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TELEVISION

March 1985

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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.

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ITT44	0.04	TIP3055	0.60	2SC2078	1.05
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ME0402	0.20	TIS88	0.40	2SC2098	2.90
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MEU21	0.60	TIS91	0.28	2SC2166	1.20
MJ400	1.25	ZTX108	0.12	2SC2314	0.80
MJ2955	0.90	ZTX109	0.12	2SC2335	1.50
MJ3000	1.98	ZTX212	0.28	2SC2371	0.90
MJE240	0.60	IN4001	0.05	2SC2749	2.70
MJE340	0.54	IN4003	0.05	2SC2752	0.60
MJE370	0.88	IN4004	0.06	2SD234	0.64
MJE520	0.48	IN4006	0.07	2SD348	3.30
MJE2955	0.99	IN4007	0.07	2SD986	0.62
MJE3055	0.70	IN4148	0.05	2SJ50	5.20
MPSLO1	0.28	IN5400	0.12	2SK134	3.80
MRF475	2.50	IN5402	0.15	2SK135	4.60
MRF479	5.20	IN5405	0.16	3N126	1.90
MRP477	10.00	IN5406	0.18	3N211	2.52
OA47	0.10	IN5408	0.20	3SK45	0.76
OA90	0.08	IS920	0.08	3SK88	0.66
OA91	0.09	2N697	0.55	3SK135	5.20
OA95	0.18	2N706A	0.33		
OA200	0.06	2N2904	0.28		
OA202	0.15	2N2906	0.24		
OC25	2.10	2N2926G	0.10		
OC26	1.70	2N3053	0.40		
OC28	1.50	2N3054	0.56		
OC29	2.47	2N3055	0.45		
OC35	1.75	2N3702	0.10		
OC36	1.75	2N3704	0.10		
OC42	0.72	2N3708	0.10		
OC42K	1.40	2N3772	1.90		
OC44	0.72	2N3773	2.70		
OC45	0.58	2N3904	0.16		
OC71	0.50	2N3906	0.16		
OC72	0.52	2N5294	0.48		
OC81	0.68	2N6107	0.71		
OC200	2.46	2N6126	0.68		
OC202	2.20	2SB337	1.60		
ORP12	0.85	2SC495	0.65		
R2008B	1.50	2SC1172Y	2.90		
R2010B	1.52	2SC1173Y	0.82		
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TAG3/400	1.78	2SC1279	0.50		
TIC44	0.40	2SC1306	0.92		
TIC45	0.45	2SC1307	1.40		
TIC46	0.48	2SC1413A	2.70		
TIC47	0.70	2SC1444	1.45		

I.C. SOCKETS

Dil to Dil

8 pin 0.08 0.70/10
14 pin 0.10 0.95/10
16 pin 0.11 1.00/10
22 pin 0.21 1.95/10
28 pin 0.30 2.75/10
40 pin 0.34 3.10/10

CAPACITORS

Metallised Paper

2n2F 600V AC 24p
10nF 1000V DC 22p
10nF 500V AC 80p
15nF 300V AC 30p
22nF 300V AC 32p
100nF 1000V DC 46p
470nF1000V DC 60p

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1kV 1.5nF 18p
8kV 10, 47, 56, 82, 100, 120, 150, 180, 200, 220pF 30p
270, 300pF 39p

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400mW Plastic 3V–75V **8p each. 10/75p.**
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CA3065	1.75	SN76533N	1.60
CA4031P	2.88	SN76650N	1.05
CA4102	3.30	SN76660N	0.75
CA4250	3.50	SN76666N	0.80
CA4400	2.98	STK015	6.50
CA4422	3.07	TA7108P	3.20
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LC7130	5.26	TA7129AP	3.65
LC7137	5.16	TA7130P	1.65
LM380N	1.65	TA7172	1.80
LM1303N	2.52	TA7193	5.50
HA1151P	3.12	TA7172P	1.80
MC1307P	1.85	TA7176	2.50
MC1310P	1.85	TA7202P	4.18
MC1312P	2.25	TA7204P	1.86
MC1327P	1.25	TA7205AP	1.50
MC1330P	0.83	TA7208P	3.27
MC1349P	1.85	TA7210P	6.50
MC1350P	1.20	TA7222P	2.12
MC1351P	2.50	TA7223P	3.68
MC1352P	1.50	TA7227P	5.60
MC1357P	2.88	TA7310P	1.80
MC1358P	1.30	TA7609P	4.28
MC1496L	1.15	TA7611AP	2.88
ML231B	2.10	TAA263	2.46
ML232B	2.10	TAA310A	2.68
ML237B	2.30	TAA550	0.50
MRF475	2.50	TAA570	1.99
MRF479	5.20	TAA611A12	3.50
MRP477	10.00	TAA630S	3.90
NE555	0.50	TAA661B	1.70
C-mos 555	0.88	TAA700	2.80
NE556	0.80	TAA840	3.38
SAA1024	5.35	TAD100	2.80
SAA1025	8.40	FM FILTER	1.20
SAS560A	2.50	TBA120 AS,	
SAS560S	1.85	S,SA,SB	1.30
SAS570S	1.85	Q,T,U,UQ	1.32
SAS580	2.85	TBA120B	1.30
SAS590	2.82	TBA231	1.45
SC9503P	1.10	TBA281	2.65
SL432A	4.00	TBA395	1.20
SL901B	5.20	TBA480Q	1.50
SL917B	7.25	TBA400	2.30
SL1327Q	1.10	TBA510	2.60
SN76003N	2.44	TBA510Q	2.60
SN76013N	1.90	TBA520/Q	1.60
SN76023ND	2.90	TBA530/Q	1.30
SN76033N	2.45	TBA540/Q	1.40
SN76110N	1.12	TBA550/Q	1.52
SN76115N	2.00	TBA560C	1.70
SN76131N	1.65	TBA560CQ	1.60

TBA570	1.50	UPC1181H	1.60
TBA641BX1	4.50	UPC1185H2	3.75
TBA673	2.40	UPC1212C	1.30
TBA700	2.85	UPC1228H	0.54
TBA750	2.80	UPC1230H	3.90
TBA800	1.60	UPC1350C	4.25
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TDA1003A	5.50		
TDA1006A	2.40		
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TDA2020	4.60		
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TDA2140	5.90		
TDA2521	4.10		
TDA2523	3.50		
TDA2530	2.70		
TDA2540	3.80		
TDA2541	3.80		
TDA2560	3.50		
TDA2571A	2.50		
TDA2581	3.20		
TDA2590	3.20		
TDA2591	2.98		
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TDA2610	3.20		
TDA2611A	1.94		
TDA2640	2.90		
TDA2680	3.40		
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UPC566H	2.95		
UPC575C2	3.20		
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UPC1025H	2.90		
UPC1032H	0.90		
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D CONNECTORS

	9 way	15 way	25 way
Male			
Solder	.75	1.00	1.50
Angle	1.40	2.00	2.40
Female			
Solder	1.00	1.45	1.85
Angle	1.50	2.00	2.40
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Metal Co-ax Plug 0.18
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Metal Line Socket 0.50
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F.M. Plugs 0.20
PL259 Plugs 0.38
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Soldering Station complete with 30W or 40W Iron (state which) 49.95
XS25 Watt Iron complete with steel and plug attached 7.20
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Antex 18W iron 5.00
Antex 25W iron 5.20
Antex elements 2.00
Antex bits 0.95
Antex stands 1.90
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Nozzles 0.65

