
SAB3210	3.10
SAF1032P	3.58
SAF1039	1.95
SAS5010	8.39
SAS560S	1.86
SAS560T	5.42
SAS570T	5.42
SAS570S	2.61
SAS580	2.85
SAS6600	1.33
SAS660	1.33
SAS6700	1.33
SAS670	1.33
SAS6710	2.21
SBA750	1.61
SC84203	19.35
SC9504P	1.95
SDA2006	17.95
SDA2112/2	10.28
SG264A	5.26
SG613	8.75
SG629	8.27
SG6533	10.31
SI1125H	7.50
SI1630HD	20.50
SKE2F1/04	1.39
SKE2G3/04	0.85
SKE4F1/06	0.35
SKE4F2/08	1.07
SKE4F2/06	0.80
SKE4F2/10	1.33
SKE4G2/02	0.96
SKE5F3/10	1.60
SKS1/10	2.15
SL1310	3.14
SL1430T	2.31
SL414	3.69
SL432A	3.44
SL439	2.48
SL471	2.88
SL480	3.14
SL490	2.37
SL901B	8.32
SL918A	9.07
SN16861AN0	0.82
SN16862AN	2.98
SN16966N	10.25
SN29717N	7.19
SN29716N	3.66
SN29715N	6.04
SN29722	11.95
SN29723AN	8.77
SN29764AN	2.38
SN29767	3.90
SN29770BN	3.69
SN29772BN	5.60
SN29771BN	4.15
SN29791	1.67
SN29798N	5.56
SN2709	0.44
SN7400N	0.61
SN7401N	0.36
SN7402N	0.65
SN7404N	0.52
SN7408N	0.27
SN7410N	0.27
SN74121	1.60
SN7413N	0.37
SN74141N	2.65
SN74151AN	1.51
SN74154N	1.27
SN74190	1.35
SN7420N	0.34
SN7430	0.49
SN7440N	0.27
SN7472	1.54
SN7474N	0.44
SN7490AN	0.93
SN74LS26N	1.45
SN76001N	1.65
SN76013ND	3.50
SN76023N	2.97
SN76023ND	3.91
SN76033N	5.54
SN76110N	0.90
SN76115AN	1.61
SN76131	0.82
SN76227N	0.85
SN76226DN	2.00
SN76228N	3.27
SN76242	5.23
SN76243	5.23
SN76396	2.90
SN76533N	2.47
SN76532N	0.91
SN76545	4.87
SN76546N	3.47
SN76549	2.45
SN76570	3.08
SN76611	2.59
SN76620	2.59
SN76660N	2.48
SN76666N	1.41
SN76708	4.86
SN76709N	5.94
SN76707N	1.23
SN76705N	6.60
SN76730	5.54
SN76810N	0.60
SN76832N	1.35
SN94041	5.54
SN94042	4.35
SPS5384	1.98
ST1702L	0.99
STA401	2.50
STA441C	3.10
STA471C	7.95
STK0029	5.54
STK0050	7.72
STK016	6.91
STK022	5.25
STK031	12.95
STK040	13.34
STK054	3.95
STK058	27.50
STK077	7.67
STK1039	5.75
STK2110	7.33
STK2145	16.95
STK2240	16.65
STK2250	18.95
STK3042	4.95
STK3044	5.75
STK4019	4.50
STK433	4.78
STK4332	6.25
STK435	4.95
STK4352	1.95
STK436	7.21
STK437	7.50
STK4372	13.13
STK460	7.02
STK466	11.77
STK4833	9.52
STK501	6.32
STK502	7.25
STK5314	12.40
STK5730	3.20
STK7216	13.10
STK772	3.71
STR1096	4.98
STR4090	9.52
STR440	5.37
STR451	4.93
STR453	8.16
STR454	4.95
STR6020	5.85
T6029V	7.98
T6035V	0.73
T6036	0.67
T6037	2.11
T6044V	0.97
T6045	1.20
T6049	1.45
T6052V	0.87
T6058	3.08
T6059	2.77
T9003V	1.25
T9005V	2.38
T9011V	1.40
T9013V	4.95
T9014V	2.42
T9016	1.02
T9019W	1.98
T9034V	1.45
T9035V	1.40
T9051	7.14
T9054V	5.46
T9057V	2.77
T9062V	0.49
T9064	3.90
TA7027	4.80
TA7050	1.74
TA7051	1.74
TA7054	2.55
TA7060AP	0.71
TA7061AP	1.27
TA7069	3.13
TA7070P	1.83
TA7072P	2.57
TA7074P	1.98
TA7076P	7.50
TA7089P	3.10
TA7092P	9.94
TA7093P	3.99
TA7102P	5.88
TA7108P	1.61
TA7109	3.71
TA7122B/P	0.87
TA7124P	2.34
TA7129P	1.50
TA7130P	1.27
TA7136AP	1.89
TA7137P	0.98
TA7141AP	3.87
TA7146P	4.23
TA7148P	1.67
TA7149P	3.26
TA7152P	2.72
TA7161P	4.50
TA7162P	3.61
TA7172P	1.41
TA7176P	1.75
TA7193P	4.80
TA7204P	2.16
TA7206P	12.49
TA7207P	1.48
TA7208P	2.15
TA7210P	1.45
TA7214P	3.63
TA7215P	2.58
TA7217AP	1.45
TA7222	1.95
TA7226	3.57
TA7229P	4.22
TA7230P	1.35
TA7233P	3.46
TA7240AP	2.55
TA7245P	5.92
TA7310P	2.15
TA7313AP	0.65
TA7314	5.94
TA7323P	3.15
TA7325P	1.15
TA7339P	1.85
TA7340P	5.95
TA7607AP	2.10
TA7609	2.65
TA7611AP	2.32
TA7616P	5.25
TA7622AP	8.94
TA7628P	2.50
TA7629P	7.50
TA7630P	0.95
TA7640AP	2.40
TA7672P	2.55
TA7676P	2.81
TA7726P	10.25
TAA320A	1.27
TAA350A	0.80
TAA570	1.85
TAA621AX1	4.85
TAA661B	1.00
TAA691	8.58
TAA700	2.37
TAA930	4.87
TAA970	2.83
TAG626-600	1.20
TBA120AS	0.70
TBA120SB	1.05
TBA120T	0.97
TBA120U	2.50
TBA120A	1.05
TBA1440	1.94
TBA1441	1.95
TBA395	1.10
TBA396	1.20
TBA400	2.39
TBA440C	2.34
TBA480Q	1.30
TBA510	1.37
TBA520	1.84
TBA530	1.30
TBA540	1.15
TBA560C	1.40
TBA570Q	1.60
TBA570A	1.71
TBA673	2.45
TBA700	1.85
TBA720	2.30
TBA730	3.55
TBA750Q	2.90
TBA760	1.71
TBA800	1.08
TBA810S	1.61
TBA810T	1.75
TBA820	0.66
TBA820M	0.82
TBA890	3.30
TBA920	1.65
TBA940	1.87
TBA950	1.55
TBA970	3.06
TBA990	1.98
TCA270S	2.15
TCA270SQ	1.05
TCA290A	2.39
TCA420A	2.16
TCA440	2.25
TCA530	2.24
TCA640	2.25
TCA650	3.05
TCA660B	2.60
TCA730	3.81
TCA750	2.25
TCA800Q	5.95
TCA830S	2.38
TCA890	5.44
TCA900	2.04
TCA910	1.65
TCA940	0.82
TCA940E	2.93
TD3F800R	3.67
TD3F900H	5.36
TDA1001B	2.31
TDA1003A	1.79
TDA1005A	2.22
TDA1006A	7.00
TDA1010AF	4.25
TDA1011	2.40
TDA1010	1.02
TDA1011A	1.51
TDA1028	2.45
TDA1034B	2.42
TDA1035S	2.95
TDA1035T	2.55
TDA1037	1.95
TDA1037D	2.05
TDA1044	1.95
TDA1047	3.25
TDA1059B	0.80
TDA1054M	1.21
TDA1060	2.60
TDA1082	3.25
TDA1151	1.22
TDA1190	2.11
TDA1190Z	2.48
TDA1200	1.51
TDA1235	3.88
TDA1236	3.30
TDA1270	3.74
TDA1327A	1.50
TDA1412	1.08
TDA1420	1.52
TDA1440	3.45
TDA1470	2.90
TDA1470P	4.25
TDA1506	6.58
TDA1510	4.60
TDA1512	2.89
TDA1515	2.89
TDA1559	3.15
TDA1670	4.48
TDA1770	2.75
TDA1905	1.27
TDA1908	2.98
TDA1940	1.95
TDA1950	2.50
TDA2005	1.45
TDA2006	1.55
TDA2004	1.48
TDA2002	0.90
TDA2003	1.00
TDA2030	1.35
TDA2140	2.14
TDA2150	6.20
TDA2151	1.30
TDA2160	4.01
TDA2161	2.40
TDA2170	4.50
TDA2270	3.96
TDA2520	2.25
TDA2522	2.50
TDA2524	4.50
TDA2525	3.90
TDA2532	2.50
TDA2530	2.20
TDA2541	1.88
TDA2540	2.15
TDA2545Q	5.94
TDA2560	2.17
TDA2575A	0.50
TDA2578A	2.73
TDA2576A+Kit	12.35
TDA2581	1.60
TDA2582	1.80
TDA2591	2.70
TDA2594	3.40
TDA2593	3.40
TDA2595	5.52
TDA2600	7.60
TDA2611AQ	1.25
TDA2612Q	4.68
TDA2611A	1.25
TDA2610	2.79
TDA2620	1.96
TDA2630	2.50
TDA2631	2.73
TDA2640	3.61
TDA2652	8.25
TDA2653	6.18
TDA2654	4.73
TDA2670	2.48
TDA2680	3.20
TDA2740	6.00
TDA2780AQ	8.84
TDA2795	2.78
TDA2791	1.81
TDA2910	13.25
TDA3300B	6.98
TDA3330	2.88
TDA3506	4.40
TDA3501	12.09
TDA3500	4.25
TDA3510	5.95
TDA3520	9.71
TDA3540	6.99
TDA3541	2.22
TDA3560	4.25
TDA3571Q	2.83
TDA3576	7.48
TDA3590	6.79
TDA3591	6.45
TDA3650	5.90
TDA3652	2.60
TDA3651AQ	3.95
TDA3651	1.95
TDA3651A	2.50
TDA3950	4.50
TDA4050B	3.40
TDA4280	7.20
TDA4290	1.95
TDA4400	4.90
TDA4420	2.30
TDA4422	8.32
TDA4427S	9.00
TDA4431	2.27
TDA4440	3.26
TDA4442	4.15
TDA4500	4.75
TDA4600-2	2.10
TDA4610	6.88
TDA4620	6.73
TDA5500	7.45
TDA5700	2.75
TDA7270S	2.25
TDA8190	3.96
TDA9403	1.50
TDA9503	2.92
TDA9513	3.15
TDB1033	2.68
TDE1081	7.05
TEA1002	2.30
TEA1009	0.80
TEA1014	1.50
TEA1020SP	4.93
TIC106C	0.61
TIC106M	0.77
TIC44	0.72
TIC45	0.56
TIC47	0.77
TIP120	1.55
TIP110	0.53
TIP112	0.34
TIP117	0.95
TIP121	0.40
TIP126	0.38
TIP132	0.99
TIP137	0.96
TIP29	0.84
TIP2955	0.86
TIP29A	0.46
TIP29B	0.63
TIP29C	0.40
TIP29D	0.75
TIP3055	0.66
TIP30A	0.41
TIP30C	0.40
TIP31A	0.34
TIP31B	0.38
TIP31C	0.30
TIP32A	0.35
TIP32B	0.46
TIP32C	0.28
TIP33	0.85
TIP33A	1.02
TIP33C	0.80
TIP34	0.75
TIP41A	0.49
TIP41B	0.31
TIP41C	0.68
TIP42A	0.60
TIP42B	0.79
TIP42C	0.82
TIP47	0.65
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UPC1032H	0.82
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UPC1161C	4.98
UPC1182H	1.50
UPC1186H	1.05
UPC1181H	1.35
UPC1185H	2.10
UPC1188	8.77
UPC1212C	0.80
UPC1225H	4.83
UPC1230	1.48
UPC1238	2.10
UPC1278H	5.95
UPC1351C	1.81
UPC1350C	1.40
UPC1353	1.58
UPC1355C	2.13
UPC1363	4.20
UPC1362	4.10
UPC1365C	2.50
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UPC1360C	4.51
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FISHER
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GEC
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Machine Nos.: 4000H 4001H 4002H — VHS I
Head Part Nos.: 5458282 5458413 5458415 5458992
Machine Nos.: 4001H 4004H — VHS K

HITACHI
Machine Nos.: VT3000 — VHS A
Head Part Nos.: 5458104
Machine Nos.: VT4000 VT4200 VT5000 VT5500 — VHS H
Head Part Nos.: 5458161 5458165
Machine Nos.: VT6500 VT7000 VT8000 VT8040 VT8100 VT8500 VT8700 VT9000 VT9300 VT9500 VT9700 VT9900 — VHS I

Head Part Nos.: 5458282 5458413 5458415 5458992
Machine Nos.: VT11 V14 VT33 VT34 VT330 VT340 VT5030 VTP10 VTP30 — VHS K

ITT
Machine Nos.: VR3605 VR3033 VR3905 VR3913 VR3914 VR3935 VR3943 VR3963 VR3993 VR3975 VR3985 VR3986 VR3833 — VHS A

JVC (see also Ferguson)
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MITSUBISHI
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HS7008 — VH700

NATIONAL PANASONIC
Head Part Nos.: VEH0099 0103 0115 0121 0131
Machine Nos.: NV300 NV322 NV332 NV333 NV340 NV390 NV2000 NV3000 NV7000 NV7200 NV7500 NV7800 NV7850 NV8170 NV8200 NV8400 NV8600 NV8610 NV8620 — VHS B
Head Part Nos.: VEH0171 VEH0218
Machine No.: NV370 NV3708 — VHS M
Head Part Nos.: VEH0171
Machine No.: NV330 NV777 — VHS N
Head Part Nos.: VEH0286
Machine No.: NV430 — VHS W
Head Part Nos.: VEH0174
Machine No.: NV366 — VHS X

SHARP
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Machine No.: VC581/2/3 651 681/2/3/5 659 699 — VHS S
Head Part Nos.: DDRMU 0001 HE00 0002 HE02 04 05 06
Machine No.: 2C9 VC110 VC200 VC220 VC300 VC381 VC384 VC386 VC387 VC388 VC477 VC481 VC482 VC930 VC970 VC3300 VC9100 VC9300 VC9400 VC9500 VC9600 VC9700 — VHS C
Head Part Nos.: DDRMU 0001 HE09
Machine No.: VC7300 VC7700 VC7750 — VHS D
Head Part Nos.: DDRMU 0001 HE10
Machine No.: VC6300 — VHS E
Head Part Nos.: DDRMU 0001 HE12
Machine No.: VC8300 — VHS L
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Machine No.: VC2300 — VHS F

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Machine No.: VTC5000 VTC5150 VTC5300 VTC5400 — BETA D
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Machine No.: VTC5350 VTC5500 — BETA D
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Machine No.: VTC9300 VTC9455 VTC9500 — BETA X
Head Part Nos.: 143072 T02100
Machine No.: VTC9300PS VTC9350 — BETA X

SONY
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Machine No.: SL3000, 8000, 8080, SLT 6Me, 7, 7E, 7ME — BETA A
Head Part Nos.: A6762 012A, 038A, 055A, 129A
Machine No.: SL5W, 5000 5100 SLC5, C6, C7 — BETA B
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01X0 033 825	£47.05
01X0 040 002	£48.32
01X0 056 013	£61.55
01X0 057 002	£31.36
01X0 082 001	£46.02
01X0 083 063	£66.03
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691 200 98	£62.02
691 201 12	£61.66
691 201 66	£61.93
691 201 78	£49.96
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VID1	01X0-003-381	Tension band T3292/PU545904A	2.55
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VID6	01X0-033-454	Roller Assy. (cass. Housing) T3V23/PU49042	4.50
VID7	01X0-040-007	Take up idler 3V29/30/PU48967B	2.90
VID8	01X0-040-017	Reel motor assembly 3V29/30/PU51381V	27.95
VID9	01X0-065-009	Capston motor 3V35/36/38/39/PU55371V	22.10
VID10	01X0-065-016	Cass. housing Assy. 3V35/36/38/39/PU29825	27.00

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VID22	VXP0432	Pinch Roller NV333	3.30
VID23	VXP0401	Idler wheel NV333	1.25

PLEASE NOTE ALL VIDEO SPARES HANDLING £1.25 + VAT

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VID25	1430662T01201	Reel drive pulley	6.50
VID26	PR2758	Pinch roller VTC5000/5150	3.85
VID27	1430490400900	Gear idler Fisher FVH-P615	6.50
VID28	1430420400300	Heart idler Fisher FVH-P615	2.95

SHARP

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VID31	NIDL0006	Idler VC387H etc	1.75
VID32	NIDL0005	Reel idler VC9300 etc	1.85
VID33	NIDL0004	Idler wheel VC2300	2.15

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HR 3660	DBK103	£1.65
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HR 7650	DBK132	£0.86
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FISHER

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SHARP

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VC 8300	DBK119	£1.76
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VT 8500	DBK144	£0.68
VT 9300	DBK129	£0.50
VT 9500	DBK129	£0.50

SONY

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SL 8600	DBK115	£2.66
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SLC 7	DBK100	£1.55
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SLJ 7	DBK100	£1.55
SLT 7 ME	DBK100	£1.55
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VTC 5400	DBK10	£0.70
VTC 5500	DBK106	£1.76
VTC 6500	VID7533	£0.78
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V 66/67	VID7540	£0.91
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TV Fault Finding

Reports from Eugene Trundle, J.S. Ruwala, Roger Burchett, Paul Hardy, Chris Avis, J.G. Grieve and Nick Beer

ITT CVC20 Chassis

Are there many of these sets still around? Fifteen years is a long time, but we've still got a few out on cheap rental. Two in succession came in recently with field cramp at the top and bottom of the picture and R73 (NS correction amplitude) acting as a height control. In both cases the NS phase coil L7A was dry-jointed and effectively open-circuit. **E.T.**

Sony KV2204

This set came in for loss of line hold (horizontal lines). When the speed was adjusted I noticed that there was a hum (fixed) on the right-hand side of the picture, as though there was an EW correction fault. The fault had almost cleared after about ten minutes' operation. All the capacitors in the power supply were checked and found to be o.k. Since there had been a speed problem I next suspected a capacitor in the line oscillator circuit. The culprit turned out to be C811 ($0{\cdot}47\mu F$). **J.S.R.**

Hitachi CPT1455

The STR4211 power supply chip IC901 had gone short-circuit. When this happens the 2·7V protection zener diode also fails – make sure you check it when you have a faulty power supply. When the defective parts had been replaced there was a nice picture but the sound was distorted. The collector of Q421 was at only 40V because the feed resistor R423 (56Ω) had gone high in value.

You get a similar problem with the **Amstrad CTV2000.** When the h.t. goes high R313 suffers giving very distorted sound. **J.S.R.**

Sony KV2022

When this set was switched on the right-hand side of the picture was blanked. After about five minutes the problem had cleared. This sort of thing is usually due to the reservoir capacitor in the h.t. supply to the RGB output transistors. In this set we found that it was C621 ($33\mu F$, 160V) in the power supply. **J.S.R.**

Pye 713 Chassis

If you get line twitching over a good quarter of the picture, replace C623 ($4{\cdot}7\mu F$). It's part of the flywheel sync filter connected to pin 12 of the TBA920 sync/line generator chip IC601. **R.B.**

Grundig CUC120 Chassis

The first time I had a tussle with one of these sets which intermittently shut down and/or refused to start I thought that it was an isolated case. It wasn't, which means that I've benefitted from my earlier frustration. What happens is that L631 in the chopper transistor's base circuit develops a dry-joint, though it looks good. The problem is caused by its leadout wires being too thin for the size of hole provided (shades of the Pye i.f. module, remember?). Quite often the TDA4600 control chip hands its notice in as well when the customer is one of those who believe that a good thump on the cabinet cures all . . . So check L631 if you find a dead TDA4600. This is the nearest to a good old stock fault you'll find with these sets. **R.B.**

Rediffusion Mk 1 Chassis

Here's a postscript to my recent remarks (May) on removing the thermal cutout in these sets. One of my regular customers moved to a large complex of apartments. After this her trusty set started to blow mains fuses violently. The resident handyman investigated, with the result that the plug fuse blew as well. What had happened was that while the set was in transit the thermal cutout, just about on its last legs, had received a blow. The contacts had disintegrated, shorting the live mains to chassis. Another good reason to modify any of these sets still in service where the cutout is an old one. **R.B.**

Philips KT3 Chassis with RC

This was another of those frustrating and very intermittent faults. The complaint was of sudden full volume. We eventually found that there was a dry-joint at the volume control output from the Telco decoder panel (pin 1 of PLB1). **R.B.**

Rediffusion Mk 1 Chassis

The customer said that this set had a line output stage fault. When the brightness and contrast controls were turned up the sound and vision oscillated madly. At lower beam current levels all was stable. What had happened was that R101, the h.t. feed to the tuning voltage stabiliser, had risen in value almost threefold. When a new 33kΩ resistor was fitted things quietened down. The giveaway was that there was no programme sound at switch on, only noise, although the set was correctly tuned in and came on with sound, vision and locked colour as soon as the valves in the line output stage had warmed up. Programme sound normally comes on almost instantaneously with these sets. The owner had purchased new valves elsewhere but took it all in good heart — especially as the tube was still in excellent condition. **R.B.**

Sony TV9-90UB

This very elderly dual-standard monochrome portable came in with field collapse. Testing and substituting components in the field output stage proved fruitless and in desperation I hooked up a set of scan coils from a colour portable (the only yoke lying around at the time!). I then had a nice sawtooth waveform at the collector of the field output transistor Q703. A check around the scan coils revealed that C708 was short-circuit and when this was replaced normal operation was restored. **P.H.**

Philips KT3 Chassis

This set was brought in because the line oscillator was off frequency. Resetting the line hold control produced an unsynchronised picture and as a replacement sync panel cured the problem I set about the old one. The voltages seemed to he roughly correct so the chip was changed, curing the problem. Note that the TDA2571Q is no longer available. You have to use a TDA3571BQ instead, but some modifications are required when this is done. These are as follows: (1) Cut pins 9 and 10 off the TDA3571BQ before installing it. (2) Change R373 to 1·5kΩ. (3) Change R368 to 150kΩ and make sure that this resistor is connected between pin 5 of the i.c. and edge connector pin 18 (on some modules it was connected between pin 5 of the chip and chassis). **P.H.**

Grundig 2200

The 280V h.t. rail had dropped to 150V, as a result of which there was a small, pulsating raster. The fault was in the electronic cut-out circuit, where zener diode Di614 (75V) had a reverse leakage of about 100kΩ. **C.A.**

Decca/Tatung 170 Chassis

At switch on there was no sound, no LED display and a bright raster which quickly went dark with a half-inch bright band across the top. Absence of the display suggested a missing l.t. rail and we found that the 6V supply had dropped to only 2·2V. The 110V and 18V supplies were o.k., and no excessive load on the 6V line was apparent. R820, the 0·22Ω resistor in the 6V supply, was the first suspect but the rectifier diode D811 (BA157) was in fact the cause of the problem. It had developed a high forward resistance, though a cold check revealed only a small increase to 18Ω instead of the usual 15Ω or so. **C.A.**

Ferguson 3757 (Thorn 9900 Chassis)

We've not come across the 9900 chassis before. It looks like a 9000 with an odd tuner board. We couldn't tune in any signals and soon spotted a 33V tuning voltage regulator minus any voltage. Track tracing led us to a 15kΩ, 2W resistor with h.t. at only one end. It was removed, checked – and read exactly 15kΩ! Much to our relief a replacement restored normal operation. **C.A.**

Philips NC3 Chassis

The channel change switch S300 has given trouble in a lot of these sets — symptoms are intermittently poor or even no picture and garbled sound. The only cure is to fit a new switch.

Failure of the BUT11AF line output transistor Q501 is usually caused by bad joints around the line output transformer, especially at pin 10. **J.G.G.**

Philips 2A Chassis

We had an unusual channel selector fault with this set, as though the memory was useless. A replacement selector, part no. 459 61047, provided a complete cure. **J.G.G.**

B and O MX1500 (78XX Series)

There was a raster but no sound or vision. The 19V and 95V rails were present and correct, as you would expect, but the 8·5V supply was missing because ICP1640 (630mA) was open-circuit. This supply is derived from the line timebase. No reason for the ICP failure could be found – this is very often the case with these devices, as in Technics disc players where removing the lid seems to blow one or two of them! The set was also afflicted by a broken level-up button in its Beolink 1000 remote control handset. This is quite common and a new mat put matters right – interesting that this seems to affect only the Link 1000 and not the earlier A, V and A/V terminals of the same design. **N.B.**

Sony KV2090/2092/2096

In the May issue I mentioned dry-joint problems on the high-wattage resistors in some of these sets. Models that have this trouble are also prone to mains switch failure. Sony have issued an official modification kit covering both problems. **N.B.**

Decca/Tatung 130 Series Chassis

The complaint with this set was of an intermittently green picture. It ran for some time without playing up, though we noted that there was a faulty seven-segment channel indicator LED which was soon replaced. Then the picture started to go green. The 100kΩ resistors on the c.r.t. base panel had already been changed so I dived for the RGB teletext interface panel to look for dry-joints, particularly as it was below where I'd been working on the display. The joints on the plug and socket were poor but the fault persisted after these had been attended to. The c.r.t. also looked poor, as most A56-540Xs do now, so I put the tester on to have a look. This showed that there was an intermittent heater-cathode short. **N.B.**

Panasonic TC2211 (U3 Chassis)

The width was slightly in and the screen got progressively brighter towards the right-hand side. We found that the trouble was due to the EW modulator diodes D552 and D553 (TVSC2715M and TVSC2406M respectively). They had been replaced with BY223s which aren't up to it in these sets. **N.B.**

Sony KV1810

The left-hand side of the screen was far too dark while the right-hand side was far too bright. Not surprisingly this was due to a crusty (open-circuit) capacitor – C543 (4·7μF, 350V) on the field/line timebase PCB. **N.B.**

Triumph CTV8209

This set came in for no results. After replacing an open-circuit 2·2Ω surge limiter and a faulty TDA4600 chopper control chip the set worked for two days after which the picture went. E.H.T. was present but the c.r.t. heaters were out due to a faulty line output transformer. We phoned Mastercare for a price and were told that they don't do spares for some Triumph models, of which this is one – we were directed to Jackson Products Ltd. (see under Harwood in the *Television* TV/VCR Spares Guide) who were able to supply the transformer at a very reasonable price. When fitted the set was restored to normal working order – for two hours, after which we had field collapse. Replacing the TDA3651 field output chip made no difference and there were no open-circuit resistors. I then noticed a TDA4503, and recalled that this series of i.c.s incorporates the field generator. Sure enough a replacement produced a full raster. Not bad going as we'd no manual or circuit diagram! **N.B.**

Servicing Compact Disc Players

Part 5: Digital Audio Coding

Joe Cieszynski

Up to this point we've been concerned mainly with compact disc players themselves and have considered only briefly the data that the player recovers from the disc. In order to deal with many aspects of the player it's necessary to understand the make-up and content of the off-disc data stream. It's best to start at the beginning, so in this instalment we'll outline the basics of digital audio, defining such "in" terms as quantization and aliasing noise as we go along.

Principle of AD Conversion

The principle used to convert an analogue waveform into a series of binary words is quite simple. First the waveform is broken down into a number of successive voltage levels. This is done by sampling the waveform at regular intervals — the sampling must be done at a higher frequency than that of the analogue waveform of course. Each level is then converted to a particular binary word. When the player comes to decode the digital audio data, all it has to do is to look at each successive word and regenerate the corresponding voltage level.

The principle of analogue-to-digital conversion is shown in Fig. 1, where the analogue waveform is shown as a simple sinewave. The audio sinewave A is applied to a switch and the following capacitor C1 charges when the switch is closed. Clock pulses B, known as the sampling signal, are used to toggle the switch, that is the clock pulses close and open the switch at regular intervals. The output obtained, C, is thus a sampled version of the input.

Quantization

At this point the sampled output is still in analogue form. A process called quantization is next carried out. This term comes from the word quantum, which is the smallest change in input waveform amplitude that occurs between two sampling points — see point X at A in Fig. 1. The use of seven levels to quantize a sinewave is shown at C in Fig. 1, i.e. the act of sampling in this case divides the amplitude of the sinewave into seven possible levels. If these levels are passed to an analogue-to-digital converter (ADC) each level can be allocated a binary code word. In other words the incoming sinewave has been converted to a string of binary words. Each time the amplitude of the input waveform varies a different word will emerge from the ADC.

The term dynamic range refers to the difference between the loudest and the quietest audio notes in a system. If just seven sample levels are used, as in Fig. 1, the dynamic range would be totally inadequate. Fig. 2 provides further clarification of this point. Clearly the greater the number of quantization levels used, the greater will be the system's dynamic range. Another advantage of using many quantization levels is that the "steps" between each one will be smaller, making it much easier to filter out the squarewave components during playback.

There's another good reason for having a large number of quantization levels. A look at Fig. 2(b) will show that as a result of the greater number of levels a loud signal will be reproduced more faithfully than a quiet signal. Thus with music quiet levels are more likely to be corrupt or noisy than louder ones for any given number of quantization levels — see Fig. 3. This noise is known as quantization noise.

Even the 25 levels shown in Fig. 2(b) would be inadequate for audio signal reproduction. All compact discs are produced using 65,536 (2^{16}) quantization levels.

In an attempt to overcome the greater quantization noise at low signal amplitudes some systems use non-linear quantization — the quantization levels are closer together at low levels, spreading out progressively with larger amplitude signals. This is illustrated in Fig. 4. Although this idea works well it's not used in the domestic CD system, perhaps because in the final analysis the large number of levels used make it unnecessary. There are hi-fi buffs who maintain that the CD can never be as faithful as the vinyl disc because its audio signal is made

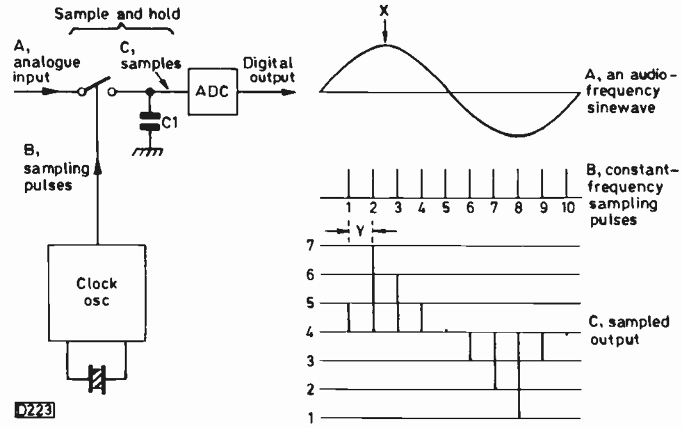

Fig. 1: The principle of analogue-to-digital conversion.

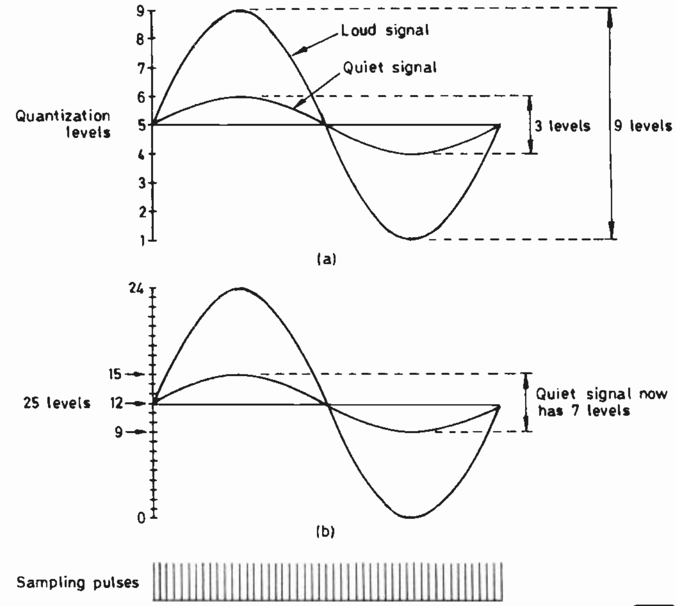

Fig. 2: Dynamic range. The nine quantization level system shown at (a) has a much smaller dynamic range than the 25 level system shown at (b).

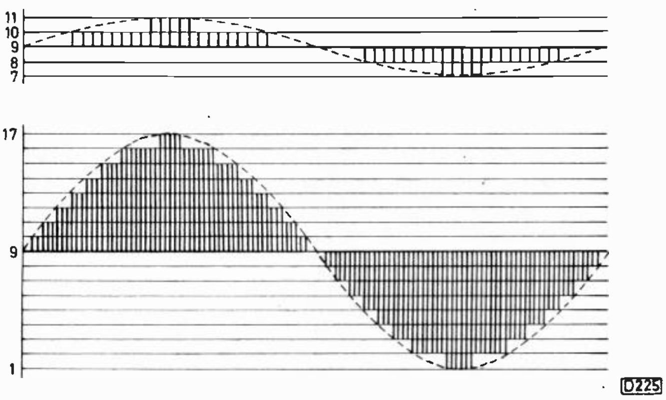

Fig. 3: The flat steps between sampling points create what is known as quantization noise. As this illustration shows, the noise will be more evident with quiet passages.

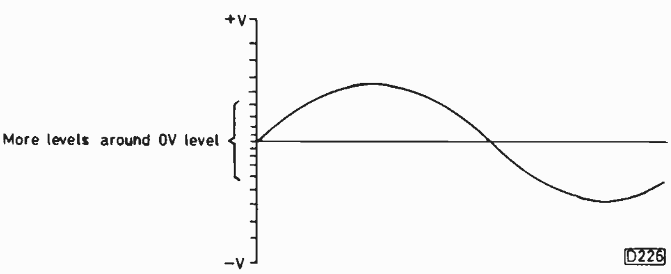

Fig. 4: Non-linear quantization.

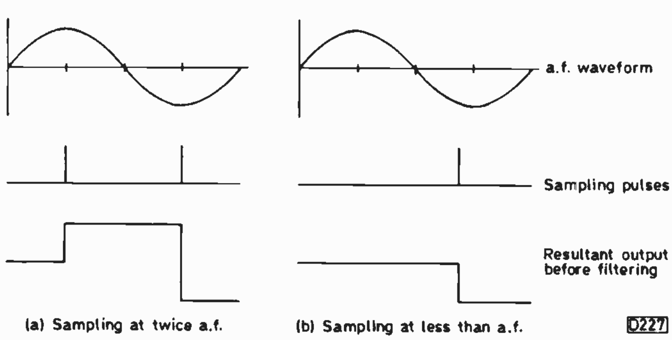

Fig. 5: The effect (a) of sampling at exactly twice the highest audio frequency and (b) of a sampling rate less than the highest audio frequency.

up from square components, in other words quantization noise is a basic feature of the system. I've never heard quantization noise however, nor have I seen it on an oscilloscope display after the filters, so does it matter whether the noise is there or not?

Sampling Rate

The a.f. sinewave shown at A in Fig. 1 is sampled ten times per cycle. C reveals the serious distortion introduced by this low number of samples per cycle. If the sampling rate is doubled the distance Y will be halved. Thus the higher the sampling rate the more faithful will be the output. Unfortunately however increasing the sampling rate widens the system bandwidth required, so a compromise has to be adopted. Nyquist theory proves that if the sampling rate is at least twice that of the highest audio frequency no information will be lost. This is called the Nyquist criterion. Thus if we take the highest audio frequency as being 20kHz a sampling rate of 40kHz would suffice. In practice the CD sampling rate is 44·1kHz.

Fig. 5 illustrates what happens when (a) the sampling rate is exactly twice that of the highest audio frequency

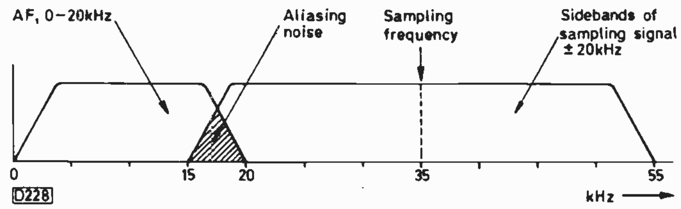

Fig. 6: Frequency spectra showing how aliasing noise occurs when the sampling rate is less than twice the maximum audio frequency.