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2 amp 12 way 0.19
5 amp 12 way 0.20
10 amp 12 way 0.40
15 amp 12 way 0.46
32 amp 12 way 0.90

SONY TV & VIDEO SPARES

Rewind Kits	SLC5-SLC7	A-670-634-8A	4.50
	SLC6	A-670-639-1A	3.50
Video Heads	SLC6-SLC7	A-676-203-8A	40.25
	SLC5	A-676-204-4A	45.60
Motor Kit		X-354-931-41	13.45
Idler Assembly		X-365-331-50	0.95
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	9000	400/400V	2.25
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GEC	2047	2048 2083 2084 2104	
		200+200+150+50/300V	2.32
		600/250V	1.50
ITT/KB		200+200+75+25/350V	2.15
		220/100V	1.95
PHILIPS	G8	600/300V	1.70
	G8 G9	600/300V	1.50
	G11	470/250V	1.50
	G9	2200/63V	1.26
EKCO	T148	125+200+100+32/275V	2.65
	691 Series	200+300/350V	2.15
		600/300V	1.80
RANK		300+300/300V	2.05
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VA1026 0.79
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VA1055s/56s/66s/ 67s all 0.23
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TELEVISION

Tomorrow's Sets

The CTV market has been in an odd state recently, with sales of small-screen sets doing well as the affluent apparently install one in every room while large-screen sets move much more slowly. In fact the traditional family, living room set market has been very flat of late. There was a period a year or so back when first generation colour sets were being replaced in large numbers. Now most people seem to be viewing fairly recent and very reliable sets. So it won't be long before the market requires a boost of some sort.

The setmakers are aware of this of course. So are their suppliers, particularly the i.c. manufacturers. What are they likely to come up with? We have reported in the past on the ITT approach – digital TV (Digivision) with the video and sound signals converted to digital form for processing then converted back to analogue form to drive the tube and loudspeaker, the timebase waveforms also being generated and processed in digital form. Doing all this under the control of a microcomputer chip enables precise control of a set's performance to be achieved and maintained. There is also much scope for future development along this path, with features such as still pictures and picture within a picture being added. More recently, Mullard have issued detailed information on how they see the next generation of TV sets, from basic models to more complex sets that are capable of very high performance standards, incorporate many new features and are compatible with a variety of signal sources – in short, the type of set to get sales moving again.

The Mullard information lists a whole mass of new i.c.s for TV use, able to do all sorts of things to exploit the possibilities of TV reception and signal processing. The basic approach is evolutionary, so that the market for more sophisticated sets can be opened up gradually as the public becomes aware of the possibilities and can be persuaded to pay for them. More complex models will employ a microcomputer i.c. to provide central control of all functions, linked to the various signal processing i.c.s by a simple two-conductor bus line. Digital techniques are used for some of the more complex processing. Many operations can be carried out perfectly satisfactorily with the signal in analogue form however, and Mullard see no point in going through A-D and D-A conversion for the sake of it – for one thing it's wasteful in terms of power consumption. There is much that can be done to improve and update analogue signal processing, for example by using delay lines in CCD form and gyrators (active filters). As with the ITT approach, transferring adjustments at present carried out manually (linearity etc.) to computer control provides long-term performance stability. Setting up data is fed into the set during production and stored in a non-volatile memory (one that continues to hold its data when the power supply is removed). Feedback control can then be used to compare the actual operating conditions with the stored data and carry out any correction necessary.

A major advance in the possibilities for signal enhancement and modification is opened up by the use of a memory that holds a whole field of video information. Features made possible once such memory capacity is built into the set include reduced flicker, noise and cross-colour interference, faster teletext page access and, in the longer term, the introduction of new viewing facilities such as freeze frame, picture-in-picture and picture zoom.

One development that could be introduced quite soon in up-market models is improved chroma processing performance. The Mullard TDA4560 provides considerably improved picture quality by increasing the speed of chroma signal transitions to match the luminance signal transitions – in effect it compensates for the narrow chroma signal bandwidth. The TDA4560 operates with YUV instead of RGB signals, so it's preceded by a decoder chip (type TDA4510) that provides YUV outputs and is followed by a TDA3505 i.c. for RGB matrixing, d.c. control of contrast, brightness and colour and the insertion of external signals. The TDA3505 incorporates white point adjustment and beam limiting while the TDA4560 incorporates a variable luminance delay line in gyrator form so that the luminance and chrominance delays can be matched. Back to a three-chip decoder – but with very different chips and much improved performance.

A further decoder possibility is opened up by the TDA8450 which integrates all the delay lines and filters required in a PAL decoder – it uses profiled peristaltic charge-coupled devices (P^2CCDs) to perform time-discrete signal processing. With this technique the analogue signal is sampled, as in digital signal processing, but is not converted to digital form, saving on power consumption and the need for shielding.

The biggest changes will come with the introduction of field stores. The Mullard approach here is to use a serial memory in CCD form rather than a conventional RAM – the latter is appropriate for computer use but for video applications a serial memory provides better organistion, eliminating the need for memory address circuitry. The CCD designed by Mullard is basically a shift register with a very high bit density (approximately four times that of a dynamic RAM). It consists of seven SAA9000 i.c.s to give a storage capacity of 2·2Mbits and operates in conjunction with an SAA9020 field memory controller and SAA9010 picture enhancement processor. The SAA9010 incorporates noise reduction algorithms, a movement detector and cross-colour reduction circuitry. For teletext use two further i.c.s are added.

Only a few of Mullard's ideas have been touched on here. There's a great deal of scope for development in what for many years has been a rather static device, the domestic telly.

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PATTERN GENERATOR PCB

A PCB for the simple pattern generator in our January issue is available from Readers' PCB Services Ltd. (TV), Fleet House, Welbeck Street, Whitwell, Worksop, Notts at £5 inclusive.

CORRECTION

On page 212 last month (VCR Clinic) the second line above Fig. 1 should have read "the machine working normally: the voltage at the cathode of D814", i.e. not the anode of D814. Our apologies.

COVER PHOTO

How they do it, US style! Most of the broadcast transmitters for the greater Los Angeles area are at a single site, shown in this month's cover photo, atop Mount Wilson in the Angeles National Forest. The photo was provided by Moseley Associates, Inc. (Santa Barbara Research Park, 111 Castilian Drive, Goleta, California 93117) and was taken by Bert Weiner. Our thanks to them for permission to reproduce it here. Moseley Associates produce the microwave studio-transmitter links used by the vast majority of Mount Wilson based broadcasters. Careful receiver design in particular is required in the sort of conditions shown to prevent overloading while maintaining signal level and dynamic range.

Teletopics

GLUT

While sales of small-screen colour sets continue to do well, there's been a glut of large-screen sets and VCRs on the market recently. It's been estimated that Europe has excess production capacity of around a million large-screen sets a year at present, and in the UK there are substantial quantities of ex-rental sets on the market. One of the problems for setmakers is that large-screen tubes are produced in Europe while the smaller sizes are produced mainly in Japan – in addition you can't suddenly switch a highly automated assembly line from producing say TX10s to TX90s. On the video side, sales/rentals of VCRs fell from 2·2 million in 1983 to an estimated 1·5 million last year – the rental share of the market has fallen from a peak of around 70 per cent to around 35 per cent. Setmakers have been trying to maintain prices, but recent interest rate increases may make this difficult – stocks are costly to finance. Expect to see some bargains about.