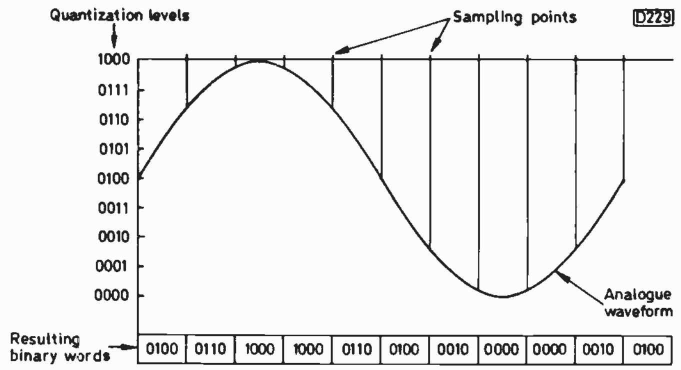

Fig. 7: Use of eight quantization levels with conversion to four-bit words. To allow enough one and zero permutations for 65,536 quantization levels 16-bit words are required.

and (b) the sampling rate is less than the highest audio frequency. The output obtained under the (b) conditions bears no resemblance to the original waveform, which in consequence can't be recovered. Even the best filters would have their work cut out trying to recover the waveform under the conditions shown at (a) — the best we could hope for would be some form of integrated sawtooth, which is a far cry from the original pure sinewave. In other words the reproduced signal would be a coarse sounding version of the original, with much distortion.

Aliasing Noise

This distortion is known as aliasing noise. Its effect is shown in Fig. 6, where the frequency spectrum of an imaginary system capable of handling a maximum audio frequency of 20kHz, with a sampling rate of 35kHz — much less than twice the maximum a.f. — is shown. The sampling system generates sidebands of ±20kHz. Hence some of these will fall within the audio spectrum, causing audible inteference. The sampling rate of 44·1kHz used with the CD system means that the lowest sideband is at 24·1kHz, which is well above the audio response.

AD Conversion

As we've seen, sampling/quantization is followed by analogue-to-digital conversion, which produces a digital output consisting of binary words that correspond to the quantized samples. Fig. 7 shows the idea. At this point in CD audio processing the analogue waveform has been converted to a series of 16-bit words, each word representing a different voltage level with a total of 65,536 possible levels. It might be thought that all we have to do is to stamp this digital code on the disc. There's more to it than that however.

The method used to represent binary ones and zeros in the CD system is known as "non-return to zero inverted"

(NRZ-I). With this method the logic voltage level changes from low to high or high to low at the start of each one but doesn't change for a zero. Thus when a series of ones occurs the voltage alternates while a continuous series of zeros produces no voltage change. Fig. 8 illustrates this.

The reason for using this form of modulation lies in the fact that the d.c. component of the resultant binary voltage signal is lower than with other forms of modulation. The only time when a high d.c. component is present is when a series of zeros occurs — compare A and B in Fig. 8. A series of ones gives an alternating pattern with a low average d.c. level. A high average d.c. level has to be avoided in the CD system as it causes problems with the tracking and the frame sync detector, as we shall see at a later date.

The NRZ-I format shown in Fig. 8 will still have a high d.c. component in the event of a series of consecutive zeros following a one that has left the system in the high state. Further steps are taken to reduce this possibility. A simple solution would be to avoid the use of any 16-bit binary word that contains a large number of consecutive zeros. To make use of the 65,536 quantization levels however all 16-bit word combinations are needed, including those with many consecutive zeros (remember that $2^{16} = 65{,}536$).

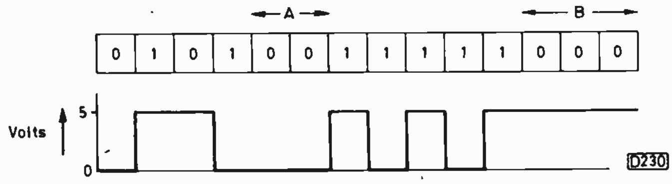

Fig. 8: Principle of NRZ-I modulation.

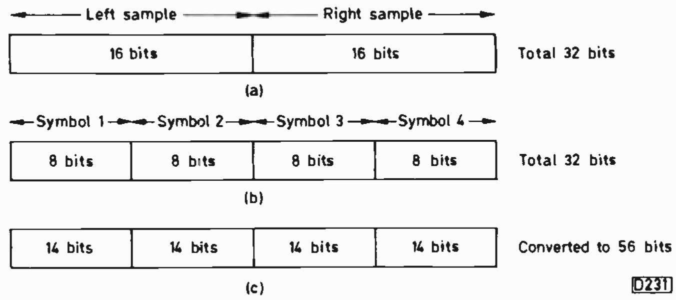

Fig. 9: Eight-to-fourteen modulation.

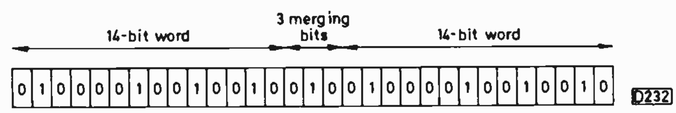

Fig. 10: Addition of merging bits to prevent consecutive ones and the occurrence of more than ten consecutive zeros.

EFM

The answer is to create words without too many zeros. This can be done by translating the 16-bit words into longer words — a form of language translation. The technique used is called eight-to-fourteen modulation (EFM). If you look at Fig. 9(a) you will see that one sample of left channel information consisting of 16 bits (one word) and one sample of right channel information in the same form gives a total of 32 bits. At (b) each of these two 16-bit words is shown split into 8-bit "symbols". Now note the following point: an 8-bit word has $2^8 = 256$ possible combinations while a 14-bit word has $2^{14} = 16{,}384$ possible combinations. 256 words that have a low d.c. value when modulated in NRZ-I format can be selected from these 16,384 14-bit words.

When the CD system was being developed it was found that to attain a low d.c. level and modulation frequency a word must have no more than ten and no fewer than two consecutive zeros. In addition there must be at least two zeros between logic ones. For reasons that will become clear this is known as the EFM rule. Fig. 9(c) illustrates how each 8-bit symbol is translated into a new 14-bit word, giving a total of $4 \times 14 = 56$ bits per left/right sample.

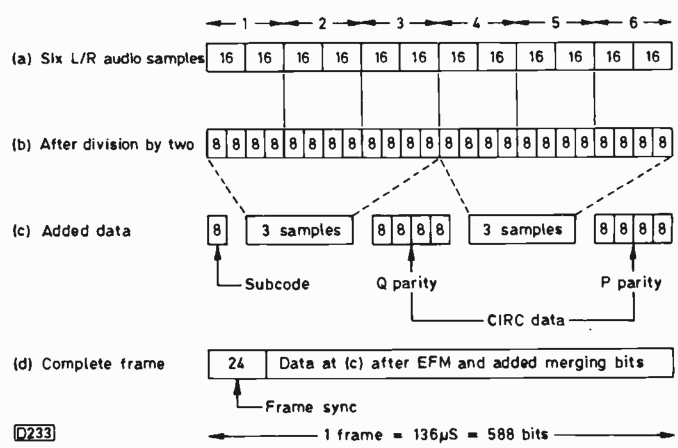

Fig. 11: The data frame format used with compact discs.

Merging Bits

With the system depicted in Fig. 9(c) it's still possible to have two consecutive ones and thus break the EFM rule. This will occur if a word ends with a one and the following word begins with a one. To prevent this, merging bits are inserted. These are 3-bit combinations which are chosen during the encoding process to link the 14-bit words in such a way that the occurrence of consecutive ones or more than ten consecutive zeros is prevented.

Modulation Frequency

In addition to maintaining a low d.c. level it's necessary to reduce the maximum modulation frequency so that the system bandwidth matches that of the laser. From Fig. 8 it can be seen that the maximum modulation frequency occurs when consecutive ones appear. In practice these ones would create disc pits that are smaller than the diameter of the laser beam (1·7 microns), making it impossible for them to be resolved — see Fig. 6 in Part 1. The use of EFM and the merging bits prevents such a condition.

Frame Format

The digital code shown in Fig. 10 contains left/right audio information and merging bits. Before this data is stamped on the disc more data has to be added. This data will be used for (1) disc servo (speed) control, (2) a subcode containing information that may be displayed by the front LCD to assist customer operation, and (3) cross-interleaved Reed-Solomon Code (CIRC) which is used to correct errors that occur as the laser reads the disc. We shall be discussing these three points in detail next month.

The final frame format stamped on the disc is shown in Fig. 11. Each frame contains six left/right audio samples in the form of 16-bit words, shown at (a). These words are divided by two as shown at (b) so that the digital audio information is now in the form of 24 8-bit symbols. Fig. 11(a) and (b) is an expanded form of Fig. 9(a) and (b). In (c) a number of 8-bit symbols containing the subcode and CIRC data have been added. Following this all the 8-bit symbols are translated to 14-bit form and merging bits are added between each symbol, including the subcode and CIRC symbols, as shown at (d). Finally 24 bits of data are added for frame sync. The complete frame consists of 588 bits.

Summary

The principles we have been looking at, i.e. sampling, quantization, AD conversion etc., are not peculiar to the CD system. As more analogue signals are converted to digital form for various purposes engineers will become all too familiar with these principles. Don't be discouraged if you find it difficult to remember the finer points in digital encoding — this won't in any way prevent you from servicing CD players. As I pointed out in my introduction at the start of this series, an appreciation of the theory on which the equipment you are servicing is based will give you greater confidence and, sometimes, help you to make an informed decision as to where the fault actually lies.

Next month we'll continue with the theory by taking a look at the frame sync, the error correction techniques used and the content of the subcode.

Thanks a Million

Les Lawry-Johns

Thank you for all the kind letters that have been arriving day by day — also the retirement card from John Boyd. I'm glad to know that you are all keeping well (sorry about the thyroid, Harold). You just don't know what these letters mean to me. Although we've bought the bungalow to retire to it looks as if we shall be here in the shop for a while yet — it just won't sell. Plenty of people have come to see it, but it either doesn't suit them or they don't want to borrow the money with the economic situation being as it is.

So I'm sitting here singing to myself with almost no customers, no money coming in and plenty going out. No old age pension either. But I mustn't bore you with the morbid details. You've probably got worries of your own, maybe more than I have.

Anyway we're still dealing with a few sets, like the ITT CVC20 that came in about a week ago with very poor field scan. The picture was only a few inches high, with a bright line across the bottom. I always dread this because it just has to be the most awkward transistor to get at, T10 (TIP33). The voltage readings confused me a bit, but then they always do. Collector right, base about right, emitter high — above the base voltage. So out came the transistor, after the usual struggle, and in went in a new one. A TIP3055, which is what I usually fit. In its cramped position at the top of the chassis, under the line output transistor, bolted to the metalwork. Once it was in there was full height and the picture looked good.

It was collected but came back a few days later, tripping for the first few seconds then lapsing into sullen silence as these sets do when an overload is present. I dived for the tripler and unhooked it from the line output transformer. This didn't make any difference so I checked the line output transistor carefully. It had a leak. I fitted one of my thick BU208A transistors and left off the tripler's contact just in case. This time the set came on, but went off again when the tripler was connected. So I had to fit a new tripler as well. Nothing to do with the first repair, but how do you charge a realistic price?

Shortly afterwards another ITT set came in, this time a 26in. model fitted with the CVC32 chassis. "Dead" they said, and dead it was. I checked the mains input and traced it through to the main deck. My suspicions centred on the CMP30 chopper control subpanel, so I took it out and checked all the resistors etc. As these seemed to be in order I changed the TDA2640 chip and replaced the panel. The set then started up without trouble and a good picture appeared.

A young lady brought in a Fidelity CTV140, saying that the screen was brightly illuminated and couldn't be turned down. When I switched it on there were some sparks inside the tube's neck and further sparks on the tube base. A check on the components mounted on the base panel revealed that the small 33kΩ resistors (three groups of four, acting as collector loads for the RGB output transistors) were overheating. The usual cause of this is incorrect drive from the TDA3330 colour decoder chip, so I checked the voltages at the output pins. The readings were wrong and I suspected that the chip had been damaged by the sparking. Despite a search I couldn't find a replacement. This meant ordering one or two, then seeing them fail after a short time.

I decided to be the coward I've always been. I reassembled the set and when its owner returned I advised her to take it to someone who would have more confidence in themselves, like Moon Television in Moon Lane. Sorry Jeff. Sooner or later I'll have to tell them that you're actually Sun TV in Sun Lane . . .

As I've been busy typing this two women have been standing outside the shop gossiping away. For about half an hour. At last one of them said something that upset me. "As sure as the sun rises in the east and sets in the west . . ." At this I rose and opened the shop door. "The sun doesn't rise in the east and set in the west," I told them, "it only appears to do so because this little planet is spinning around the enormous sun. Now go and do some thinking instead of gossiping all day."

Sorry about that. Cheers to you all. Love from Zeb, Tessa, Spock and that bad-tempered bird. And Honey Bunch of course.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a £2 cheque or postal order (made out to IPC Magazines Ltd.), the query coupon and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

SHARP C2002

Operation of this set is by the mains on/off switch followed by the standby switch. Every few weeks pressing the standby switch at turn on produces a dead set, with no programme indictor illumination. By the time the rear cover is removed, repeat operation of the switches produces perfect results — for the next few weeks! The supply voltages are o.k., the chopper transistor has been replaced and the joints in the power supply and line output stage have been resoldered.

The most likely cause of the problem is the 390kΩ resistor R717. If necessary, also check C720 and R712. Though unlikely, it's possible that IC701 could be responsible.

HITACHI VT17

After replacing the heads a lovely picture was obtained for about three minutes, then the picture began to flutter as though the tracking required adjustment. The machine next switched off. On pressing the play button the picture obtained had a band of interference about four inches thick across the screen, as though the heads were worn or the tracking out.

This problem is generally caused by a head flip-flop squarewave with an unequal mark-space ratio, the culprit being D481 (type VD1221, part number 5340205) on the drum motor board. Squirt it with freezer as a check.

THORN 9650 SERIES CHASSIS

The problem is with teletext operation. Pressing the TX button produces no sound blip, does not light the LED on the front panel and does not change the picture to the 100 index page. The picture remains, the only difference being that the channel cannot be changed until the set has been returned to the TV mode.

First check the 5V and the 12V supplies at the teletext decoder, not only for correct voltage but also for absence of hash and noise. If necessary then check for pulse activity on the DLIM and DATA lines. Since there's no audio bleep in the fault condition it's likely that the DLIM and DATA lines are incorrect, implicating the PC983/004 panel. The SAA5010 chip here is the first suspect — so long as its 5V supply is correct at pins 23/24.

FERGUSON 3V16

When this machine is switched on a solenoid can be heard to operate under the deck, but when an attempt is made to play or record the threading mechanism and tape drive fail to operate though the head drum rotates. There is also no tape drive in rewind and fast forward. This machine has given excellent service with only one minor fault but I'm told that it's not worth repairing.

The mechanical functions that have failed are all driven from the capstan motor. Check that the capstan motor turns when a key is pressed, then check the relay belt (top of deck) and the reel and capstan drive belts (below the deck). If the capstan motor doesn't turn, check the motor itself and its drive circuits on the servo board — there should in particular be 5V d.c. at TP16.

JVC HRD170

This machine accepts a cassette, laces up then stops. It appears that the problem is failure of the capstan motor to run. I've been told that the STK5481 voltage regulator chip can cause this, but the rest of the controls work. Fast forward and rewind operate for only about three-four seconds.

We've had the STK5481 voltage regulator chip fail on several occasions and it could well be the cause of this fault. Before condemning it, check the continuity of the minifuses CP1/2/3/4. These are all on the regulator board.

TOSHIBA C800

Most of the time this set works normally. Although the house is not damp the touch tuning system seems to be sensitive to the moisture in the air. On a rainy day or maybe after cooking (though the set is not in the kitchen) it will select channel 6, which is a spare tuner position. The only way to correct this is to apply heat from a hairdryer on the selector panel for a few seconds.

Dismantle the channel selector unit and clean it thoroughly with a solvent like methylated or surgical spirit. Check the 10MΩ resistors wired to each touch pad and replace all the neon bulbs. This should cure the problem permanently.

SHARP VC482

The problem with this machine is slight field bounce on playback. It's gradually become worse. Both own recorded and prerecorded tapes are affected, but sometimes the fault is more evident on some tapes than on others. With some tapes the symptom is slight movement of the whole picture from top to bottom while with others it's so bad that the picture is unwatchable. The wheel idler assembly and pinch roller have been replaced.

The cause of the problem is poor field sync. As the field sync pulses are transferred at the beginning of the head's sweep across the tape we suggest you check the back tension, look for dirt on the guides, head drum (lower assembly) etc. and if necessary check the inlet guide adjustment. The latter calls for an alignment tape, service manual and an oscilloscope.

RANK T22 CHASSIS

There are flashing green lines on red areas of the picture and flashing red lines on green areas. Blue is o.k., and the fault is evident only with weak signals. The 8·8MHz crystal has been replaced and the setting of the associated trimmer has been checked. The colour decoder chips have also been replaced.

The problem is one of ident, which relates to pin 12 of the TDA2522 chip 2IC5. We suggest you replace C83/4/5/6 and if necessary also check R103 and the alignment of the chroma bandpass filter L9.

TEST CASE

319

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

Satellite TV has arrived! The test case workshop staff have been boning up on LNBs, declination, polar mounts, energy-dispersal and true south. Our aerial rigger's head has been even more in the clouds than usual — he now boasts a compass and spirit level in his box of tricks. The sales department is spending lots of money on advertising, and overnight all the shops in the group have sprouted white dustbin lids.

In spite of problems with the first, rushed-out batches of satellite tuners, things gave been going reasonably well — helped here in the south by the good field strength of the signals from Astra. The following tale nevertheless relates to an Astra installation. For these we supply a fixed 60cm offset dish, a 1·5 or 1·8dB noise LNB, and one of the several types of small satellite TV tuners currently available. These tuners have IR remote control, provision for magnetic polariser drive, and an LNB d.c. supply which is sent up the coaxial cable.

A few weeks after he joined the Satellite Set one of our customers rang to complain of black dashes on the Sky pictures. The effect was sporadic: when it was present, some channels were worse than others. Periods of wind and rain were the most likely times for the fault to put in an appearance. Could we come and look?

These symptoms suggested that the carrier-to-noise ratio of the signal was insufficient to cope with the presence of rain etc., but the suddenness of the coming and going of the sparklies belied this theory. It didn't have to be raining either! With windy conditions the problem came and went — it would also sometimes do so at random.