The microcomputer market has also been going through a bad phase. Demand during the important Christmas period was well down on a year ago. Acorn and Sinclair have announced price cuts while a receiver has been called in at Oric and at computer distributor Prism.

CONTRASTING RESULTS

Thorn-EMI's poor results for the half year to the end of last September, with profits down 28 per cent, reflect mainly the difficulties in the Ferguson consumer electronics division which, caught in the situation described above, just about broke even and is not expected to make a profit for the full year. While Ferguson cut back large-screen set production early in the year stocks have remained high: good business with colour portables is reported, but price competition is severe in this sector of the market and margins are low. Thorn's rental operations have fared much better – in the first nine months an increased share of the market was obtained, with rental contracts advancing by 100,000 to 900,000.

Philips have reported good results for 1984, with profits up 55 per cent. This takes in the company's activities world wide of course: in the UK, trading profit declined. Philips UK's chairman and managing director Anton Poot commented that "the struggle for commercial survival in the UK is tough now and 1984 turned out to be a very difficult year".

Grundig's struggle to return to profitability is likely to lead to further job losses. The firm had over 38,000 employees in 1979 and the total is already down to 24,000. A further 5,000 jobs are expected to go. Grundig is now controlled by Philips.

Matsushita, which like Philips operates world wide, has reported a profit increase of 4·5 per cent last year on sales up 19·9 per cent to a record level. The main increases were in VCRs, office automation equipment and electronic components. VCR sales increased by 29 per cent.

SONY'S VIDEO EIGHT

Sony have opened up the 8mm video market in Japan with the introduction of a camcorder called the Video Eight. Production will initially be at around 20,000 a month, increasing by 50 per cent this summer, but there are no plans so far for launches in export markets. Those who saw the camcorder at its Tokyo launch are reported to have been impressed by the picture quality. The price is around £950 and the weight some 5lb including the batteries and cassette. Unlike the Beta Movie the Video Eight includes an electronic viewfinder that can be used for playback.

The cassettes, which Sony will be producing at the rate of a million a month, have playing times of 30, 60, 90 and 120 minutes. Prices start at around £6.

PANASONIC'S FOUR-HOUR CAMCORDER

Panasonic have announced a new camcorder, the VHS Movie Model NVM1, which is due for release in the UK early this summer and is unique so far in having a four-hour capability, i.e. it uses standard VHS tapes. A battery charge is required after two hours.

Like VHS-C camcorders, it has a small head drum (41·33mm instead of the standard 62mm) with four heads that operate in sequence: the tape wrap is increased to 270° and the drum speed is increased to compensate for the reduced drum diameter.

The VHS Movie is larger than VHS-C camcorders, in order to accommodate the standard VHS cassette, but nevertheless weighs only 5·5lb (without battery). Normal power consumption is 8·5W. Features include clean edits, cue and review and still playback pictures. The Newvicon pickup tube gives operation at light levels down to 10 lux. Price will be around £1,000.

MITSUBISHI's 35in. CTV

Mitsubishi have announced in Tokyo the development of a 35in. colour tube, the world's largest for domestic direct viewing, and a chassis to drive it. One of the main problems was to reduce the weight of the tube and make it suitable for mass production. This was done by using computer simulation to optimise the distribution of glass thickness, in conjunction with experience gained in the development of a 40in. tube for high-definition TV. The deflection angle is 110° and the screen area is over three times that of a 20in. tube.

NEW JVC VIDEO TAPES

Video tapes using two new formulations have been introduced by JVC – they're called "HF" and "New HG". Cassettes loaded with HF tape are intended for use with VCRs that employ the VHS hi-fi sound system and are available in half-hour to three-hour lengths. The New HG formulation has been devised to give greater magnetic energy for optimum performance generally and is available in half- to three-hour standard cassettes and VHS-C cassettes.

MAC-C IN OPERATION

The IBA's Engineering Centre at Winchester reports successful reception via ECS-2 (Eutelsat I-F2) of Norwegian (NRK) TV transmissions using the C-MAC/packet system. The NRK service, which started on December 22nd, is being transmitted by the Norwegian Telecommunications Administration for communal or direct reception in the Svalbard Islands off the northern coast of

Norway, well within the Arctic Circle. NRK is the first broadcast authority to use the EBU recommended C-MAC/packet system operationally. The EBU specification provides for up to eight high-quality digital sound channels to accompany each vision channel: NRK is using this capacity to provide the TV sound channel plus two stereo radio channels.

IBA engineers who developed the original MAC system are at present working on an experimental enhanced form of wide-screen MAC transmission.

SATELLITE DISHES – LEGALITIES

Under the 1949 Wireless Telegraphy Act a letter of authorisation from the Home Office is required to use a dish aerial for satellite TV reception. Officials appear to have come to the conclusion that enforcement of this regulation is impractical and are understood to be recommending that the law should be "liberalised".

VIDEO BATTERY PACK

Powercell International (Unit 7, Fleetwood Road, Leicester LE2 1YA, telephone 0533 706080) have introduced a nickel-cadmium battery pack, type VB4, for use with video cameras and recorders to give extended location shooting. The 12V/4AH capacity pack weighs only 3·5lb, measures roughly 8 x 6 x 2in. and costs £79·95 complete with mains charger and full instructions. Connection is via a cigar lighter socket for simplicity and the pack is unharmed by long storage periods – it's claimed to be capable of 2,500 charge/discharge cycles. It can be topped up at any time without need for deep discharge.

CABLE FRANCHISES – BATCH TWO

The new Cable Television Authority, which hopes to advertise a further five cable TV franchises shortly, has written to forty companies with a view to determining the present level of interest in bidding for cable franchises. The aim is to advertise five franchises every four months. With the initial batch of eleven franchises, which were awarded before the legislation on cable TV came into effect, prospective cable operators were able to specify the areas in which they were interested but were encouraged to adopt a high-technology approach. In future the Authority will specify the areas and will sound out local opinion before coming to a decision: the use of advanced technology will not be a major consideration but will still be taken into account. A more flexible approach is being adopted as a result of the difficulties experienced by the initial eleven franchisees, only one of whom has so far started a service.

EURO VHS VCRs

Grundig and Philips have both added a budget priced VCR to their ranges of European manufactured VHS machines. The Grundig VS180 and Philips VR6460 are both front-loaders: the VS180 has a recommended price of £379 or £399 with IR remote control; Philips' VR6460 comes at £399 or £431 with IR remote control. Two Pye European made VHS machines have been announced: the 64VR60 budget model is a version of the Philips VR6460 while the 65VR60, with top loading and extra features, is a version of the recently introduced Philips VR6560. In addition, Philips have announced the Japanese manufactured Model VR6920 which features hi-fi sound: it's a single-speed, front loading machine with IR remote control and a suggested price of £679.

TV COMPONENTS

A new generation of video output transistors for use in monochrome and colour sets has been introduced by Mullard. The new transistors, type numbers BF483/485/487 and BF583/585/587, have a novel mask design with ring emitter structure. The BF483-7 series has TO92 encapsulation and a maximum power dissipation of 830mW; the BF583-7 series has TO202 encapsulation and a maximum power dissipation of 1·6W. Both series have a collector-base voltage rating of 400V, a peak non-repetitive collector current rating of 100mA, a d.c. gain of 50 and an upper frequency cut-off at 70-110MHz. The new transistors are all npn types and are regarded as successors to the BF420/422 and BF869/871 series respectively.