Fortunately the dish was within reach of a step-ladder, so the first check was for good connections to the LNB's output socket. There were no problems here, and fitting a new F connector failed to produce an improvement. Maybe the dish was slightly misaligned? The newly-fixed bolts were slackened and a "satellite-peaker" field strength meter was hooked into circuit. This proved that the alignment was accurate, since no higher reading was obtained when the dish was moved in either the vertical or the horizontal plane. During this exercise the fault was seen twice — there was a sudden loss of signal, then a dither, and finally a return to normal. Since the signal strength meter being used was independent of the satellite tuner the latter was eliminated as a suspect (or was it?). The obvious conclusion was that something was amiss with the LNB. A replacement unit was fitted and aligned. This seemed to cure the problem. The customer received his step-ladder back with an assurance that the problem had been cleared.

Next day we were back on site, listening to tales of big black sparklies on Sky Channel and Sky News and little white sparklies on Eurosport and the Children's Channel. Back up the ladder then — with the customer one rung behind! Look in the feed horn, recheck the LNB's connector, examine the coaxial cable run for damage or tight bends. There were no visible problems. Tap the LNB, wriggle the connections to the tuner unit, thrash through the available channels. The Astra notice-board captions were a bit rough, possibly due to reduced up-link power this morning.

In all these attempts at diagnosis of a frustrating intermittent fault one factor had been overlooked by the technician. In the event, it provided the key to the problem. What other aspect of the installation should have been considered in the light of the evidence? See next month for the solution to the problem.

ANSWER TO TEST CASE 318
— page 614 last month —

Poor Philbert! He was struggling, under pressure from the clock and the service manager, with a Sanyo E2 chassis which produced a display totally lacking in red. It's a fact that the red component of a monochrome display on a colour c.r.t. has the least effect on the grey scale, while cyan looks like a rather cold white. But as the investigation proceeded it became obvious that the picture tube's red gun was not emitting at all.

Philbert had checked the low-level R drive and the operating conditions of the red output stage in some detail. What he didn't check until much later was whether its output was being applied to the tube's red cathode! In fact the output stage was working perfectly, and had the scope's probe been applied to the red output transistor's collector a whopping red signal would have been displayed. It was not present at pin 8 of the tube however, or at output pin 3 of the thick-film collector load resistor unit A601. The internal series resistor between pins 2 and 3 had gone open-circuit.

Philbert temporarily bridged it with an external 1·5kΩ, 0·5W resistor. This restored good pictures, so he returned to order a new thick-film unit. The service manager wanted to know what had taken him so long?

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TELEVISION JULY 1989

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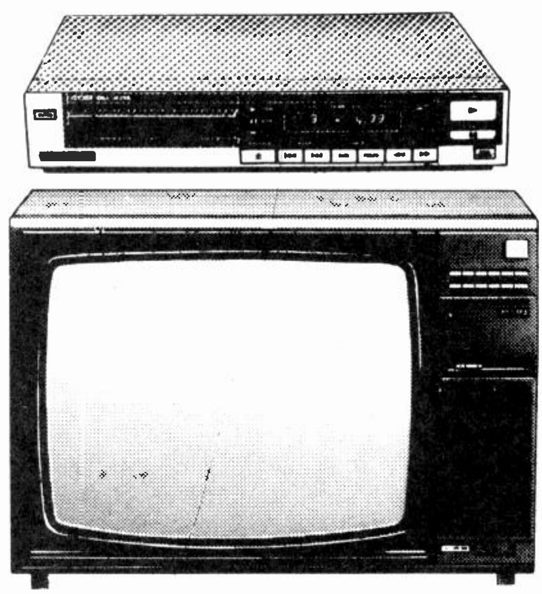

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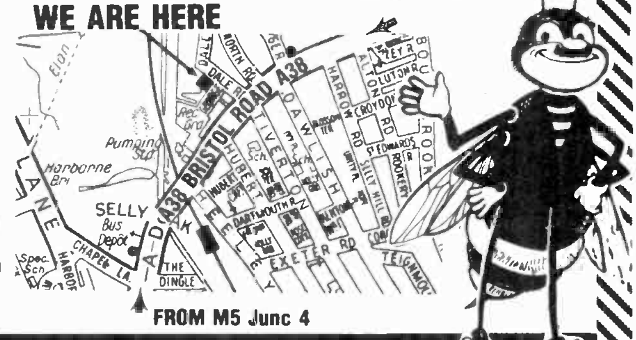

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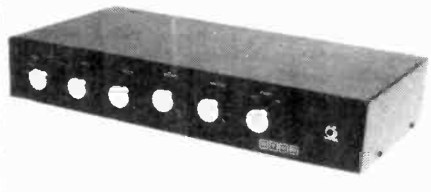

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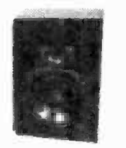

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AD149	60p
AD161	35p
AD162	35p
AD164	200p
AF106	50p
AF109	45p
AF124	50p
AF125	50p
AF126	50p
AF127	50p
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AM158	50p
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BA148	10p
BA154	6p
BA157	12p
BAY78	250p
BAY82	20p
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BB103	16p
BB105B	18p
BB205B	24p
BC107	8p
BC108	8p
BC109	8p
BC109C	10p
BC115	10p
BC118	11p
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BF461	60p
BF462	62p
BF469	30p
BF470	28p
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BF479	30p
BF493	18p
BF494	16p
BF495	16p
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BF596	16p
BF597	10p
BF615	30p
BF617	30p
BF680	30p
BF757	40p
BF758	41p
BF759	40p
BF760	40p
BF763	40p
BF869	22p
BF870	22p
BF871	22p
BF872	23p
BF960	38p
BF961	35p
BF963	40p
BF964	38p
BF966	40p
BFR34	110p
BFR36	110p
BFR40	25p
BFR51	21p
BFR62	21p
BFR79	25p
BFR90	52p
BFR91	99p
BFR94	500p
BFS22	110p
BFT37	130p
BFT42	30p
BFT43	30p
BFW84	30p
BFW92	35p
BFX29	20p
BFX84	20p
BFX85	20p
BFX87	15p
BFX88	15p
BFX89	60p
BFY17	30p
BFY18	40p
BFY41	28p
BFY50	14p
BFY51	14p
BFY52	14p
BFY56	25p
BFY57	25p
BFY64	25p
BFY90	45p
BLY48	85p
BLY49	85p
BR100	14p
BR101	43p
BR103	37p
BR303	85p
BRY39	55p
BRY49	38p
BRY56	33p
BSS74	33p
BSX20	15p
BSX26	18p
BSX29	19p
BT100A	70p
BT106	120p
BT109	90p
BT116	80p
BT119	100p
BT120	100p
BT138	60p
BT146	99p
BT151	58p
BTY79	140p
BU100A	110p
BU104	100p
BU105	80p
BU108	100p
BU109	100p
BU110	110p
BU111	140p
BU124	60p
BU126	70p
BU180	150p
BU184	100p
BU204	75p
BU205	70p
BU206	100p
BU208	75p
BU208A	80p
BU208D	100p
BU209	140p
BU225	190p
BU226	190p
BU312	120p
BU325	55p
BU326	85p
BU406	85p
BU406D	95p
BU407	75p
BU407D	95p
BU408	85p
BU408D	95p
BU409	95p
BU426	120p
BU500	110p
BU508A	120p
BU508D	100p
BY536	150p
BU526	80p
BU546	140p
BU608	150p
BU626	150p
BU636	150p
BU801	95p
BU806	120p
BU807	95p
BU902	130p
BU903	130p
BU920	130p
BU921	130p
BU922	130p
BU930	130p
BUX80	180p
BUX82	180p
BUX84	65p
BUX85	65p
BUY69A	200p
BUY70C	160p
C106D	28p
J174	38p
J300	50p
MCR220	120p
MEO411	38p
MEO414	125p
ME3001	12p
ME4103	12p
ME6001	12p
ME6002	15p
ME8001	15p
ME9021	12p
MJ802	350p
MJ900	200p
MJ901	200p
MJ1000	200p
MJ1001	200p
MJ10012	300p
MJ15001	325p
MJ15002	300p
MJ15003	325p
MJ15004	370p
MJ15022	400p
MJ2500	100p

MJ2501	110p
MJ2955	55p
MJ3000	115p
MJ3001	115p
MJE29A	30p
MJE30A	30p
MJE340	25p
MJE350	80p
MJE520	30p
MJE2955K	90p
MP8111	40p
MP8112	45p
MP8113	55p
MP8512	50p
MPN3404	30p
MPS6571	20p
MPS9012	20p
MPS9013	20p
MPS9014	20p
MPS9015	20p
MPSA05	15p
MPSA06	15p
MPSA13	15p
MPSA20	15p
MPSA42	15p
MPSA43	15p
MPSA65	25p
MPSA66	25p
MPSA70	15p
MPSA92	20p
MPSA93	20p
MR510	35p
MR856	36p
MRF479	350p
MV1622	80p
MV209	48p
MV2209	48p
OC28	250p
OC29	250p
OC35	250p
OC36	250p
OC45	50p
OC71	30p
OC72	50p
OC200	180p
OT121	120p
R2008B	100p
R2010B	100p
R2030	100p
R2306	55p
S2800D	52p
S2800M	72p
T2800D	52p
T2800M	72p
TAG4442	76p
TAG4443	76p
TAG4444	76p
TIP29	15p
TIP29A	22p
TIP29C	25p
TIP30	25p
TIP30C	30p
TIP31A	24p
TIP31C	30p
TIP32	24p
TIP32A	24p
TIP32C	28p
TIP33	50p
TIP33C	60p
TIP34	50p
TIP34C	60p
TIP35C	65p
TIP36C	65p
TIP41A	22p
TIP41C	25p
TIP42A	22p
TIP42C	25p
TIP47	40p
TIP48	40p
TIP50	60p
TIP51	120p
TIP52	120p
TIP53	120p
TIP54	140p
TIP105	65p
TIP106	65p
TIP107	65p
TIP110	47p
TIP111	50p
TIP112	40p
TIP115	45p
TIP116	45p
TIP117	50p
TIP120	43p
TIP121	46p
TIP122	47p
TIP125	47p
TIP126	56p
TIP127	56p
TIP130	30p
TIP131	30p
TIP130	30p
TIP141	90p
TIP142	90p
TIP145	65p
TIP146	90p
TIP147	100p
TIP150	90p
TIP151	90p
TIP2955	42p
TIP3054	45p
TIP3055	42p
TIS43	45p
TIS44	40p
TIS61	15p
TIS88A	45p
TIS90	15p
TIS91	18p
TIS93	20p
VK1010	88p
VN.10KM	60p
VN.46AF	88p
VN.66AF	100p
VN.88AF	115p
VN.89AF	110p
Y723	75p
Y827	75p
Y860	22p
Y969	65p
ZTX107	11p
ZTX108	11p
ZTX109	12p
ZTX212	27p
ZTX300	13p
ZTX301	16p
ZTX302	16p
ZTX303	24p
ZTX304	17p
ZTX320	29p
ZTX326	29p
ZTX500	13p
ZTX501	13p
ZTX502	18p
ZTX503	18p
ZTX504	25p
ZTX550	24p
2N.696	26p
2N.697	22p
2N.698	40p
2N.699	45p
2N.706	22p
2N.708	22p
2N.914	28p
2N.918	36p
2N.930	18p
2N.1131	28p

2N.1132	28p
2N.1613	24p
2N.1711	24p
2N.1893	30p
2N.2102	50p
2N.2160	300p
2N.2218A	24p
2N.2219	24p
2N.2221	23p
2N.2222	23p
2N.2369	15p
2N.2484	20p
2N.2646	40p
2N.2904	20p
2N.2905	20p
2N.2906	18p
2N.2907	18p
2N.2926	8p
2N.3019	28p
2N.3053	18p
2N.3054	40p
2N.3055	38p
2N.3055H	50p
2N.3440	58p
2N.3442	85p
2N.3525	150p
2N.3583	90p
2N.3585	120p
2N.3702	9p
2N.3703	9p
2N.3704	9p
2N.3705	9p
2N.3706	9p
2N.3707	9p
2N.3708	9p
2N.3710	12p
2N.3711	12p
2N.3771	85p
2N.3772	90p
2N.3773	110p
2N.3799	18p
2N.3819	29p
2N.3866	68p
2N.3903	11p
2N.3904	11p
2N.3905	11p
2N.3906	11p
2N.4031	25p
2N.4036	25p
2N.4037	25p
2N.4058	13p
2N.4062	12p
2N.4064	100p
2N.4240	150p
2N.4248	130p
2N.4401	12p
2N.4403	12p
2N.4443	76p
2N.4444	76p
2N.4904	75p
2N.5061	20p
2N.5062	28p
2N.5088	20p
2N.5163	45p
2N.5192	50p
2N.5241	500p
2N.5245	45p
2N.5294	30p
2N.5296	30p
2N.5303	200p
2N.5320	90p
2N.5321	60p
2N.5366	25p
2N.5401	12p
2N.5448	12p
2N.5496	80p
2N.5777	40p
2N.6106	40p
2N.6107	40p
2N.6109	40p
2N.6254	110p
2N.6292	40p
2N.6384	120p
2N.6385	120p
2N.6403	160p
2N.6649	140p
3N.128	55p
3N.143	65p
DIODES	
AA119	9p
BY100	40p
BY103	32p
BY126	6p
BY127	8p
BY133	8p
BY164	40p
BY176	85p
BY179	35p
BY182	32p
BY184	32p
BY187	32p
BY196	20p
BY206	11p
BY207	11p
BY208	18p
BY210	22p
BY223	72p
BY225	120p
BY226	18p
BY227	19p
BY228	32p
BY296	20p
BY298	26p
BY299	28p
BY476	90p
BYX10	15p
BYX55/350	30p
BYX55/600	30p
BYX55/800	32p
BYX70/300	29p
BYX70/500	32p
BYX70/800	36p
BYX71/600	80p
OA47	6p
OA90	6p
OA91	8p
OA200	7p
OA202	7p
IN.914	2p
IN.4001	4p
IN.4002	4p
IN.4003	4p
IN.4004	4p
IN.4005	4p
IN.4006	4p
IN.4007	5p
IN.4148	2p
IN.5400	9p
IN.5401	10p
IN.5402	10p
IN.5403	11p
IN.5404	11p
IN.5405	12p
IN.5406	13p
IN.5407	13p
IN.5408	13p
SKE4F2/06	50p
SKE4F2/08	70p
SKE4F2/10	90p
I.C. SOCKETS	
8pin	6p
14pin	8p
16pin	9p
18pin	12p
20pin	14p
22pin	16p
24pin	18p

28pin	20p
40pin	25p
ZENER	
400MV	
BYZ88 RANGE	
2V7 to 39V	6p
1.3W	
BZX61 RANGE	
2V7 to 39V	12p
VOLTAGE REGULATORS	
7805	35p
7806	35p
7808	35p
7812	35p
7815	35p
7818	35p
7824	35p
7905	35p
7906	40p
7908	40p
7912	40p
7915	40p
7918	40p
7924	40p
78L05	28p
78L08	28p
78L12	28p
78L15	28p
78L18	28p
78L24	28p
79L05	40p
79L08	40p
79L12	40p
79L15	40p
7818KC	100p
7824KC	100p
LM309K	100p
LM317K	220p
LM317T	180p
LM323K	420p
LM723	40p
78HGKC	570p
78HO5KC	800p
78H12KC	700p
78GU1C	190p
79GU1C	215p
79HGKC	800p
VALVES	
DAF96	60p
DF96	50p
DL92	60p
DY86	50p
DY87	60p
DY802	75p
EABC80	60p
E891	44p
EBF80	45p
EBF89	50p
ECC82	80p
ECC83	80p
ECC84	70p
ECC85	80p
ECH81	100p
ECH84	70p
ECL80	65p
ECL82	80p
ECL84	70p
ECL85	70p
ECL86	90p
EF80	65p
EF85	65p
EF89	85p
EF183	75p
EF184	85p
EL34	250p
EL36	90p
EL84	75p
EL95	85p
EL500	100p
EL504	130p
EY86	45p
EY87	45p
EY88	65p
EZ35	65p
EZ80	70p
EZ81	55p
GZ34	200p
PC97	100p
PCC85	60p
PCF80	80p
PCF200	135p
PCF801	110p
PCF802	80p
PCF806	115p
PCH200	100p
PCL81	62p
PCL82	80p
PCL84	50p
PCL85	80p
PCL86	80p
PCL805	80p
PFL200	110p
PL36	120p
PL82	60p
PL83	60p
PL84	80p
PL95	180p
PL500	110p
PL504	120p
PL508	200p
PL519	450p
PY81	90p
PY88	70p
PY500A	190p
L.E.D.'S	
LED 3MM RED	5p
LED	3MM
YEL	10p
LED	3MM
GRN	10p
LED 5MM RED	5p
LED	5MM
YEL	10p
LED	5MM
GRN	10p
LINEAR IC'S	
AN-203	210p
AN-210	165p
AN-214Q	170p
AN-228	280p
AN-240P	150p
AN-241	135p
AN-245	290p
AN-247	230p
AN-252	150p
AN-259	250p
AN-262	140p
AN-271	230p
AN-272	480p
AN-274	250p
AN-301	330p
AN-303	250p
AN-304	360p
AN-305	320p
AN-315	210p
AN-316	350p
AN-318	460p
AN-360	100p
AN-362	140p
AN-366	150p
AN-610	160p
AN-612	160p
AN-5151	600p
AN-5612	400p
AN-5620	330p

AN-5712	350p
AN-5722	140p
AN-5730	160p
AN-5732	160p
AN-5753	170p
AN-6135	150p
AN-6300	600p
AN-6320	300p
AN-6330	380p
AN-6341	350p
AN-6344	440p
AN-6350	610p
AN-6359	810p
AN-6360	400p
AN-6362	480p
AN-6371	510p
AN-6387	560p
AN-6677	550p
AN-6811	130p
AN-6876	270p
AN-6884	240p
AN-7105	210p
AN-7110	130p
AN-7114	150p
AN-7115	150p
AN-7116	130p
AN-7120	130p
AN-7130	110p
AN-7222	300p
AN-7310	90p
AN-7311	90p
AN-7410	250p
AN-7420	250p
AN-7140	450p
AN-7145	195p
AN-7146	210p
AN-7154	180p
AN-7156	240p
AN-7158	310p
AN-7168	260p
AN-7178	270p
AY3-1015	290p
AY3-1270	800p
AY3-1350	450p
AY3-8910	360p
AY3-8912	400p
BA-301	65p
BA-311	80p
BA-313	60p
BA-333	100p
BA-340	150p
BA-401	60p
BA-402	60p
BA-511	160p
BA-514	160p
BA-516	150p
BA-521	160p
BA-524	240p
BA-526	220p
BA-527	95p
BA-532	140p
BA-534	290p
BA-536	180p
BA-546	180p
BA-612	160p
BA-656	150p
BA-658	380p
BA-684	400p
BA-685	400p
BA-1310	160p
BA-1320	110p
BA-1330	160p
BA-1360	160p
BA-4403	220p
BA-5101	500p
BA-5102	250p
BA-5204	200p
BA 5402	250p
BA-5406	280p
BA-5408	220p
BA-6104	250p
BA-6135	250p
BA-6208	250p
BA-6209	320p
BA-6304	190p
BA-6305	200p
BA-6410	220p
BA-6411	250p
BA-6993	150p
BA-7001	150p
BA-7004	200p
BA-7007	200p
BA-7021	180p
BA-7022	350p
BA-7752	250p
BA-7755	150p
BA-8420	350p
CA-3011	110p
CA-3012	150p
CA-3028A	95p
CA-3048	190p
CA-3052	190p
CA-3054	95p
CA-3059	300p
CA-3060	280p
CA-3065	210p
CA-3080E	60p
CA-3085	135p
CA-3086	55p
CA-3088E	200p
CA-3089E	150p
CA-3089Q	250p
CA-3130E	80p
CA-3130S	100p
CA-3134E	280p
CA-3140E	38p
CA-3160	85p
CA-3161E	140p
CA-3162E	450p
CA-3189E	230p
CA-3193E	230p
CA-3240E	90p
CA-3260E	170p
CA 3290E	150p
ER-1400	200p
HA-1125	150p
HA-1137W	135p
HA-1144	380p
HA-1156	110p
HA-1197	150p
HA-1199	145p
HA-1319	240p
HA-1338	300p
HA-1339A	350p
HA-1366WR	160p
HA-1367	300p
HA-1368	160p
HA-1372	300p
HA-1374	230p
HA-1377	200p
HA-1388	320p
HA-1389	210p
HA-1392	230p
HA-1394	280p
HA-1397	250p
HA 1398	240p
HA-1452	120p
HA-1457	120p
HA-11219	280p
HA-11221	210p
HA-11225	170p
HA-11235	170p
HA-11251	240p

HA-11423	210p
HA-11714	400p
HA-11724	800p
HA-12002	300p
HA-12003	250p
HA-12005	400p
HA-12017	130p
HA-13001	260p
HA-13002	250p
HA-13006	400p
HA-13007	400p
HA-13108	350p
HA-13412	600p
HA-13432	400p
HA-17301	250p
HA-17458	100p
HA-17524	250p
HA-17555	100p
HA-17558	100p
HA-17723	150p
HA-17747	150p
HA-17805	100p
HA-17806	100p
HA-17807	100p
HA-17808	100p
HA-17901	150p
HA-17902	150p
HA-17904	150p
ICL-7016	650p
ICL-7017	950p
ICL-7611	90p
ICL-7660	240p
ICM-7555	60p
ICM-7556	130p
KA-2206	150p
KA-2210	230p
KA-2212	80p
KA-2213	130p
KA-2261	100p
LA-1130	240p
LA-1150	150p
LA-1185	150p
LA-1201	75p
LA-1210	140p
LA-1222	80p
LA-1230	130p
LA-1231	210p
LA-1364	200p
LA-1365	120p
LA-1368	220p
LA-1385	170p
LA-1460	220p
LA-2000	150p
LA-2101	270p
LA-2200	190p
LA-3101	160p
LA-3160	120p
LA-3201	80p
LA-3210	65p
LA-3220	100p
LA-3300	140p
LA-3301	110p
LA-3350	110p
LA-3361	100p
LA-3375	300p
LA-4030	180p
LA-4031	140p
LA-4032	140p
LA-4051	160p
LA-4100	85p
LA-4101	80p
LA-4102	120p
LA-4110	120p
LA-4112	120p
LA-4120	270p
LA-4125	200p
LA-4126	240p
LA-4135	250p
LA-4137	180p
LA-4140	70p
LA-4160	220p
LA-4180	300p
LA-4182	190p
LA-4190	300p
LA-4192	180p
LA-4200	130p
LA-4201	120p
LA-4220	120p
LA-4260	230p
LA-4261	300p
LA-4270	300p
LA-4420	140p
LA-4422	130p
LA-4430	130p
LA-4440	230p
LA-4445	260p
LA-4460	170p
LA-4461	180p
LA-4500	230p
LA-4505	260p
LA-4507	360p
LA-4508	260p
LA-4510	160p
LA-4520	230p
LA-4530	250p
LA-4540	300p
LA-4550	200p
LA-4555	220p
LA-4560	300p
LA-4570	300p
LA-5112	120p
LA-5523	150p
LA-5527	150p
LA-5700	300p
LA-6324	200p
LA-6358	100p
LA-7011	220p
LA-7031	250p
LA-7033	400p
LA-7040	280p
LA-7042	280p
LA-7046	300p
LA-7224	150p
LA-7230	500p
LA-7505	250p
LA-7506	250p
LA-7507	250p
LA-7508	250p
LA-7520	500p
LA-7620	500p
LA-7621	500p
LA-7751	450p
LA-7755	300p
LA-7770	300p
LA-7800	180p
LA-7801	280p
LA-7802	300p
LA-7806	260p
LA-7808	250p
LA-7810	300p
LA-7811	300p
LA-7820	250p
LA-7822	280p
LA-7823	280p
LA-7910	150p
LA-7920	150p
LC-7131	260p
LC-7132	400p
LC-7137	450p
LF-347	110p
LF-351	45p
LF-353	48p
LF-355	60p
LF-356	60p
LF-357	70p
LF-398	300p

LM-301	26p
LM-307	42p
LM-308CN	70p
LM-311	35p
LM-318	120p
LM-319	165p
LM-324	35p
LM-334Z	115p
LM-335Z	120p
LM-337	250p
LM-339	37p
LM-348	55p
LM-358	45p
LM-377	220p
LM-380	100p
LM-381	150p
LM-382	130p
LM-384	130p
LM-386	85p
LM-387	100p
LM-392	100p
LM-393	55p
LM-709DIL	30p
LM-710	45p
LM-711	85p
LM-723	40p
LM-733	60p
LM-741DIL	18p
LM-741MET	45p
LM-747	58p
LM-748	35p
LM-1458	33p
LM-1889	400p
LM-3900	40p
LM-3909	80p
LM-3911	160p
LM-3914	250p
LM-3915	255p
LM-3916	290p
M-51102	290p
M-51514	160p
M-51515BL	220p
M-51516	260p
M-51518	200p
MB-3515	240p
MB-3614	180p
MB-3712	140p
MB-3713	130p
MB-3714	270p
MB-3715	250p
MB-3722	310p
MB 3730	240p
MB-3731	300p
MB-3756	230p
MB-3759	200p
MB-8719	360p
MC-1310P	130p
MC-1455	45p
MC-1458	33p
MC-1469	290p
MC-1488	65p
MC-1489	65p
MC-1496	65p
MC-3302	70p
MC-3401	45p
MC-3403	60p
MC-3423	75p
NE-531	115p
NE-544	170p
NE-555	20p
NE-556	40p
NE-565	110p
NE-566	130p
NE-567	115p
NE-570	360p
NE-571	290p
NE-592	85p
NE-5532P	140p
NE-5534P	110p
SAS-560	110p
SAS-570	110p
SAA-1006	300p
SAA-1008	450p
SAA-1009B	350p
SAA-1010	400p
SAA-1020	450p
SAA-1024	250p
SAA-1025	250p
SAA-1016T	400p
SAA-1075	350p
SAA-1094	350p
SAA-1121	600p
SAA-1124	200p
SAA-1174	300p
SAA-1220	400p
SAA-1250	280p
SAA-1251	380p
SAA-1272C	280p
SAA-1274	280p
SAA-3004	400p
SAA-5000	200p
SAA-5010	220p
SAA-5012	400p
SAA-5020	350p
SAA-5030	440p
SAA-5040A	280p
SAA-5040B	400p
SAA-5050	420p
SAB-3013	200p
SAB-3022	600p
SAB-3023	500p
SAB-3035	600p
STA-301A	380p
STA-312	280p
STA-401A	380p
STA-403A	300p
STA-432A	250p
STA-434A	300p
STA-435A	300p
STA-441C	250p
STA-901M	300p
STK-0025	420p
STK-0029	430p
STK-0039	410p
STK-0040	560p
STK-0049	570p
STK-0050	570p
STK-0059	620p
STK-0060	900p
STK-0070	1100p
STK-0080	690p
STK-011	370p
STK-015	490p
STK-016	800p
STK-025	700p
STK-043	980p
STK-056	820p
STK-077	600p
STK-078	620p
STK-080	710p
STK-082	720p
STK-084	740p
STK-086	910p
STK-420	400p
STK-430	500p
STK-433	490p
STK-435	510p
STK-436	490p
STK-437	600p
STK-439	550p
STK-441	740p
STK-443	740p
STK-457	580p
STK-459	610p
STK-460	720p
STK-461	720p
STK-463	780p
STK-465	800p

STK-501	580p
STK-561	550p
STK-563	480p
STK-583	600p
STK-734B	510p
STK-745	600p
STK-760	600p
STK-772B	480p
STK-780	650p
STK-1039	550p
STK-1040	700p
STK-1049	800p
STK-1050	750p
STK-1060	760p
STK-1070	1200p
STK-1080	1000p
STK-2025	800p
STK-2028	650p
STK-2029	500p
STK-2038	900p
STK-2048	1000p
STK-2110	680p
STK-2120	820p
STK-2125	650p
STK-2129	610p
STK-2139	800p
STK-2155	1000p
STK-2230	580p
STK-2240	920p
STK-2250	920p
STK-3041	600p
STK-3042	580p
STK-3044	575p
STK-3062	600p
STK-3082	700p
STK-3083	550p
STK-3156	560p
STK-4017	450p
STK-4021	425p
STK-4025	600p
STK-4026	800p
STK-4028	620p
STK-4036	500p
STK-4038	680p
STK-4044	1000p
STK-4046	1100p
STK-4048	1280p
STK-4060	580p
STK-4101	650p
STK-4111	650p
STK-4112	950p
STK-4121	800p
STK-4122	560p
STK-4131	650p
STK-4141	700p
STK-4162	800p
STK-4151	680p
STK-4152	720p
STK-4161	820p
STK-4162	820p
STK-4171	1000p
STK-4181	820p
STK-4191	1100p
STK-4192	1000p
STK-4272	720p
STK-4301	700p
STK-4311	800p
STK-4332	500p
STK-4352	700p
STK-4362	625p
STK-4372	600p
STK-4392	720p
STK-4773	1000p
STK-4793	1180p
STK-4803	820p
STK-4813	950p
STK-4833	920p
STK-4843	865p
STK-4853	950p
STK-4863	850p
STK-4873	1100p
STK-4893	1400p
STK-4913	1220p
STK-5314	625p
STK-5315	650p
STK-5322	620p
STK-5324	550p
STK-5325	650p
STK-5332	300p
STK-5361	480p
STK-5372	300p
STK-5421	625p
STK-5422	600p
STK-5431	650p
STK-5434	650p
STK-5441	500p
STK-5451	550p
STK-5457	425p
STK-5471	500p
STK-5476	600p
STK-5481	520p
STK-5482	520p
STK-5483	550p
STK-5488	600p
STK-6722	900p
STK-6822	1200p
STK-6922	600p
STK-6932	600p
STK-6962	320p
STK 6972	630p
STK-6982	800p
STK-7216	610p
STK-7217	650p
STK-7308	800p
STK-7309	650p
STK-7348	600p
STK-7356	650p
STK-7358	650p
STK-7402	660p
STK-7404	680p
STK-7406	800p
STK-7408	880p
STK-7410	1200p
STK-7554	1000p
STK-7563	1000p
STK-8050	880p
STK-8250	700p
STK-8260	1500p
STR-370	650p
STR-371	600p
STR-380	580p
STR-381	570p
STR-383	570p
STR-384	570p
STR-440	520p
STR-441	480p
STR-450	680p
STR-451	480p
STR-452	680p
STR-453	700p
STR-454	490p
STR-455	680p
STR-456	680p
STR-457	680p
STR-470	680p
STR-1096	420p
STR-2005	580p
STR-2012	650p
STR-2013	460p
STR-2105	680p
STR-3115	580p
STR-3123	490p
STR-3125	580p
STR-4211	600p
STR-4090	650p
STR-5015	600p
STR-5412	500p

STR-6020	600p
STR-9005	600p
STR-10006	600p
STR-11006	600p
STR-12006	600p
STR-20012	600p
STR-20015	600p
STR-30123	600p
STR-40090	600p
STR-41090	600p
S,2t,2r,2- 50103A	800p
STR-53041	650p
STR-54041	650p
STR-58041	650p
STR-59041	650p
T28800D	52p
TA-7054	190p
TA-7061	115p
TA-7063	70p
TA-7066	120p
TA-7073	200p
TA-7089	300p
TA-7108	130p
TA-7109	220p
TA-7119	150p
TA-7120	55p
TA-7130	80p
TA-7137	83p
TA-7140	130p
TA-7157	140p
TA-7176	240p
TA-7193	400p
TA-7200	200p
TA-7203	180p
TA-7204	140p
TA-7205	80p
TA-7207	150p
TA-7208	145p
TA-7210	200p
TA-7214	260p
TA-7217	145p
TA-7220	220p
TA-7222	120p
TA-7223	210p
TA-7225	300p
TA-7226	290p
TA-7227	190p
TA-7229	300p
TA-7230	170p
TA-7232	250p
TA-7233	250p
TA-7237	400p
TA-7238	400p
TA-7240	260p
TA-7241	260p
TA-7242	290p
TA-7243	350p
TA-7245	450p
TA-7267	290p
TA-7269	850p
TA-7270	250p
TA-7271	400p
TA-7272	260p
TA-7273	350p
TA-7274	260p
TA-7280	330p
TA-7281	270p
TA-7282	260p
TA-7283	260p
TA-7288	260p
TA-7299	400p
TA-7310	100p
TA-7312	120p
TA-7313	110p
TA-7314	210p
TA-7315	200p
TA-7317P	240p
TA-7324	200p
TA-7325	90p
TA-7328	200p
TA-7335	200p
TA-7336	250p
TA-7341	250p
TA-7343	250p
TA-7357	400p
TA-7358	200p
TA-7401	400p
TA-7607	270p
TA-7608	360p
TA-7609	270p
TA-7611	280p
TA-7612	360p
TA-7614	230p
TA-7616	400p
TA-7621	520p
TA-7622	420p
TA-7625	420p
TA-7628	240p
TA-7629	420p
TA-7630	300p
TA-7632	400p
TA-7640	150p
TA-7641	170p
TA-7658	130p
TA-7668	160p
TA-7680	480p
TA-7688	250p
TA-7698	720p
TA-7699	1200p
TA-7705	300p
TA-7745	300p
TA-7750	200p
TA-7757	250p
TA-7768	250p
TA-7769	300p
TA-7774	300p
TA-7784	250p
TAA-550	25p
T,0a,0a,0- 611B12	100p
TAA-661	100p
TBA-120S	50p
TBA-395	60p
TBA-396	70p
TBA-520	120p
TBA-530	120p
TBA-540	120p
TBA 560	120p
TBA-800	40p
TBA-810AS	60p
TBA-820	65p
TBA-820M	50p
TBA-920	120p
TBA-950	120p
TBA-990	120p
TCA-240	200p
TCA-740	130p
TCA-830	90p
TCA-940	100p
TCEP-100	200p
TDA-1001	200p
TDA-1002	200p
TDA-1003	150p
TDA-1005A	220p
TDA-1008	350p
TDA-1010A	100p
TDA-1011	120p
TDA 1012	120p
TDA-1013A	120p
TDA 1015	120p
TDA 1020	150p
TDA-1022	350p
TDA-1023	200p
TDA-1024	200p
TDA-1025	320p
TDA-1028	220p

TDA-1029	300p
TDA-1035	120p
TDA-1037	190p
TDA-1044	300p
TDA-1048	225p
TDA 1053	400p
TDA-1054	200p
TDA-1059	80p
TDA-1060	220p
TDA-1070	400p
TDA-1074	420p
TDA-1082	290p
TDA-1083	200p
TDA 1085	400p
TDA-1097	550p
TDA-1104	800p
TDA-1151	60p
TDA-1154	50p
TDA-1170	100p
TDA-1180	190p
TDA-1190	100p
TDA-1200B	80p
TDA-1220	150p
TDA-1235	350p
TDA-1236	295p
TDA 1270	200p
TDA 1410	210p
TDA 1412	100p
TDA 1420	200p
TDA-1470	140p
TDA-1510	380p
TDA-1512	200p
TDA-1515A	250p
TDA-1520	350p
TDA-1522	200p
TDA-1524	350p
TDA-1541	1600p
TDA-1670A	300p
TDA-1701	320p
TDA-1770A	300p
TDA-1870A	300p
TDA-1872A	450p
TDA-1904	120p
TDA-1908A	100p
TDA-1940	280p
TDA-1941	300p
TDA-1950	280p
TDA-2002	80p
TDA-2003	150p
TDA-2004	170p
TDA-2005	170p
TDA-2006	150p
TDA 2008	175p
TDA-2009	200p
TDA-2010	100p
TDA-2020	140p
TDA-2030	140p
TDA-2038	900p
TDA-2040	200p
TDA-2054M	120p
TDA-2170	300p
TDA-2190	400p
TDA-2270	340p
TDA-2320	80p
TDA-2510	450p
TDA-2524	120p
TDA-2532	120p
TDA 2540	100p
TDA 2541	150p
TDA-2542	150p
TDA-2543	300p
TDA-2545	200p
TDA 2556	350p
TDA-2560	120p
TDA-2575A	100p
TDA-2577	180p
TDA-2578A	200p
TDA-2579	250p
TDA-2581	155p
TDA-2582	160p
TDA-2590	200p
TDA-2593	150p
TDA-2594	300p
TDA-2595	300p
TDA-2600	580p
TDA-2611A	120p
TDA-2620	200p
TDA-2630	300p
TDA-2640	220p
TDA-2653A	350p
TDA-2654	250p
TDA-2670	150p
TDA-2690	100p
TDA-2760	400p
TDA-2822M	80p
TDA-2840	200p
TDA-3082	300p
TDA-3190	100p
TDA-3300B	480p
TDA 3301B	380p
TDA-3303	400p
TDA-3310	120p
TDA-3420	250p
TDA-3501	400p
TDA-3502	600p
TDA-3505	300p
TDA-3506	350p
TDA-3540	300p
TDA-3541	200p
TDA-3560	350p
TDA-3561	280p
TDA-3562	260p
TDA-3563	350p
TDA-3565	300p
TDA-3566	330p
TDA-3580	500p
TDA-3590	320p
TDA-3592A	350p
TDA-3640	350p
TDA-3650	300p
TDA-3651	250p
TDA-3652	240p
TDA-3653	150p
TDA-3654	200p
TDA-3710	320p
TDA-3800	350p
TDA-3810	300p
TDA-3950	300p
TDA-4050	250p
TDA-4180	400p
TDA-4290	250p
TDA-4400	350p
TDA-4420	180p
TDA-4421	400p
TDA-4426	250p
TDA-4427	500p
TDA-4431	200p
TDA-4437	450p
TDA-4440	250p
TDA-4442	320p
TDA-4445	250p
TDA-4500	360p
TDA-4501	450p
TDA-4502	900p
TDA-4503	400p
TDA-4505	300p
TDA-4510	400p
TDA-4555	600p
TDA-4556	650p
TDA-4560	450p
TDA-4600	260p
TDA-4601	250p
TDA-4610	650p
TDA-4950	200p
TDA-5600	450p

LINEAR IC'S — Cont.