Mitsubishi have announced a new range of gallium arsenide field-effect transistors, the MGF1300 series, for use in domestic satellite receiver front-ends. The most expensive transistor in this range, type MGF1305, has a noise figure of 0·6dB or less at 4GHz. A super low-noise device, the MGF1405, has been designed primarily for microwave communications use: it has a noise figure of 0·5dB at 4GHz and 1·4dB at 12GHz.

BBC SURVEY VANS

We have, quite rightly, been taken to task by the BBC for referring to "BBC detector vans" in the subscription service adverts that were contained in our last two issues. The notion of a BBC detector van was dreamt up by our advert copy writer. As the BBC point out, the licence evasion detector vans are operated by the Home Office. The BBC's particular concern is that these detector vans should not be confused with their own *reception survey* vehicles which are used to survey the coverage from all new radio and TV transmitters so that queries on reception problems can be dealt with. The BBC has a special telephone number, 01-927 5040, for enquiries about reception.

LIFESTYLE TV CHANNEL

A consortium consisting of W.H. Smith, Reed Publishing, Blackrod Video and Yorkshire Television has been set up to create a "lifestyle" channel for cable and satellite television. The aim is to provide a service covering such subjects as food, health and fitness, fashion, domestic finance, travel and leisure activities. Initially the partners will produce a business plan with a view to establishing the project's viability.

PHILIPS' 60 YEARS IN THE UK

Philips Electronic and Associated Industries Limited have been celebrating the sixtieth anniversary of their operations in the UK. Philips first came to the UK as Philips Lamps Limited on January 23rd, 1925. The business subsequently spread to other fields and over the sixty years no less than 20,000 UK patents have been granted to the company – a rate of around one per working day. Philips have always been at the forefront in the TV field – from 30-line TV sets for the Baird system in the early thirties to today's microcomputer controlled models.

Nobody Told Me

Les Lawry-Johns

A while ago I commented that no one in this trade ever has the chance to get a big head. No sooner does one overcome an impossible job and start to glow than another presents itself and you're back in the dumps, wondering how you ever had the gall to think you could cope. So often it's a question of a dead set, but where does one start with modern designs?

Power Supplies

Take the Rank T20 and related chassis for example. They come in and without switching on you check the usual things with an ohmmeter. There's a good chance that you'll score a bullseye right away. The 910Ω resistor (4R16) in the 12V regulator circuit tends to go high in value; the 1Ω resistor (5R8) in the BU208A's base circuit tends to go open-circuit; and the two EW modulator diodes 5D6/7 tend to fail. The drill is to check these items first. Suppose they are all o.k? You may plug in and find that there's no 200V output from the chopper power supply circuit. This has happened to me several times recently, so I thought I'd dwell on it for a moment.

There are two fuses on the centre power supply panel. The one nearest to you (7FS1, 1·6A HRC) is on the d.c. side of the mains bridge rectifier. You may well find that it has blown and wonder why. As a first step you check the BU326 chopper transistor 7VT7 and find it short-circuit. "Ah ha" you say as you replace it. If you're daft you then replace the fuse and see it blow just like the first one did. The next step is the tedious business of checking all the other components in the area. Start with the two diodes in the overvoltage crowbar circuit – 7D12 (1N4148) and the 27V zener diode 7D13 (BZX79/C27). One or both will probably be short-circuit. You then scurry around looking for a 27V zener diode – naughty boys settle for 30V if they can't find a 27V diode. The two thyristors 7THY1 (chopper drive) and 7THY2 (crowbar) could have suffered and should be carefully checked together with all the associated diodes. If you're lucky you'll have got the 200V back by now. If the tube's heaters don't light up, go on to check the line timebase.

The GEC C2110 Series

The GEC C2110 series is another old stager with which we should all be thoroughly familiar. Most troubles arise in the line output stage. The BU108 (use a BU208) line output transistor goes short-circuit, taking the 47V zener diode D51 with it; the 1MΩ resistors R607/8 on top of the line output transformer cook up; and the 560kΩ resistor in series with the first anode presets goes high or open-circuit. Once again however the pattern is changing.

We've had several of these sets in recently with excessive e.h.t. due to the h.t. line rising to well over 200V. This will occur if transistor TR701 in the thyristor control circuit isn't conducting sufficiently. The cause is likely to be one of the resistors in its base circuit changing value. The usual culprit is the feedback resistor R706 (470kΩ). It goes high, a replacement bringing the firework display to a halt. The excessive voltages in the line output stage may have resulted in one of the wirewound resistors on the side of the line output transformer housing springing open after the associated zener diode has gone short-circuit.

Pinky and Perky

We all get our share of strange customers. I think I get more than my share, but they do give us a laugh now and again.

An elderly couple pulled up outside, in an equally elderly Morris Minor. I heard them arguing away so I went out to see if I could be of help.

"You get in and get one end and I'll pull it out this way."

"No, you get in and I'll lift it from here."

I solved the problem for them and thought the dispute was over. No such luck. It was a 20in. Philips G8. The man was rather small and had a pink tam-o'-shanter on his head. The lady was equally small and wore a black hat with a white feather in it. So he was Pinky and she was Perky and they never stopped chattering (mostly both at once) and arguing.

"The switch doesn't work."

"No it's not the switch because you can hear it click."

"That doesn't mean it's doing its job."

"Shut up and let the man look at it."

So I looked. I could hear the degaussing buzz, so the switch was working. I started at the bottom of the mains dropper, to ensure that the mains a.c. was present here. It was, and was also present at the next tag up. I switched the meter to d.c. and checked the upper section. The set immediately started up – as soon as the meter probe was applied. I thought there was a dry-joint and checked carefully, but there were no obvious ones. Switch off, wait a while, then switch on again. Nothing. Check for h.t. at the upper tags and again the set starts up. I switched off and checked the dropper cold. It was intact. To cut a long story short and to cut out Pinky and Perky's tirade, which continued non-stop, I was called upon to make a decision and despite the fact that I nearly always make the wrong one this time I rose to the occasion.

"Well what's wrong with the bloody thing?" asked Perky.

"My opinion, which in your view may be silly, is that the thyristor has an internal open-circuit which makes when the circuit is disturbed – in this instance by application of the test prod."

Pinky gazed at me for a while. "To me that's a load of old bull."

Perky wasn't going to let him get away with that.

"If you had any sense you'd realize the man knows what he's talking about, which is a damn sight more than you ever do. You just rabbit on and on while saying nothing."

It was time to put my theory to the test. I'd noted that the thyristor wasn't the usual BT106. It was of the BT116 type, though the number couldn't be read. I removed it and transferred the nut, bolt and washer to a new SN4444. With this installed the set came on each time it was asked to. I coughed slightly, straining to hear the thunderous applause that should have been forthcoming. It wasn't.

"Well, will it be all right from now on?" demanded Pinky.

"How the bloody hell should I know?" I snapped, losing my cool at last. "You brought the thing in because it wouldn't switch on and now it does. That's my job

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completed. What happens hereafter is up to you."

I put the set back in the Minor and off they went, still nattering away at each other like mad. I reflected on the quiet life that HB and I lead. We are such nice people. If only she wouldn't stir the coffee up so quickly.

The Bush BC6004A

This Rank colour portable was made in West Germany and I wasn't familiar with the circuit at all. As it belonged to the "hire and fire" man at the local builders' yard, and as Don has been helpful to us on occasions, I couldn't say no.