TDA-5700	200p
TDA-5800	600p
TDA 5820	480p
TDA-7000	200p
TDA-7040	250p
TDA-7050	200p
TDA-7211	150p
TDA-7220	150p
TDA-7240	300p
TDA-7250	600p
TDA-7255	600p
TDA-7270	150p
TDA-7274	100p
TDA-8115	300p
TDA-8140	300p
TDA-8170	320p
TDA-8190	280p
TDA-8440	380p
TDA-9403	250p
TDA-9503	240p
TDA-9513	350p
TEA-1002	650p
TLO-61	40p
TLO-64	80p
TLO-71	38p
TLO-72	55p
TLO-74	92p
TLO-81	40p
TLO-82	46p
TLO-83	67p
TLO-84	80p
ULN-2002	70p
ULN-2003	69p
ULN-2004	69p

JAPANESE TRANSISTORS

2SA-473	35p
2SA-483	400p
2SA-490	60p
2SA-562	57p
2SA-563	45p
2SA-571	500p
2SA-634	50p
2SA-636	50p
2SA-673	20p
2SA-684	60p
2SA-699	100p
2SA-715	90p
2SA-720	20p
2SA-733	30p
2SA-798	55p
2SA-844	30p
2SA-872	40p
2SA-872A	50p
2SA-886	90p
2SA-899	60p
2SA-907	650p
2SA-909	700p
2SA-933	40p
2SA-934	40p
2SA-935	40p
2SA-937	40p
2SA-940	70p
2SA-950	30p
2SA-952	50p
2SA-953	60p
2SA-965	60p
2SA-966	70p
2SA-970	50p
2SA-979	85p
2SA-984	50p
2SA-992	30p
2SA-1012	130p
2SA-1015	30p
2SA-1102	190p
2SA-1103	200p
2SA-1104	200p
2SA-1105	250p
2SA-1106	250p
2SB-022	80p
2SB-324	55p
2SB-370	45p
2SB-546	70p
2SB-557	225p
2SB-561	50p
2SB-566	130p
2SB-595	80p
2SB-598	60p
2SB-600	500p
2SB-600	500p
2SB-616	190p
2SB-621	85p
2SB-646A	90p
2SB-647	30p
2SB-649	40p
2SB-688	120p
2SB-703	125p
2SB-705	200p
2SB-707	200p
2SB-716	30p
2SB-727	200p
2SB-754	80p
2SB-755	310p
2SB-761	170p
2SB-764	60p
2SB-772	45p
2SB-775	160p
2SB-791	280p
2SB-792	70p
2SB-795	60p
2SB-825	135p
2SB-861	160p
2SB-882	180p
2SB-884	120p
2SB-886	225p
2SB-895	120p
2SB-950	180p
2SB-951	190p
2SB-1009	110p
2SB-1037	110p
2SB-1077	180p
2SB-1091	100p
2SC-97A	380p
2SC-454	45p
2SC-458	15p
2SC-461	30p
2SC-495	60p
2SC-536	30p
2SC 681	340p
2SC-710	50p
2SC-733	30p
2SC-790	125p
2SC-792	380p
2SC-828	25p
2SC-930	50p
2SC-943	160p
2SC-945	40p
2SC-1010	300p
2SC-1050	300p
2SC-1060	99p
2SC-1061	100p
2SC-1070	65p
2SC-1096	60p
2SC-1106	180p
2SC-1114	415p
2SC-1115	400p
2SC-1116	290p
2SC-1161	110p
2SC-1162	35p
2SC-1164	600p
2SC-1172	150p
2SC-1173	60p
2SC-1213	50p
2SC-1214	40p
2SC-1226	75p
2SC-1279	30p
2SC-1306	90p
2SC-1308K	350p
2SC-1317	25p
2SC-1318	25p
2SC-1327	20p
2SC-1342	120p
2SC-1383	50p
2SC-1384	50p
2SC-1398	80p
2SC-1413	265p
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2SC-1515	60p
2SC-1520	120p
2SC-1573	95p
2SC-1586	540p
2SC-1624	140p
2SC-1675	100p
2SC-1678	120p
2SC-1729	900p
2SC-1730	540p
2SC-1740	40p
2SC-1741	45p
2SC-1755	90p
2SC-1756	40p
2SC-1758	30p
2SC-1775	20p
2SC-1809	40p
2SC-1815	30p
2SC-1826	60p
2SC-1845	20p
2SC-1847	120p
2SC-1865	120p
2SC-1875	260p
2SC-1881	210p
2SC-1906	75p
2SC-1907	75p
2SC-1909	250p
2SC-1921	60p
2SC-1923	25p
2SC-1941	40p
2SC-1942	260p
2SC-1944	350p
2SC-1945	350p
2SC-1946	1500p
2SC-1947	450p
2SC-1957	70p
2SC-1969	160p
2SC-1971	400p
2SC-1972	600p
2SC-1983	130p
2SC-2001	60p
2SC-2002	40p
2SC-2003	25p
2SC-2023	180p
2SC-2026	60p
2SC-2028	75p
2SC-2029	120p
2SC-2053	120p
2SC-2060	60p
2SC-2068	90p
2SC-2073	70p
2SC-2075	80p
2SC-2078	95p
2SC-2086	60p
2SC-2098	600p
2SC-2166	90p
2SC-2228A	60p
2SC-2229	25p
2SC-2233	125p
2SC-2235	60p
2SC-2236	60p
2SC-2238	70p
2SC-2240	45p
2SC-2259	80p
2SC-2271	60p
2SC-2275	50p
2SC-2290	1800p
2SC-2314	70p
2SC-2324	120p
2SC-2329	480p
2SC-2334	240p
2SC-2335	120p
2SC-2335	120p
2SC-2369	100p
2SC-2371	45p
2SC-2373	210p
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2SC-2408	120p
2SC-2470	85p
2SC-2482	40p
2SC-2484	240p
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2SC-2545	55p
2SC-2547	65p
2SC-2550	70p
2SC-2551	70p
2SC-2562	90p
2SC-2564	245p
2SC-2565	280p
2SC-2570	60p
2SC-2577	125p
2SC-2578	220p
2SC-2579	200p
2SC-2580	240p
2SC-2581	290p
2SC-2608	620p
2SC-2611	40p
2SC-2611	65p
2SC-2625	380p
2SC-2681	270p
2SC-2688	70p
2SC-2695	2100p
2SC-2719	80p
2SC-2749	350p
2SC-2785	60p
2SC-2810	360p
2SC-2837	360p
2SC-2922	610p
2SC-2979	320p
2SC-2988	280p
2SC-3025	500p
2SC-3039	140p
2SC-3040	260p
2SC-3042	300p
2SC-3060	900p
2SC-3148	410p
2SC-3150	200p
2SC-3151	230p
2SC-3152	250p
2SC-3153	350p
2SC-3156	400p
2SC-3158	260p
2SC-3173	180p
2SC-3178	340p
2SC-3181	240p
2SC-3210	400p
2SC-3212	510p
2SC-3264	510p
2SC-3277	280p
2SC-3293	85p
2SC-3299	120p
2SC-3318	500p
2SC-3355	90p
2SC-3358	80p
2SC-3402	50p
2SC-3416	80p
2SC-3417	90p
2SC-3422	110p
2SC-3467	70p
2SC-3468	70p
2SC-3503	90p
2SC-3568	200p
2SC-3675	160p
2SC-3685	400p
2SC-3789	75p
2SD-024	60p
2SD-313	70p
2SD-325	60p
2SD-348	460p
2SD 371	240p
2SD-401	130p
2SD-438	100p
2SD-600	120p
2SD-613	70p
2SD-718	100p
2SD 1277	190p
2SD 1398	250p
2SD 1453	180p
2SD-1609	110p

BRIDGE RECTIFIERS

1A/50V	16p
1A/100V	18p
1A/200V	19p
1A/400V	21p
1A/600V	23p
1A/800V	28p
2A/100V	33p
2A/200V	33p
2A/400V	37p
2A/600V	43p
2A/800V	43p
3A/200V	43p
3A/400V	43p
3A/600V	44p
6A/200V	80p
6A/400V	72p
25A/100V	150p
25A/200V	165p
25A/400V	185p
25A/600V	200p
25A/800V	240p
35A/100V	185p
35A/200V	200p
35A/400V	220p
35A/600V	230p
35A/800V	260p
1.5A/100V	40p
1.5A/800V	40p

PLASTIC CASED TRIACS

4A/400V	60p
6A/400V	69p
8A/400V	68p
12A/400V	85p
16A/400V	105p
20A/400V	190p
25A/400V	205p
8A/400V	52p

THYRISTORS

0.8A/60V	20p
0.8A/100V	28p
0.8A/200V	29p
4A/400V	28p
8A/300V	59p
8A/400V	70p
8A/600V	79p
12A/400V	75p
12A/600V	90p
2N4444	76p
BR103	37p
BR303	85p
BT106	120p
BT116	80p
BT119	100p
BT120	100p
OT121	120p
TIC44	22p
TIC45	27p
TIC47	32p
17088	200p
17089	200p
17127	200p
15/80H	230p
15/85R	230p
SG613	850p
SG264A	300p

4000B SERIES CMOS IC's

4000	13p
4001	13p
4002	13p
4006	34p
4007	13p
4008	38p
4009	20p
4010	21p
4011	13p
4012	13p
4013	19p
4014	32p
4015	32p
4016	18p
4017	29p
4018	30p
4019	28p
4020	33p
4021	36p
4022	36p
4023	13p
4024	25p
4025	13p
4026	60p
4027	18p
4028	29p
4029	34p
4030	17p
4031	90p
4032	52p
4033	60p
4034	76p
4035	42p
4036	180p
4037	75p
4038	46p
4039	180p
4040	30p
4041	36p
4042	30p
4043	36p
4044	36p
4045	72p
4046	42p
4047	45p
4048	27p
4049	18p
4050	20p
4051	38p
4052	35p
4053	35p
4054	53p
4055	52p
4056	52p
4060	40p
4063	52p
4066	20p
4067	120p
4068	13p
4069	13p
4070	13p
4071	13p
4072	13p
4073	13p
4075	13p
4076	42p
4077	13p
4078	13p
4081	13p
4082	13p
4085	36p
4086	30p
4089	75p
4093	18p
4094	44p
4095	58p
4098	50p
4099	42p
4501	27p
4502	36p
4503	30p
4504	55p
4505	180p
4506	58p
4507	30p
4508	67p
4510	32p
4511	30p
4512	38p
4513	80p
4514	65p
4515	65p
4516	36p
4517	100p
4518	36p
4519	28p
4520	36p
4521	86p
4522	43p
4526	38p
4527	41p
4528	38p
4529	65p
4532	48p
4551	75p
4553	140p
4555	29p
4556	38p
4557	140p
4583	60p
4584	30p
4585	40p
40100	120p
40101	78p
40102	150p
40103	120p
40104	90p
40105	140p
40106	35p
40107	50p
40108	260p
40109	74p
40110	170p
40114	180p
40117	180p
40147	240p
40160	55p
40161	55p
40162	55p
40163	55p
40174	48p
40175	60p
40181	170p
40182	70p
40192	48p
40193	48p
40194	58p
40208	240p
40257	120p

74 SERIES

7400	20p
7401	16p
7402	18p
7403	20p
7404	35p
7405	10p
7406	40p
7407	40p
7408	25p
7409	20p
7413	35p
7414	45p
7416	40p
7417	32p
7420	22p
7421	25p
7425	15p
7430	25p
7437	28p
7438	35p
7442	45p
7447	60p
7450	22p
7451	10p
7454	25p
7470	30p
7473	30p
7474	40p
7475	25p
7481	90p
7482	70p
7485	30p
7486	28p
7489	80p
7490	35p
7492	45p
7493	35p
7495	48p
7497	80p
74107	30p
74111	52p
74116	85p
74119	85p
74122	40p
74123	20p
74125	40p
74126	45p
74132	42p
74141	56p
74145	70p
74153	45p
74155	45p
74157	45p
74160	50p
74164	50p
74167	35p
74173	50p
74174	70p
74175	65p
74176	45p
74180	50p
74182	45p
74192	40p
74196	40p
74197	45p
74393	70p

74HC SERIES HIGH SPEED CMOS

74HC00	14p
74HC02	14p
74HC03	14p
74HC04	15p
74HC08	18p
74HC10	20p
74HC11	14p
74HC14	28p
74HC20	20p
74HC21	20p
74HC27	20p
74HC30	20p
74HC32	20p
74HC42	32p
74HC51	20p
74HC73	26p
74HC74	26p
74HC75	30p
74HC76	30p
74HC77	40p
74HC85	33p
74HC86	29p
74HC93	50p
74HC107	31p
74HC109	31p
74HC112	31p
74HC113	31p
74HC123	43p
74HC125	35p
74HC126	36p
74HC131	38p
74HC132	37p
74HC133	35p
74HC137	55p
74HC138	36p
74HC139	24p
74HC147	45p
74HC148	40p
74HC151	36p
74HC153	35p
74HC154	110p
74HC155	50p
74HC157	36p
74HC158	36p
74HC160	44p
74HC161	44p
74HC162	44p
74HC163	44p
74HC164	44p
74HC165	58p
74HC166	70p
74HC173	55p
74HC174	38p
74HC175	38p
74HC181	130p
74HC182	60p
74HC190	46p
74HC191	60p
74HC192	60p
74HC193	43p
74HC194	47p
74HC195	47p
74HC221	100p
74HC237	50p
74HC238	65p
74HC240	48p
74HC241	47p
74HC242	55p
74HC243	60p
74HC244	44p
74HC245	49p
74HC251	25p
74HC253	37p
74HC257	41p
74HC258	50p
74HC259	55p
74HC273	42p
74HC279	37p
74HC280	65p
74HC283	65p
74HC297	950p
74HC298	52p
74HC299	105p
74HC354	38p
74HC356	45p
74HC365	34p
74HC366	36p
74HC367	36p
74HC368	36p
74HC373	47p
74HC374	50p
74HC375	60p
74HC377	55p
74HC386	20p
74HC390	55p
74HC393	50p
74HC423	70p
74HC533	68p
74HC534	65p
74HC540	73p
74HC541	73p
74HC563	73p
74HC564	73p
74HC573	73p
74HC574	70p
74HC583	90p
74HC595	85p
74HC597	85p
74HC620	110p
74HC623	110p
74HC640	90p
74HC643	90p
74HC646	150p
74HC648	150p
74HC651	110p
74HC652	110p
74HC670	90p
74HC688	150p
74HC690	120p
74HC691	120p
74HC4002	25p
74HC4015	85p
74HC4016	75p
74HC4017	48p
74HC4020	50p
74HC4022	40p
74HC4024	34p
74HC4028	40p
74HC4040	34p
74HC4049	50p
74HC4050	50p
74HC4051	95p
74HC4052	95p
74HC4053	95p
74HC4059	85p
74HC4050	33p
74HC4066	33p
74HC4072	33p
74HC4075	26p
74HC4078	32p
74HC4094	50p
74HC4316	100p
74HC4351	110p
74HC4352	160p
74HC4310	120p
74HC4511	85p
74HC4514	140p
74HC4515	130p
74HC4516	130p
74HC4518	70p
74HC4520	80p
74HC4538	90p
74HC4543	120p
74HC7266	75p
74HC22106	580p
74HC40104	190p
74HC40105	250p

74LS SERIES LOW POWER SCHOTTKY T.T.L.

74LS00	14p
74LS01	14p
74LS02	14p
74LS03	14p
74LS04	14p
74LS05	14p
74LS08	14p
74LS09	15p
74LS10	14p
74LS11	14p
74LS12	14p
74LS13	22p
74LS15	15p
74LS20	15p
74LS21	15p
74LS22	15p
74LS24	38p
74LS26	15p
74LS27	15p
74LS28	15p
74LS30	15p
74LS32	17p
74LS33	17p
74LS31	16p
74LS38	17p
74LS40	16p
74LS42	28p
74LS47	56p
74LS48	52p
74LS51	15p
74LS54	15p
74LS55	17p
74LS73	26p
74LS74	20p
74LS75	26p
74LS76	26p
74LS78	26p
74LS83	40p
74LS85	40p
74LS86	28p
74LS90	29p
74LS91	60p
74LS92	35p
74LS93	28p
74LS95	45p
74LS96	56p
74LS107	30p
74LS109	30p
74LS112	30p
74LS113	30p
74LS114	30p
74LS122	38p
74LS123	38p
74LS124	85p
74LS125	32p
74LS126	32p
74LS132	32p
74LS133	32p
74LS136	32p
74LS138	31p
74LS139	31p
74LS145	70p
74LS147	100p
74LS148	80p
74LS151	30p
74LS153	36p
74LS154	85p
74LS155	36p
74LS156	41p
74LS157	28p
74LS158	31p
74LS160	44p
74LS161	44p
74LS162	44p
74LS163	40p
74LS164	40p
74LS165	56p
74LS166	60p
74LS168	68p
74LS169	60p
74LS170	75p
74LS174	36p
74LS175	38p
74LS190	51p
74LS191	48p
74LS192	46p
74LS193	47p
74LS194	47p
74LS195	50p
74LS196	55p
74LS197	48p
74LS221	50p
74LS240	50p
74LS241	46p
74LS242	50p
74LS243	55p
74LS244	45p
74LS245	46p
74LS247	46p
74LS248	48p
74LS249	78p
74LS251	28p
74LS253	40p
74LS256	58p
74LS257	38p
74LS258	40p
74LS259	55p
74LS260	38p
74LS266	26p
74LS273	50p
74LS279	37p
74LS280	100p
74LS283	55p
74LS290	30p
74LS293	30p
74LS365	30p
74LS366	35p
74LS367	33p
74LS368	35p
74LS373	50p
74LS374	50p
74LS375	52p
74LS390	46p
74LS393	41p
74LS399	75p
74LS629	105p
74LS641	100p
74LS642	140p
74LS644	140p
74LS645	140p
74LS670	68p
74LS674	320p
74LS687	260p

COMPUTER IC'S

2114	200p
2532	330p
2716	200p
2732	280p
2732A	300p
2764	240p
27C64	550p
27128	350p
26256-25	400p
41256-15	450p
256DRAM	450p
4116	75p
4164	150p
6116	200p
6264-15	300p
6502	300p
6502A	400p
65C02	930p
6503	570p
6520	170p
6522	330p
6530	1050p
6532	460p
6545	880p
6551	530p
6800	210p
6802	220p
6803	800p
6808	500p
6809	600p
6810	150p
6818	380p
6820	140p
6821	140p
6840	310p
6845	620p
6850	110p
8080A	400p
8085A	300p
8155	360p
8156	360p
81LS95	120p
81LS96	130p
81LS98	130p
8224	270p
8226	270p
8228	270p
8243	250p
8250	850p
8087	11000p
8251	320p
8253	320p
8255	310p
8256	1200p
8257	350p
8259	360p
8271	3400p
8272	1200p
8279	450p
8282	300p
8283	400p
8284	440p
8287	360p
8288	650p
8748	1100p
8755	1400p
AY3-1015	290p
AY5-3600	570p
SP0256AL2	500p
Z80ACPU	180p
Z80BCPU	500p
Z80ADMA	650p
Z80AP10	230p
Z80BP10	480p
Z80ACTC	250p
Z80AS10	660p
Z80AS10-1	700p
Z80BP10-2	700p
Z80ADRT	680p
74S188	175p
74S189	210p
74S201	240p
74S287	190p
74S288	160p
74S289	180p
74S387	200p
75107	80p
75108	80p
75109	110p
75110	80p
75112	140p
75113	105p
75114	130p
75115	130p
75121	125p
75122	125p
75150	110p
75154	110p
75158	140p
75159	200p
75160	400p
75161	400p
75162	700p
75172	720p
75182	100p
75183	100p
75188	60p
75189	60p
75195	185p
75322	130p
75324	340p
75325	155p
75365	145p
75450	45p
75451	42p
75452	42p
75453	65p
75454	65p
75480	135p
75491	60p
75492	60p
8T26	95p
8T28	110p
8T31	330p
8T95	90p
8T96	110p
8T97	90p
8T98	110p

UHF TUNERS

U322LO	600p
U341	500p
U342	500p

VIDEO RUBBER BELTS

AKAI

VS-2EG/5EG 5 belts/kit	180p
VS-9300 7 belts/kit	220p
VS-9700EG 6 belts/kit	200p
VS-9500/9800 7 belts/kit	220p

JVC

HR-3300/3600 9 belts/kit	220p
HR-3330 7 belts/kit	200p
HR-3360/3660 7 belts/kit	190p
HR-4130 7 belts/kit	195p
HR-7200 3 belts/kit	75p
HR-7600 3 belts/kit	145p
HR-7730 3 belts/kit	77p

NATIONAL

NV-300 5 belts/kit	160p
NV-333 5 belts/kit	135p
NV-777 4 belts/kit	130p
NV-2000 5 belts/kit	155p
NV-3000 6 belts/kit	180p
NV-7000 5 belts/kit	100p
NV-7200 5 belts/kit	90p
NV-8600 7 belts/kit	200p

SONY

SL-C72SL-J7 6 belts/kit	140p
SL-T7ME/T7MER 6 belts/kit	170p
SL-T9/P7/J9 7 belts/kit	210p
SL-8000-8080 6 belts/kit	240p

SANYO

VTC-5300 5 belts/kit	190p
VTC-5500 3 belts/kit	95p
VTC-9300 4 belts/kit	240p

HITACHI

VT-5000 7 belts/kit	155p
VT-8000 3 belts/kit	110p
VT-11 5 belts/kit	190p

FISHER

VBS-7000 6 belts/kit	245p
VBS-9000 3 belts/kit	120p

TOSHIBA

V-5250/5280 5 belts/kit	230p
V-5480 7 belts/kit	210p
V-5475 6 belts/kit	190p
V-7540 5 belts/kit	190p
V-8600 6 belts/kit	150p

SHARP

VC-6300 5 belts/kit	195p
VC-7300 5 belts/kit	160p
VC-8300 5 belts/kit	175p
VC-9300 5 belts/kit	155p

CASSETTE MOTOR

6V	290p
9VCW	290p
12VCCW	290p
12VCW	290p
13.2VCW	290p
13.2VCCW	290p

CASSETTE TAPE HEADS

Mono Head	90p
Stereo Head	150p
Mono Mini Head	230p
Auto Reverse Head	260p

VIDEO MOTORS

Sanyo

Reel Motor (RM11) P/N 4-529V-10800	790p
Capstan Motor 4-527V-51000	2400p

Sony

Capstan Motor BHF-1100D	2500p

Sharp

Reel Motor RMOTB 1007 Gezz	1750p
Reel Motor RMOTM 1008 Gezz	1750p
Loading Motor RMOTM 1017	1000p

JVC

Capstan Motor PU-55371V	2200p
Capstan Motor PU-45979	2250p
Drum Motor PU-46414	2250p

VIDEO PINCH ROLLERS

National

NV-300	475p
NV-7000	475p

Sanyo

VTC-9300	475p
VTC-5500	475p

Sony

SL-T7	475p
SL-C7	475p

JVC

HR-3300	500p
HR-3330	500p
HR-3360/3660	500p
HR-7200	500p
HR-3300	500p

Akai

VS-9700EG	360p

Hitachi

VT-5000	475p

Sharp

VC-6300/6500

IDLERS & PULLEYS REPLACEMENTS

Sanyo

Reel, Pulley 143-0-662T-01201	520p
Gear Idler 143 04904-00900	450p
Take Up Idler 143-0-4204-00100	650p
Idler 143-256T-03200	450p

Sony

Rew Pulley A-6706-348-B	400p
Rew Pulley A-6706-391-A/B	300p

Sharp

Idler Assembley NIDL0005 Gezz	325p
Idler Assembley NIDL0006 Gezz	325p
Idler Sharp NIDL0005 Gezz	225p

Hitachi

Idler Assembley 6886971	300p
Idler Assembley V-68661482	385p

JVC

Idler Assembley PU-47752	480p
Take Up Idler PU-51402A	145p
Take Clutch PU-55373	225p
Idler Arm PU-55374-3-8	285p
Fast Forward Idl PU-45896C	210p

National

Idler	300p

SERVICE AIDS

SERVISOL PRODUCTS

V. Head Cleaner	100p
Switch Cleaner	115p
Silicone Grease	135p
Freeze It	125p
Foam Cleaner	120p
Anti-Static	120p
Aeroklean	100p
Aero Duster	125p
Plastic Seal	115p

★ UNIVERSAL TRIPLERS 500p ★

★ SONY on/off SWITCHES 250p ★

VIDEO LAMPS

UNIVERSAL VIDEO LAMP 30p
12V 60mA (300mm Wires)
RED OR BLUE

VIDEO LAMP FOR PANASONIC 60p

FLOPPY DISCS

5¼ inch DSDD (10 in box) Branded Name	£12.50
5¼ inch DSDD (bulk pack) 25	£10.00
3½ inch DSDD (10 in box) Branded Name	£21.00
3 inch CF2 Branded Name	£2.40
3 inch CF2D Branded Name	£3.00

ELECTROLYTIC CAPACITORS RADIAL LEAD

10 Volts	
22 MF	15p
47 MF	15p
100 MF	18p
220 MF	18p
470 MF	25p
1000 MF	35p

16 Volts	
10 MF	15p
22 MF	15p
47 MF	15p
100 MF	18p
220 MF	18p
470 MF	25p
1000 MF	50p
2200 MF	60p
4700 MF	110p

25 Volts	
10 MF	15p
22 MF	15p
47 MF	15p
100 MF	18p
220 MF	18p
470 MF	25p
1000 MF	50p
2200 MF	70p

35 Volts	
10 MF	15p
22 MF	15p
47 MF	15p
100 MF	20p
220 MF	25p
470 MF	30p
1000 MF	60p
2200 MF	100p

40 Volts	
10 MF	15p
15 MF	15p
22 MF	15p
47 MF	20p
100 MF	25p
220 MF	30p
470 MF	35p
1000 MF	50p
2200 MF	190p

50 Volts	
1 MF	15p
2.2 MF	15p
4.7 MF	15p
10 MF	20p
22 MF	25p

63 Volts	
0.47 MF	15p
1.0 MF	15p
2.2 MF	15p
4.7 MF	15p
10 MF	15p
22 MF	20p
47 MF	25p
100 MF	30p
220 MF	35p
470 MF	50p
1000 MF	100p

100 Volts	
0.47 MF	15p
1.0 MF	15p
2.2 MF	15p
4.7 MF	15p
10 MF	15p

ELECTROLYTIC CAPACITORS

AXIAL LEAD

16 VOLTS	
47 MF	25p
100 MF	30p
220 MF	35p
470 MF	45p
1000 MF	60p
2200 MF	120p
4700 MF	160p

10 VOLTS	
470 MF	40p
1000 MF	50p
2200 MF	70p

25 VOLTS	
22 MF	25p
47 MF	35p
100 MF	35p
220 MF	40p
470 MF	45p
1000 MF	70p
2200 MF	125p

35 VOLTS	
10 MF	25p
22 MF	25p
47 MF	30p
100 MF	35p
220 MF	40p
470 MF	90p
1000 MF	110p
2200 MF	160p

40 VOLTS	
10 MF	25p
22 MF	30p
47 MF	35p
100 MF	40p
220 MF	50p
470 MF	60p
1000 MF	100p
2200 MF	160p

63 VOLTS	
1.0 MF	25p
2.2 MF	25p
4.7 MF	25p
10 MF	30p
22 MF	35p
47 MF	40p
100 MF	50p
220 MF	60p
470 MF	100p
1000 MF	160p

100 VOLTS	
1.0 MF	25p
2.2 MF	25p
4.7 MF	30p
10 MF	35p
22 MF	35p
47 MF	40p

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ANTEX XS25W 240V Soldering Iron 240Vac	540p
Spare Element for XS25W 240V	260p
ANTEX C15W 240V Soldering Iron 240Vcm	540p
Spare Element for C15W 240V	260p

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SOLDER MOP 65p

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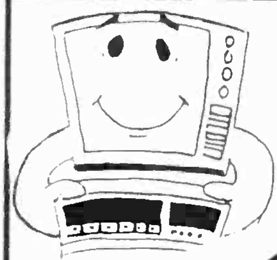

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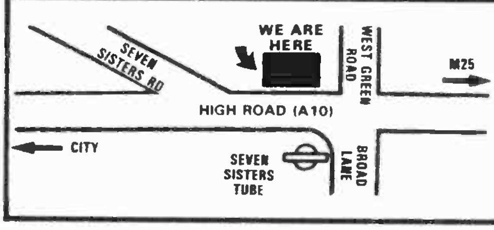

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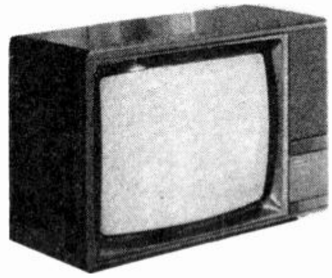

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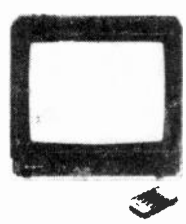

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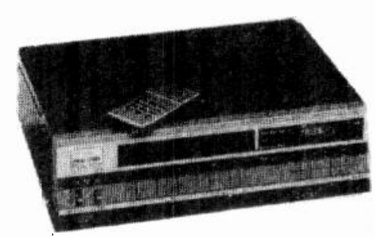

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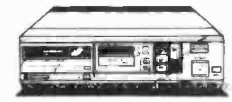

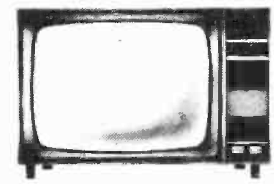

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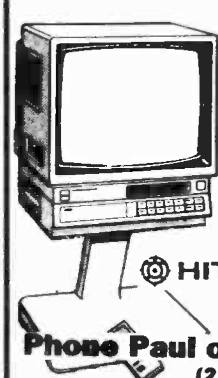

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NV333/366 Idler Arm (VXL0997)	£3.10
NV8400/8600/8610/8620 (VXP0245)	£0.70
NV333/366 etc. (VXP0401) NV700/7200/7800 (VXP0344) NV2000/3000 (VXP0331) (VXP0329)	£0.70
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Sony

SLC5/7 Rewind Kit	£4.20

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Reel Motors

Sanyo VTC5000/5150/5300/5400/6500	£7.90
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Ferguson 3V29/30 JVC HR7200/300. Gen.	£22.70

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Thorn 1690, 1691, 1694, 1615	£7.10

All Sony. Please ask for quotation.

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BC238	£0.07	BU326A	£0.75
BC308B	£0.07	BU407	£0.50
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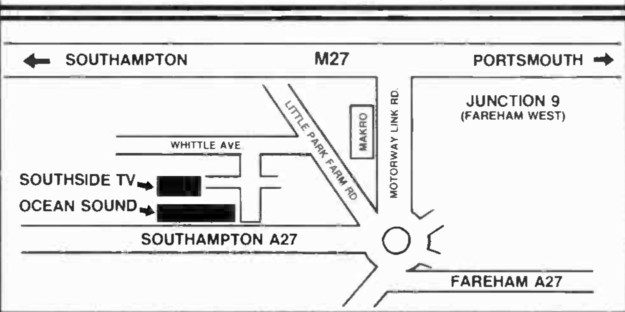

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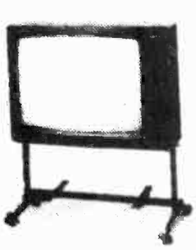

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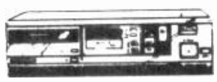

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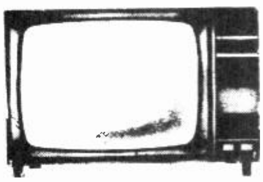

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AN214	100p
AN253	100p
AN262	150p
AN272	500p
AN301	350p
AN302	350p
AN303	275p
AN315	225p
AN318	495p
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AN612	175p
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AN5440	225p
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AN5612	450p
AN5712	375p
AN5720	150p
AN5722	160p
AN5730	175p
AN5732	175p
AN5738	125p
AN5900	150p
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AN6249	125p
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AN7110	150p
AN7116	150p
AN7117	100p
AN7118	150p
AN7130	130p
AN7140	225p
AN7143	295p
AN7145	250p
AN7146	250p
AN7156	275p
AN7161	325p
AN7168	295p
AN7213	150p
AN7218	125p
AN7220	175p
AN7222	350p
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HA1199	100p
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HA1368	100p
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STR50103	595p
HA1350S	500p
HA1370	375p
HA1372	350p
HA1374	250p
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HA1397	275p
HA1398	200p
HA13001	199p
LA4220	150p
LA4230	200p
LA4420	160p
LA4422	150p
LA4430	150p
LA4440	250p
LA4445	275p
LA4460	100p
LA4461	100p
LA4500	250p
LA4505	200p
LA4507	400p
LA4508	200p
LA4520	250p
LA7800	195p
TA7205AP	100p
TA7207P	100p
TA7208P	170p
TA7214P	200p
TA7215P	250p
TA7271P	160p
TA7220P	250p
TA7222AP	140p
TA7223P	230p
TA7225P	340p
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TA7232P	290p
TA7233P	290p
TA7240AP	290p
TA7241AP	290p
TA7269P	550p
TA7270P	275p
TA7271P	275p
TA7272P	300p
TA7273P	325p
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TA7280P	375p
MB3705	100p
MB3712	150p
MB3713	160p
MB3714	300p
MB3722	350p
MB3730	250p
MB3731	350p
M51102L	375p
M51104L	375p
M51516L	200p
M51517L	200p
STK011	395p
STK014	725p
STK015	550p
STK016	850p
STK020	575p
STK025	750p

STK043	1000p
STK080	750p
STK082	750p
STK084	800p
STK430	550p
STK431	600p
STK433	525p
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STK436	525p
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STK439	600p
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STK443	775p
STK457	625p
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STK461	750p
STK463	825p
STK465	825p
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STK0080	750p
STK1060	800p
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STK2028	750p
STK2029	550p
STK2129	675p
STK2230	650p
STK2240	950p
STK2250	950p
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STK3042	650p
STK3044	650p
STK3062II	650p
STK4026	650p
STK4060	650p
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STK4141II	700p
STK4151	700p
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STR380	575p
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UPC1182H	150p
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TDA2005	250p
TDA2006	175p

TDA2020	160p
TDA2030	160p
TDA2170	300p
TDA2571	450p
TDA2593	300p
TDA2581	199p
TDA2600	575p
TDA2653A	400p
TDA3505	550p
TDA3540	400p
TDA3541	400p
TDA3560	325p
TDA3561A	300p
TDA3562A	300p
TDA3650	325p
TDA3652	225p
TDA4420	400p
TDA4500	495p
TDA4600	300p
TDA7270	295p

TRANSISTORS

2SA-473	40p
2SA-489	55p
2SA-490	60p
2SA-495	45p
2SA-496	45p
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2SA-673	20p
2SA-677	60p
2SA-683	25p
2SA-684	40p
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2SA-733	20p
2SA-748	100p
2SA-765	300p
2SA-769	150p
2SA-771	150p
2SA-794	60p
2SA-798	60p
2SA-808	150p
2SA-817	25p
2SA-844	15p
2SA-850	30p
2SA-893	30p
2SA-896	35p
2SA-916	30p
2SA-921	10p
2SA-940	50p
2SA-950	25p
2SA-958	75p
2SA-968	75p
2SA-985	65p
2SA-992	30p
2SA-1048	20p
2SA-1060	150p
2SA-1062	120p
2SA-1094	190p
2SA-1102	190p
2SA-1104	285p
2SA-1106	200p
2SA-1110	45p
2SA-1142	290p
2SA-1145	60p
2SA-1147	190p
2SA-1156	60p
2SB-545	150p
2SB-546	100p
2SB-548	40p
2SB-555	150p