It has full v.h.f. as well as u.h.f. reception facilities, so the tuner is not the run of the mill type. The poor reception with very grainy picture suggested that the tuner could well be at fault, but careful investigation failed to reveal anything amiss. The a.g.c. also seemed to be about right. The tuner and i.f. sections are of the plug-in type, so I next removed the covers of the i.f. section and carefully checked the input and first stage. This consists of a BF199 transistor (T251) which is followed by a TDA440 i.f. i.c. The voltages around the transistor didn't seem right but a replacement produced no improvement. I repeated the voltage checks and injected signals to see where they went missing. The trouble still seemed to be in the first stage, and as I was probing around a small item caught my eye. It was a tiny 4·7kΩ resistor with the wire ends doubled up ready for insertion into the printed board – but it had never been fitted. It had just layed there inside the i.f. unit, doing nothing until (I presume) it had got jolted and upset things. A look at the circuit revealed that it was part of the tuner a.g.c. circuit, but as the tuner a.g.c. voltage seemed o.k. I simply removed it. This restored normal operation, but I won't tell you how many hours were spent before the errant resistor was spotted.

Electronic Speech for TVs and VCRs

David Botto

Pete pushed the workshop door open and turned on the main power switch. A babble of electronic voices immediately greeted him.

"Good morning!" "It's 9.17 a.m." "Attention please!" "Danger! Smoke!"

"Quiet" yelled Pete, and the voices stopped as built in sensors in the TV sets and VCRs detected his voice. It was well past the time to start work, so Pete picked up his much-used digital meter – he refused to use the new talking multimeter the Boss had ordered from a rep in a weak moment . . .

No, this is not the start of a futuristic story, merely a pointer to what TV engineers may have to put up with in the not too distant future. Thanks to the recent development of very low priced speech generating i.c.s, TV sets, VCRs and perhaps a whole host of domestic appliances will soon be talking electronically. They'll inform, remind and warn in a natural sounding voice, using inexpensive circuitry built into the equipment.

Before discussing electronic speech synthesis it's useful to know how human speech is produced – being able to talk is something we tend to take for granted, but it's quite a complex business. A column of air is sent up by the lungs, pushed up by a dome-shaped muscle called the diaphragm, the lungs acting as a sort of bellows. This air goes through the windpipe, entering the larynx – the voicebox or Adam's apple – in the middle of the throat. There are two small folds of muscle inside this voicebox – the vocal chords – which open and shut to let air in and out (and also to stop foreign objects getting into the lungs). As air is forced from the lungs the vocal cords vibrate, producing sound, the speed of vibration controlling the tone.

After passing through the larynx the air enters the upper part of the throat, going on into the mouth and nasal passages. Overtones are added, and the roof of the mouth, the teeth, gums, jaw and lips break up and control the sound waves so that the listener hears sounds he can understand.

Speech Synthesis

To synthesize speech calls for an entirely different approach, but one that takes into account the way in which the human voice works. Integrated circuits can do the job easily, cheaply and reliably by combining the component parts that go to make up speech. The basic unit of speech is the phone, a sound made by one's vocal system. Alter a phone just a little and you get an allophone. Bring together phones and allophones and you've the sounds that enable one word to be distinguished from another: these sounds are called phonemes and are composed of many different frequencies.

There are two basic methods of electronic speech synthesis. The first uses digitally stored words and/or phrases. The second stores phonemes or allophones which are combined to produce words and sentences. This second method enables any word in almost any language to be formed – and is thus ideal for robots with a lot to say! For talking TVs and VCRs however the former, stored words/phrases method is more likely to be used: the number of words is limited by the storage method, but is still considerable.

The cost of electronic speech was until quite recently prohibitive so far as domestic equipment is concerned. Now however several large-scale speech processor i.c.s have become available: they contain extremely complex circuitry yet cost only a few pounds. Some examples will be considered in a moment.

An input code such as a binary number is fed to the synthesizer i.c. which then selects the required word/ phrase or stored speech element from an internal or external read-only memory (ROM). It then processes the ROM's output before passing this to an electronic circuit that models the human voice tract. The output is amplified and then fed to a normal loudspeaker. The synthesizer could be controlled by switches for single words/phrases or single parts of speech: in practice control is done by a microprocessor or microcomputer.

Synthesizer ICs

The National Semiconductor MM54104 speech processor i.c. is designed for use with specially designed speech ROMS – type MM52164 – and is housed in a 40-pin pack.

The MM52164 contains stored phonemes and words which have been converted from analogue to digital form by changing analogue values into binary ones. These are n-channel MOS devices: the MM54104 requires a 9V d.c. supply while the MM52164 requires a 5V supply. They are able to synthesize high-quality speech – the voice of a man, woman or child. Operation can be "stand alone" with switches or by means of a microcomputer i.c. using an eight-bit address code. The output from the processor is fed via a filter to an audio amplifier.

The Votrax SC01A 22-pin speech processor i.c. uses phonemes. It has two voicing generators, four speech bandpass filters that model the human voice tract, an internal audio amplifier designed to drive a larger external one, and a 720kHz clock oscillator that can be crystal controlled. Sixty four phonemes for voice, nasal, fractive sounds (those made by friction, such as F, S etc.) and also silence are stored in the i.c. To get the i.c. to select the required phoneme, a binary signal is fed to input port PO-5. The SC01A can form words and sentences in any language and can select words and phrases stored in external ROMS. It requires a 7-14V (usually 10V or 12V) supply at about 20-28mA. The Heath Company's Hero-1 robot uses this i.c.

The General Instruments SP0256-AL2 voice synthesizer is a 28-pin, n-channel MOS device that produces very good natural-sounding speech, music and other sounds. Its own memory contains 64 allophones for speech and sound synthesis and it can select stored words and phrases from an external ROM. Normal operation is at 5V d.c. – maximum 12V. As with all speech i.c.s it contains extremely complex circuitry: it's nevertheless easy and simple to use.

The SP0256-AL2 has an electric vocal tract consisting of a 12-pole digital filter. The output from this goes to an internal pulse-width modulator whose digital output is fed to an external low-pass filter to produce an analogue signal for amplification. The eight-bit binary input data, to select the required words or sounds, is fed into a start address latch. The SP0256-AL2 operates as a "stand alone" device or can be interfaced with a microprocessor or microcomputer. Fig. 1 shows a simplified block diagram of the device and Fig. 2 the simplest possible circuit for speech synthesis, using the stored word (or "canned speech") method. It's simple to build and is shown here so that TV engineers can become familiar with the method TVs and VCRs will probably use to talk.

Using the GI Chip Set

The SP0256-AL2 and the associated SPR16 ROM are best obtained as a matched pair from Tandy – the cost is an extremely reasonable £12·95 (including VAT). The ROM is preprogrammed with words, phrases and music (see Table 1). The unit is easy to construct on a solderless breadboard: the i.c.s and components simply plug in, connections being made with push-in wires (simple to alter if you want to experiment). A stabilised 5V supply is required, or a 9V battery can be used as shown in Fig. 2: power consumption is 130mA with a 9V battery, 68mA with a stabilised supply.

Switches SW1-6 enable single words and phrases to be selected. When using the switches, leave the 20-way lead (only seven connections are used) disconnected. Omit the connector altogether if you don't intend to use the circuit with a microcomputer. The switch positions that produce various words and phrases are shown in Table 1: 1 represents a closed switch and 0 an open one. The various 1/0 combinations are the binary equivalents of 0-35 decimal.

Table 1: Binary commands for some of the words etc. in the SPR16 ROM.

Binary number	*Sound*
000000	oh
000001	one
000010	two
000011	three
000100	four
010100	twenty
010111	fifty
011110	good morning
011111	attention please
100001	Big Ben chimes
100011	tune plays

Note: maximum number = 35 decimal.

Speech quality is good and natural. With all the switches open you'll hear "oh, oh, oh . . ." repeated indefinitely when the unit is powered. If the circuit doesn't start up, connect and disconnect the power a couple of times – pin 20 (address load) requires the leading edge of a negative pulse to start loading the address and is capacitively coupled (C4) to pin 6. Don't exceed the binary numbers shown in Table 1 or you'll get horrible noises that won't stop until you remove the power.

To use the speech synthesizer with a BBC Model B microcomputer, connect the 20-way link to the computer's user port (see Fig. 3) – ensure that switches SW1-6 are all open. Enter the simple program shown in Table 2. It may not be brilliant, but it works! Run the program, then switch the synthesizer unit on. You should hear voices.

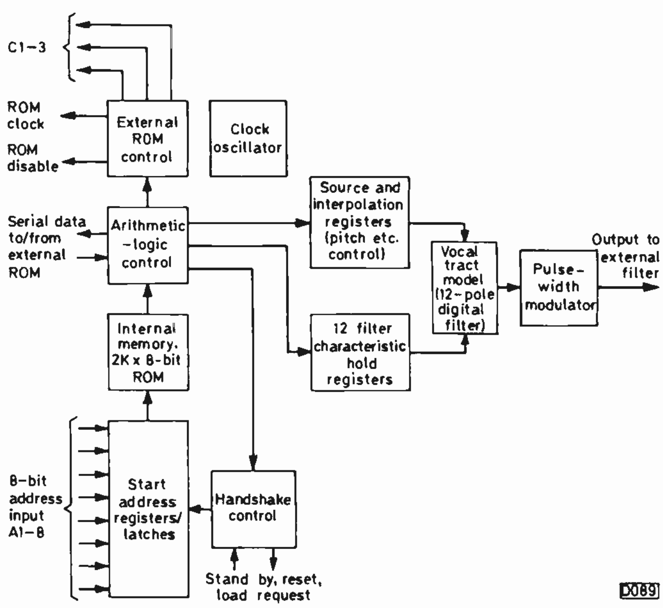


Fig. 1: Simplified block diagram of the General Instruments SP0256-AL2 speech synthesizer i.c. The i.c.'s internal memory holds 256 phonemes. The stored phoneme data is applied to the vocal-tract model (VTC) in two ways, via twelve hold registers that alter the tract's filter characteristics and the source/interpolation registers that control the pitch, amplitude and repeat periods. Alternatively, data stored in an external ROM can be applied to the hold and source/interpolation registers: this data generally consists of complete words, phrases or sound sequences. The output from the VTC goes to a 7-bit pulse-width modulator which in conjunction with an external low-pass filter provides digital-to-analogue conversion.

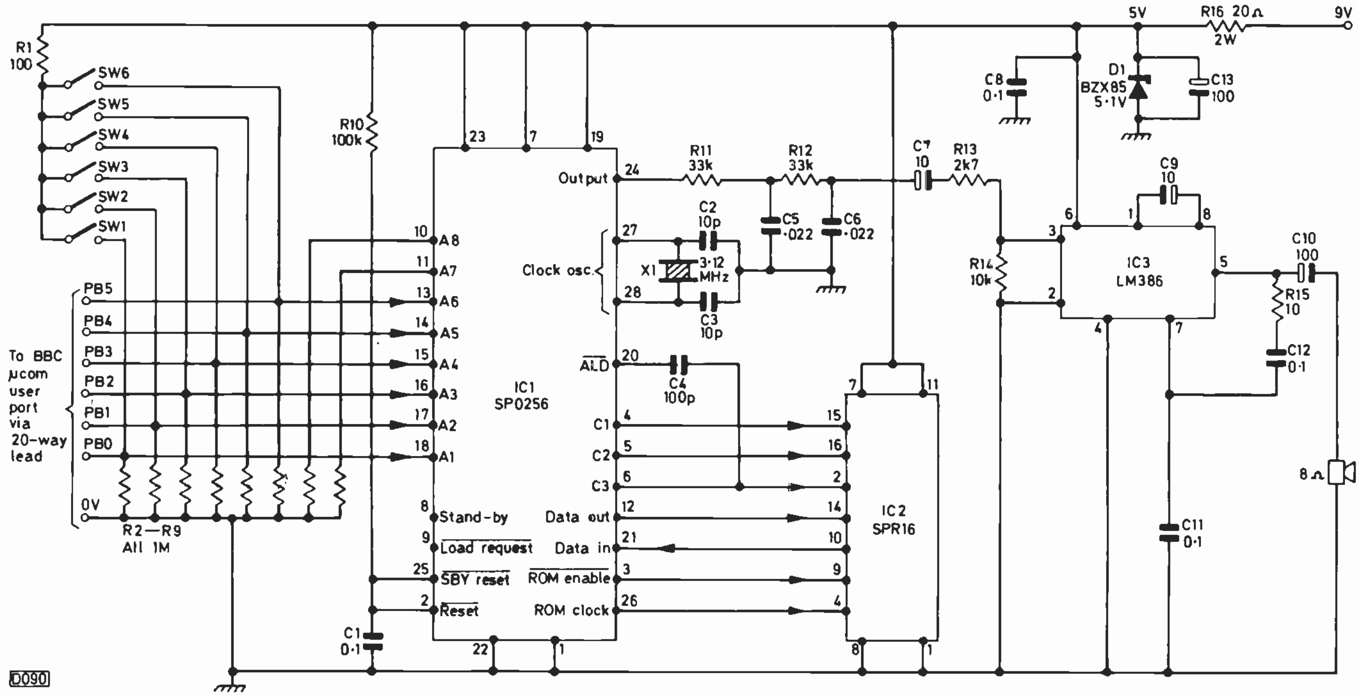


Fig. 2: The simplest way of using the SP0256/SPR16 combination to provide electronic speech.

Table 2: Simple program for use with the BBC microcomputer Model B.

```
40?&FE62=&FF
50?&FE60=33:PROCDEL
60?&FE60=30:PROCDEL
70?&FE60=32:PROCDEL
80?&FE60=24:PROCDEL
90?&FE60=12:PROCDEL
100?&FE60=25:PROCDEL
110?&FE60=31:PROCDEL
120?&FE60=32:PROCDEL
130?&FE60=18:PROCDEL
140?&FE60=29:PROCDEL
150?&FE60=12:PROCDEL
160?&FE60=29:PROCDEL
170?&FE60=24:PROCDEL
180PROCDEL
190GOTO60
200DEF PROCDEL
210FOR V=1TO2000
220NEXT
230ENDPROC
```

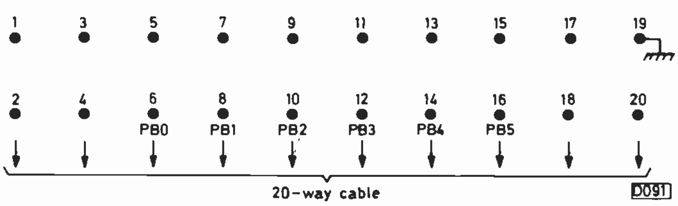


Fig. 3: Twenty-pin plug for a BBC microcomputer user port, looking into the socket holes – the arrows denote the cable coming away from the plug.