2SB-556	150p
2SB-557	225p
2SB-560	40p
2SB-562	40p
2SB-566	120p
2SB-568	40p
2SB-595	80p
2SB-596	85p
2SB-647	40p
2SB-648	65p
2SB-649	65p
2SB-681	250p
2SB-688	125p
2SB-705	250p
2SB-716	40p
2SB-717	70p
2SB-718	80p
2SB-757	130p
2SB-772	50p
2SB-837	60p
2SB-857	60p
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2SC-372	15p
2SC-380	25p
2SC-458	20p
2SC-460	10p
2SC-495	65p
2SC-496	80p
2SC-497	150p
2SC-536	20p
2SC-644	30p
2SC-681	195p
2SC-693	100p
2SC-710	25p
2SC-717	45p
2SC-733	30p
2SC-738	30p
2SC-741	195p
2SC-783	110p
2SC-789	50p
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2SC-828	25p
2SC-829	25p
2SC-839	30p
2SC-929	20p
2SC-930	20p
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2SC-945	20p
2SC-959	65p
2SC-998	60p
2SC-1012	90p
2SC-1018	90p
2SC-1030	220p
2SC-1050	320p
2SC-1060	90p
2SC-1061	90p
2SC-1096	75p
2SC-1106	210p
2SC-1115	290p
2SC-1116	290p
2SC-1162	40p
2SC-1172	190p
2SC-1173	50p
2SC-1195	250p

2SC-1212	60p
2SC-1213	65p
2SC-1214	45p
2SC-1222	35p
2SC-1226	80p
2SC-1317	25p
2SC-1318	30p
2SC-1327	25p
2SC-1328	25p
2SC-1345	30p
2SC-1368	40p
2SC-1383	40p
2SC-1384	40p
2SC-1403	150p
2SC-1413	300p
2SC-1445	125p
2SC-1446	75p
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2SC-1567	60p
2SC-1568	60p
2SC-1577	770p
2SC-1550	60p
2SC-1514	75p
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2SC-1815	15p
2SC-1819	75p
2SC-1845	20p
2SC-1875	240p
2SC-1890	20p
2SC-1906	35p
2SC-1913	100p
2SC-1914	30p
2SC-1922	250p
2SC-1941	65p
2SC-1942	270p
2SC-1986	60p
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2SC-2022	60p
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2SC-2240	25p
2SC-2274	30p
2SC-2278	75p
2SC-2275	80p
2SC-2320	25p
2SC-2335	125p
2SC-2371	60p
2SC-2427	80p
2SC-2482	50p
2SC-2501	65p
2SC-2502	90p

2SC-2537	450p
2SC-2546	20p
2SC-2550	75p
2SC-2555	175p
2SC-2564	250p
2SC-2565	200p
2SC-2575	25p
2SC-2557	125p
2SC-2579	130p
2SC-2611	50p
2SC-2551	200p
2SC-2944	150p
2SC-3078	40p
2SC-3182	250p
2SC-3284	150p
2SC-3298	150p
2SC-3506	230p
2SC-3519	150p
2SC-8050	25p
2SD-198	200p
2SD-200	310p
2SD-235	40p
2SD-288	80p
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2SD-313	40p
2SD-315	75p
2SD-325	45p
2SD-352	50p
2SD-357	40p
2SD-358	40p
2SD-381	90p
2SD-386	80p
2SD-388	100p
2SD-389	100p
2SD-400	20p
2SD-401	50p
2SD-426	150p
2SD-428	150p
2SD-438	50p
2SD-468	30p
2SD-476	60p
2SD-478	100p
2SD-525	75p
2SD-526	75p
2SD-600	90p
2SD-612	40p
2SD-613	100p
2SD-669	45p
2SD-716	125p
2SD-718	125p
2SD-733	230p
2SD-745	250p
2SD-748	150p
2SD-761	50p
2SD-8228	450p
2SD-837	95p
2SD-838K	475p
2SD-845	275p
2SD-850	260p
2SD-859	100p
2SD-869	320p
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COPY DEADLINE FOR AUGUST ISSUE PUBLISHED JULY IS: 21st JUNE '89

MAIL ORDER ADVERTISING

British Code of Advertising Practice
Advertisements in this publication are required to conform to the British Code of Advertising Practice. In respect of mail order advertisements where money is paid in advance, the code requires advertisers to fulfil orders within 28 days, unless a longer delivery period is stated. Where goods are returned undamaged within seven days, the purchaser's money must be refunded. Please retain proof of postage/despatch as this may be needed.

Mail Order Protection Scheme
If you order goods as a private individual from Mail Order advertisements in this magazine and pay by post in advance of delivery, Television will consider you for compensation if the Advertiser should become bankrupt or go into liquidation provided:

(1) You have not received the goods or had your money returned; and

(2) You write to the Publisher of Television summarising the situation not earlier than 28 days from the official on sale date of the publication and not later than three months from that date. (Please retain proof of payment).

Please do not wait until the last moment to inform us. When you write, we will tell you how to make your claim and what evidence of payment is required.

We guarantee to meet claims from readers made in accordance with the above procedure as soon as possible after the Advertiser has become subject to bankruptcy proceedings or gone into liquidation up to a limit of £4,050 per annum for any one Advertiser so affected and up to £12,150 per annum in respect of all advertisers.*

This guarantee covers only advance payment sent in direct response to an advertisement in this magazine (not, for example, payment made in response to catalogues etc., received as a result of answering such advertisements. All display advertisements are covered but only boxed trader classified advertisements are included. Advertisements as loose inserts are not covered.

INDEX TO ADVERTISERS

Hill Intercom £10

Philips small stereo headphones £2.50

Rank UHF 4 push button tuner £4

GRC power supply PC743B £10

Rank front panel Z950 £5

GEC IF tuner panel PC786B £12.50

Rank IF 742 £3

TX10 8 Button Unit £10

6 Button Unit Rediffusion Mark 3 £5

Rediffusion Mark 4 & 7 Push Button unit £10

Tuner IF Cans ITT CMR200 £10

ITT SEL HF Modul 2 UK IF Tuner £8

4 types of front panels Fidelity 2000/3000 types £5

CVC20, CVC32 I.F. CVC40 Cans £5
CMR800/3 NEW £20

CMR800/3 £20
CMR803/2 £20

20AX Line lin coil 50p

GEC switch mode trans 20AX
ITT mains CVC9 to CVC33 print type 60p

ITT 2,800 mains remote switch 50p

NEW

2110 GEC Sound O/P Panel £1

2110 GEC L O.P.T. Panel £6

2110 GEC Power Panel £5

Line o/p frame panels GEC 20AX £10.00

ITT CVC40 Push Button Unit & Mains Switch £12

Tuner & IF Panel. Complete 6 button and preset IF with s/wave filter and tuner. Mullard M342 5"×6½" £6.00

POTS

BA 301 £1
TA 4127 £1
HD 3884 2A23 £3
TA 4184 £1
TA 2125 £1
TA 4190 £1
TA 4138 £1
TA 4196 £1
TA 4174 £1
TA 4139 £1
TA 4198 £1
TA 4167 £1
TA 4199 £1
BA 546 £1
BA 328 £1
TA 4176 £1
TA 4145 £1
TA 4191 £1
HA 11710 £1
TA 4188 £1
TA 4197 £1
TA 4183 £1
TA 4197 £1
TA 4183 £1
TA 4195 £1
TA 4175 £1
TA 4177 £1
TA 4192 £1
TA 4146 £1
TA 7265 £3
TA 7699P £3

The Service Engineers Guide to Teletex £2

4 Types Fedility front panels with i.c. & pats £2 each

BB 103 10p
BB 105A×12 £1
BB 105B×12 £1
BB 105G×12 £1
BB 121a 10p
47 10p each

1A/1600V 10p

DG3P EQV-BY228 10 for £1

2 amp bridge rec. wire end 15p

SKE4G2/02 Eqv. BYX71/600 500ns. 15p

CV 8617 10p
Y 716 10p
Y 729 30p
Y 730 10p
Y 827: 6A/1KV 20p
Y 860 30p
Y 933 5p
Y 969 50p
Y 997 30p
Min 12 volt Relays 75p
R 1038 40p
R 1039 40p
R 2009 80p
R 2010b £1
R 2029 50p
R 2210 60p
R 2257 60p
R 2265 50p
R 2305 50p
R 2306 30p
R 2322/2323 pair 80p
R 2323 15p
R 2396 50p
R 2461 80p
R 2030 50p
R 2443=BD124 30p
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R 2738=TIP41 30p
R 2775=TIP41c 40p
R 3129=TIP47 40p
R 4050 £1.00
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2SC1942 £1
Hitachi sets etc.
STR454 £2
STR6020 £2
S 2000AF line o.p. £1
2SC940 £1
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BU 126 80p
BU 180a 65p
BU 204 60p
BU 205 75p
BU 206 £1
BU 207 £1
BU 208 80p
BU 208A 75p
BU 208D 90p
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BU 326 £1
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BU 426A 45p
BU 426V 60p
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BU 500D £1
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ZTX 109k 5p
ZTX 213 5p
ZTX 341 10p
ZTX 342 10p
ZTX 384 10p
ZTX 451 10p
ZTX 550 10p
MJ 2253 60p
MJE 3040 60p
MJE 2209 10p
SP 8385 50p
SAB 3205 £1.00
SAB 4209 £1.00
300M + 700 320V £1.80
200 + 100 + 100 + 50 300V 50p
150 + 200 + 250M 300V 50p

Computer Transformer 20v/2.25A; 20v/1.5A; 17/.5A; 19/.5A; 28/.05A £3

OLD TYPE TEX. I.C.
TX004F £3.50
TX005GN £3.00
TX904 £3.00
X908 £4.00
MM2102AN £2.00

Voltage Regulators
+5V/UA78PO5SC 30p
−8V/79M08c 30p
+6V/78M06c 30p
+10v/78LA10 20p
LM 317T 30p
LM 337 30p
LM 342/18 30p
LM 340T 5.0 50p
+12V/LM 340T12 50p
+18V/MC78M18 20p
+24V/78M24 30p
MC 7724cp 40p
MC 7824 40p

TIS 90 10p
TIS 92 20p
TIS 93 20p

U 19885 40p
U 3832 15p
U 3845 15p
MR 508 10p
MR 501 10p
MR 502 10p
BCW 71R 30p
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BYF 1204 10p
BYF 3126 40p
BYF 3214 40p
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BYX 38/300 25p
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BYX 55/350 10p
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BYX 71/600 50p
BYX 72/300 20p
BYX 36/600 50p
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BVY 95C 12p
BYV 96D 10p
BYZ 106 10p
BPW 41 15p
BYW 56 2A/1000v G11 8p
BYW 29/50 15p
BYW 95C 10p
BZU 15/24 54p
BZY 93c75 50p
BZV 15/18 30p
BZV 15/30 30p
BZW 70c6v2 10p
BZX 79.3v 10p

Bush thyristor RCA 76122 £1
Transformer 240v/20v-500Ma 75p
Chassis type Transformer 240v/12 Volts 500m/a 75p
CVC 20 tube base £2
Tube Base Rank & G11 £1.20

Infra red led LD57CA 15p
15K-20 turn pots 20p
Thorn 3500 2A cut out 50p

BBH/SAFETY MAINS ISOLATING TRANSFORMER
250V-250V/A £10

BRIDGES
KBL 005 30p
KBL 02 30p
KBP 04 30p
W02 15p
W004 15p
W005 20p
800V Bridges 2½ Amp 30p

MAINS MICRO SWITCH
GEC & Double etc. £1

Varta Batteries 2.4V 100M/A 50p

TV Battery 1.2V NC. 2.4V NC. 50p each

4 amp-1.2V Nickel Cadmium Battery D Cell £1.00

3.25V Battery 50p
12V Video Battery Packs 4Amp U2 Cells £10

24V 4Amp (100VA) Trans £4.00

Mains 240V (100VA) to 240V out fully shrouded £5.00

ITT CVC45 8 way resistor unit for v/cap £3

CVC40 8 button unit with mains lead & slider pots with sockets £10.00

Book on An Introduction to Satellite TV £5.95 No VAT

Book TV DX Handbook by R. Bunny £5.95 No VAT

Electronics Hobbyists Handbook £4.95 No VAT
Hills £4.50

NI.CD 5 Hours Battery Charger with battery test £6

Hill Deluxe Universal Ni-Cad Charger £6

Nickel Cadmium Battery Charger AA-C-D-PP9 £4.50

12 Volt Aerial Changer over Relays 144 Mc/s 45 watts 50p

6 Push Button Unit for GEC 2100 Series Replacement for Touch Button Unit £8

8 SEG LED Display with driver I.C. LM1017 50p

PHILIPS' MIN. HEAD PHONES £1.50

Electronic Buzzer 6 volt, 12 volt 40p

15V, 015V, 1A Print Type Trans £1

12v DC Relay 1½×1½×2 print type 10 amp D.P. Changeover £1

Regulated Power Supply 3-12 volts 1 amp in box with switch and mains lead £4

Philips' Video Cleaning Cassette SBC461 £6

Philips' Headphones Compact Disc Stereo Type £10

ITT Display Tube 58705 50p

8 Seg Display FND500 20p

Model 3000 Pocket Personal D.M.M. Volts range AC, DC 200M/V to 400V. Res. 2000Km £20

Export PYE731 6 Push Button unit with (UHF-VHF) band switch £4

ITT Micro Phone M5 50p with switch

1½ Volt Sub Min Relays 25p

Philips Solar Scientific SBC1730 Calculator £12

15v-0-15v 1 Amp Transformers £1

RGP30K 10p
RGP30G 8p
RGP10B 5p
RGP15 10p
RGP15G 6p
T6024WG1 10p
GP10 5p
GP15Q 5p

THORN RGP80G 30p
DUBLE 7 SEG Displays 15p
LN5 26RA or 10 for £1

Multi Core £4.50
60-40 Soldar 500G 20 SWG £5.00
15 Watt Stereo Amp Sanyo Module with Data 50p
PHILIPS
25 Watt Solder Iron £4.00

Various Tools and Accessories

Self adjusting cutter stripper £5.00
10 mixed tube bars £4.00
5000 Diodes-Resistors £3 pack
T/V V/Aerial 300Ω or 75Ω £1.50
• D/P push mains switch 20p each
Mains lead & two pin socket for radio cassette 35p
T/V loop aerial 75p
Radio Telescopic Aerial £1.00
Philips Neon Lamps for TV sets 5p
Freeze Philips £1.20
Foam Cleaner Philips £1.20
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Cans of Anti Static, Degrease Cleaner and Anti Corona All at £1.40
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Red E.H.T. LAED and Anode Cap £1.00
Weller solder iron 25 watt £4.00
Hitachi Silver Oxide Battery G13 UCC357 IEC SR44 1.5V 60p
100 Coax Plugs £12.00
De-solder pump + 2 nozzels Philips £4.00
Flat Red LED and Green 5p
500gm 60/40 solder reel £6
Solder 1 kilo reel £5.50
Dual v/u meter -20 - +10db £1
K30 thermistor 232266298009 75p
De-solder Pump £2.50
Portasol Flameless Gas Soldering Iron £16.00
Green & Red, LED pack mixed 100 for £1.00
Hill Meter Leads, S/Rubber and Probes £4.00

HILLS
Miniature Linesman Pliers £2.20
Miniature Side Cutters £2.20
Miniature Pliers £2.20
Miniature End Cutters £2.20

KT3 PANELS
Sound Output RGB Output Chroma Panel, I.F. Panel and Line OSC £7.00 each

PYE 6 Key Switch & Panel G11 Front Panel £10

SONY 1400KV Chroma Panel £6
SONY 1400KV Touch button unit £3.50

GEC Decoder Panel PC772A3 PC446A5 £6

12 Volt Mains Trans 500M/A £1.00

Double 1.5 Digital Display. High brightness 20p

Quantity Reductions
BY204/4 25 for £1.00
BY206 25 for £1.00
KT3 touch button black 6 for £1
G11 touch button red 6 for £1
K30 full remote Dawer Ass with 3 I.C. £7.00
K30 VHF. UHF Dawer Ass £6.00
BY298 3 amp/fast/R 20 for £1.50
BU126 10 for £6.00
BU205 10 for £8.00
BU105 10 for £6.00
BF458 10 for £1.00
BF224 20 for £1.40
OA90 40 for £1.00
50 Ceramic Condensers £1.50
Mixed Mounting Kit for Power Transistors 50p
300 Condensers £1.50
300 Resistors £1.50
150 Electrolytics £2.00
15 Bulbs Philips 40p
GEC-Hitachi Thick Film Frame £5

100 Fuses £2.00
100 W/W Res. £1.50
BF 199 20 for £1
10 × 20 Turn 100k pots. Rank £2
BF 470 20 for £2

6 Mixed UHF Aerial Isolating Sockets, some with long leads. Fit ITT, GEC, Philips, Pye £1.00

Mixed Packs
TO66 12 Power Trans RCA 16182 NPN Replacement for BD124 and Mounting Kits £1.00
25 Panel Mount Bulbs & Neons £1.50
10A £1.50
25 LED red/yellow/green £1.50
20I/C Holders £1.20
20 Large LED Red £1.00
20 Small LED Red £1.00
10×20 Turn 100K Pots £1.00

Red & Green LED on Panel 1p each

Mixed 100 Transistor B.F. and B.C. and PET £1.50 1000 for £10.00

12 Volt 4 Amp Video Battery Pack 10 of Type D Cells £8.50

40 glass reed switch £1
10 press to make switch 70p
40 Pots £1.50
With Focus Pin, 10 Tube Bases, mixed £2.00
1,000 Diodes, Condensers, Resistors on Bandolier £1.00
20mm Fuse Holders
Chassis Mount 20 for £1
EHT Diodes, small 20 for £1

300 Mixed Diodes £2

100 500M/A Fuse £1
Mixed V/Cap Pots ITT-GEC-Hitachi-Philips etc. 20 for £1
ITT Mains Switch with Remont CMC113 £1

12v DC relay 1½×1½×2 print type 10 amp D.P. change over £1

SENDZ COMPONENTS
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