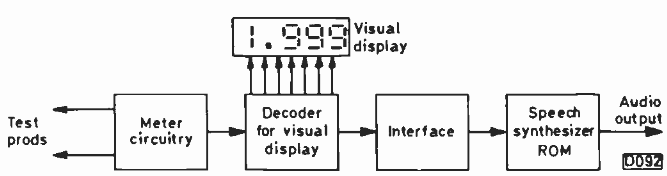


Fig. 4: Possible visual/talking multimeter arrangement.

Press the escape button, type RUN on the computer keyboard, and you'll hear the chimes of Big Ben followed by spoken words, phrases and numbers that continue until you stop the program. This may give you an idea of the workshop of the near future!

Talking Meters and Speech Recognition

A talking multimeter could be made in much the same way as a standard digital meter but with the signals that activate the display also applied, via an interfacing i.c. to produce the required binary signals, to a speech synthesizer i.c. with a suitable set of speech ROMS. See Fig. 4.

Inexpensive speech recognition systems that operate with a microprocessor or microcomputer are being developed. They detect the voice and transform the audio signal into multiple blocks of digital signals that give instructions to the controlled equipment. Thus the TV service engineer of the future will be able to hold a conversation with a set being repaired!

★ components list

IC1/2	Synthesizer set, Tandy part no. 276-1783		
IC3	LM386. Tandy, Watford Electronics etc.		
X1	3·12MHz crystal. Maplin, Watford Electronics.		
R1	100Ω, 0·5W	R2-9	1MΩ, 0.25W
R10	100kΩ, 0·5W	R11-12	33kΩ, 0·25W
R13	2·7kΩ, 0·25W	R14	10kΩ, 0·25W
R15	10Ω, 0·5W	R16	20Ω, 2W
C1, 8, 11, 12	0·1µF 100V ceramic		
C2, 3	10pF ceramic		
C4	100pF ceramic		
C5, 6	0·022µF ceramic		
C7, 9	10µF, 63V electrolytic		
C10, 13	100µF, 25V electrolytic		
D1	BZX85 5·1V zener diode		
Loudspeaker	Miniature 8Ω		
Breadboard	Tandy, Veroblock, RS etc.		

20-way cable with connector to suit BBC Model B microcomputer user port – Watford Electronics etc.
8-position SPST DIP switches – Tandy 275-1301, Maplin etc.

Long-distance Television

Roger Bunney

Time to pause for a moment and consider the year just past. 1984 was hardly spectacular from the DX-TV viewpoint. Perhaps the most dramatic event was reception of CBHT Halifax, Nova Scotia ch. A3 in Yorkshire, with remarkably clear sound, while on the same day an "NTV" ch.A2 caption which subsequently turned out to be from a 3kW e.r.p. transmitter in Newfoundland was received. Various Arabic Band I signals were received during the SpE season, including Iran ch. E2. Just recently the important event has been the final closedown of the BBC's 405-line transmitters, on January 2nd. This leaves the future of Band I in the UK largely undecided. Band III subsequently lost its IBA 405-line transmitters, on January 3rd – many of the transmitters have been donated for medical research purposes.

The new French fourth channel Canal Plus duly arrived, with scrambled video, Lille in particular being well received over much of the UK – as it was in the days of 819 lines! The main stations are at present in Band III, with u.h.f. relays, though openings in Band I are expected. Interesting to note that the decoders apparently create interference in Band I.

With Band I empty of local TV transmissions in the UK, DXers have a golden opportunity in 1985. It will be worth making every effort to exploit the situation during the SpE season. During the next few years it's expected that more Band I networks will close, while alternative uses for the spectrum will come into operation. Things could be much more difficult and frustrating in five years' time.

TV-DXers have not shown a great deal of interest in satellite reception during 1984, primarily due to the cost of the equipment required and the limited potential in the 4 and 12GHz bands.

The New Year

So to the start of 1985, and may I first wish readers all the best for the coming year. The period under review this time is December/early January. There was a characteristic mid-winter lift to SpE conditions, with strong signals on certain days if you were lucky enough to be about – December 18th was particularly lively. The SpE log is as follows.

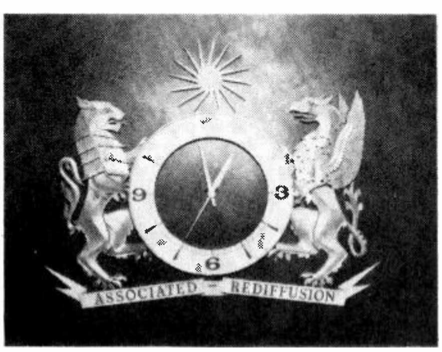
8/12/84	SR (Sweden) ch. E2; TVE (Spain) E2.
9/12/84	TVE E4; ARD (W. Germany) E2.
10-11/12/84	Unidentified signals on the E channels.
13/12/84	TSS (USSR) R1. An aurora was noted in Scotland.
14/12/84	TSS R2.
16/12/84	JRT (Yugoslavia) E4.
18/12/84	TSS R1, 2; TVP (Poland) R1; RAI (Italy) IA; MTV (Hungary) R1.
19/12/84	TVE E2.
2/1/85	Unidentified signals on ch. E2.

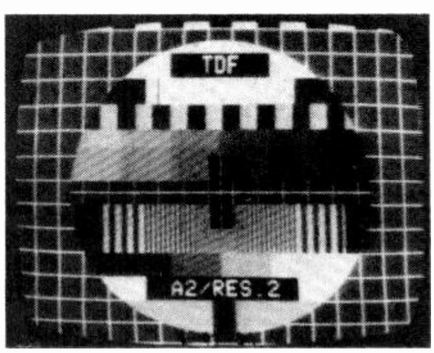
December 12th saw active MS conditions which also occurred at the start of January with the Quadrantids shower.

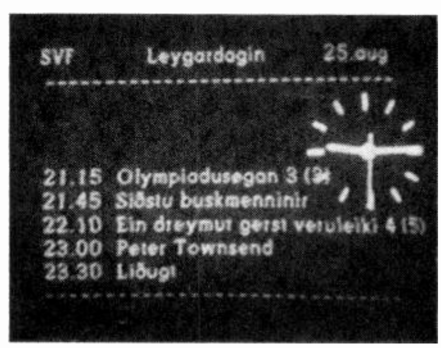
The most important event during December was undoubtedly the enhanced tropospheric spell that started on the 9th, improved on the 10th, peaked on the 11th and gradually faded on the 12th. As with the other tropospheric openings in 1984 this one was hardly dramatic though good signals were received from W/E Germany, Norway and Denmark. Here at Romsey there were intense W. German signals up to ch. E50 but very little above that. Band III was jammed with W. German, Benelux and Canal Plus signals though there was no sign of E. Germany or Denmark. RTL (Luxembourg) ch. E7 was seen with the RTL corner insert identification, not unlike RAI during summer openings. Certainly Belgium provided excellent signals throughout most of the UK.

Simon Harmer did well to receive Denmark ch. E7 in deepest Wales on the 10th. Cyril Willis (Ely) received "lots of WGs" and many ATV stations (Benelux 435MHz operators) on the 11th. On the 12th he had Norway chs. E7-10, Denmark ch. E7 and E. Germany chs. E12 and 34. Iain Menzies in Aberdeen found that the southerly path was best on the 12th, with signals from Holland and Belgium – the sea path gave deep fading. The identification "Hessen Dre", a third network identification, appeared on several test patterns and captions. In Dunstable Robin Crossley received Shape-AFRTS ch. 34 on the 11th with about P3 picture quality. The inland pirate Thameside TV came on air at 2100 on the 28th in the London area, with seasonal cheer. So the year ended with a flourish for DX-TV enthusiasts.

My thanks to many readers for their support during the year. Thanks for reception reports this month from Tony Privett (Basingstoke), Cyril Willis (Ely), Arthur Milliken (Wigan), Graeme Wilson (Cleveland), Ryn Muntjewerff (Holland), Simon Hamer (Presteigne), Tim Anderson







Left: A sight that was familiar in the early days of ITV, the Rediffusion clock – something to remind us of the now departed 405-line system. Centre: New identification carried on French PM5544 test patterns – this one is for Antenne-2. Photo Ryn Muntjewerff. Right: Programme schedule from SVF, Faroe Islands TV, received in Holland by Ryn Muntjewerff on ch. E6.

(Bexhill), Iain Menzies (Aberdeen) and Robin Crossley (Dunstable).

News Items

Belgium: There are plans to open two transmitters, Eupen (ch. E59) and Malmedy (ch. E63 or E65), to provide a service for the German speaking part of the country. Transmitter powers will probably be 20kW and the service will be known as BHF (Belgische Horfunk).

W. Germany: In last month's column reception of BFBS in Finland on ch. E51 was reported. It was assumed that the signal came from the 10W Celle transmitter. Hobeck provides a directional BFBS link to W. Berlin on ch. E51 at 200kW e.r.p. however – TV pictures but no sound.

Africa: Zimbabwe (ZTV) is to expand its radio/TV network with transmitters at Gokwe, Binga, Kenmaur and the Zambezi Valley where reception is difficult. Equipment purchased from Pye in 1975 for the expansion of TV into the northern part of Nigeria has still to be installed. The v.h.f. equipment was never commissioned as the national government took over the v.h.f. channels, allocating u.h.f. channels to the regions. There have been attempts recently to get the equipment into operation and an experimental service is expected to start shortly. Ghana (GBC) is upgrading its TV system with new transmitters, studio and production equipment supplied by NEC.

Asia: Two standards are now in use in Afghanistan, with Kabul using system B PAL and a new transmitter at Kandahar providing system D SECAM signals received via the Statsionar-T u.h.f. downlink. Chinese network-1 programmes are being transmitted from Lhasa, Tibet, the link being via a Chinese communications satellite. Delhi's new 1kW transmitter came into operation last autumn, carrying the second TV channel for some two-three hours nightly. The primary service area has a 20-mile radius. The extensive v.h.f. network covering Sabah and Sarawak will carry a service compiled from the Malaysian first and second TV networks when, as planned, the East Malaysian Network-3 comes to an end.

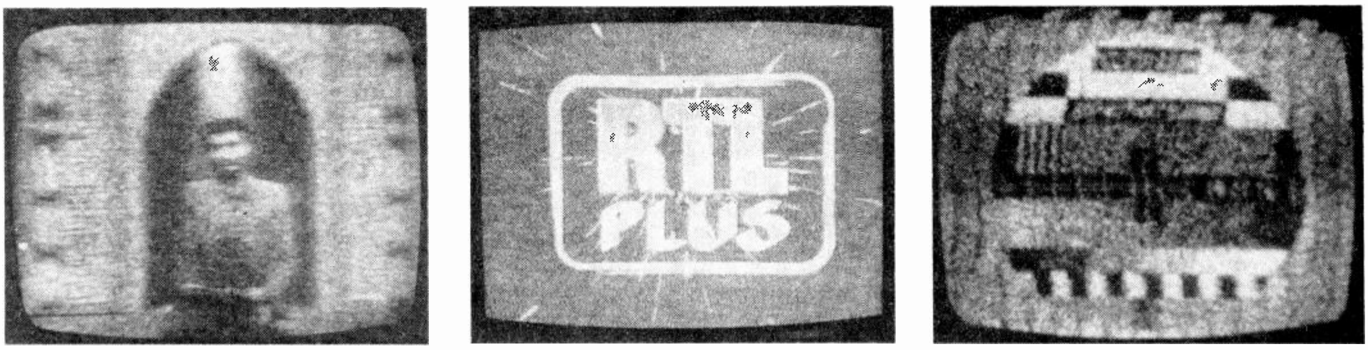
Canal Plus Decoder

The French magazine *Radio Plans* was served with an injunction to prevent distribution of its December issue which carried a full constructional feature on a Canal Plus decoder. It appears that the newspaper *Le Quotidien de Paris* went ahead and published the circuit before they too could be served with an injunction! The *Radio Plans* feature had ostensibly been for the benefit of readers outside France unable to obtain decoders from Canal Plus. The matter is complicated by the Treaty of Rome which in section 59 et seq. states that a service available in one EEC country should be available to residents of a neighbouring EEC country on the same conditions.

Circuit details of the decoder have come our way. The sound section is fairly simple but the vision section is complicated by the need to introduce a delay of 888nsec for each of the steps in the timing of each line – the delay is provided by two TDA4560 i.c.s. The system works by detecting the three per cent (or less) change from the blanking level to picture black at the start of each line to determine how much delay to insert.

Interference

The problem of high-power 49MHz cordless phones is causing considerable difficulty in many areas. Interesting to report that the Hampshire National Farmers' Union



Left: Exotic reception of an Arabic ch. E2 signal in Holland by Ryn Muntjewerff – an example of double-hop SpE reception. Centre: The RTL Plus (Luxembourg) identification slide. Received by Robin Crossley on ch. E7. Right: Bophuthatswana TV test pattern received in S. Africa by Jim Maden – the 200W, ch. E37 transmitter was received at a distance of 70 miles.

issued a warning to its members advising them to avoid the use of unapproved types – such as the five-mile Supaphone. Attractive as these units are for a farmer out in the fields with his tractor, the NFU warns that fines of up to £1,000 are possible. Interference has also been experienced from the British Telecom Ambassador line phone using the type 852 handset Models 1, 2 – it can produce a high-pitched tone and pulses at frequencies up to 150MHz. If this problem is encountered, BT should be contacted.

A paper on TV head amplifier overloading near a high-powered Band II f.m. transmitter was presented at the 1984 Las Vegas NAB convention. The high energy from the f.m. transmitter can result in harmonic distortion, a second harmonic being sent down the aerial feeder. This causes Band III (High Band in the USA) interference to the installation concerned and also to neighbouring ones, with complaints to the innocent f.m. station. The requirement is for aerial amplifier manufacturers to ensure that the second order intermodulation distortion and cross-modulation performance of their products is such as to minimise the problem.

Interference from computers, particularly Spectrums, is an increasing problem. Radiated interference levels in the USA are lower and strictly regulated. There was an attempt recently by a manufacturer to get large industrial computer installations produced in quantities of 300 or less exempted from the stringent suppression standards laid down by the FCC. The FCC ruled against such a production level exemption, suggesting a level of ten or less instead. Further research on the subject is being carried out.

The FCC is studying a proposal for a long-range cordless phone band at 900MHz, known as PRCS. Tests are currently being carried out by General Electric in New York. There would be some 133 channels with a five-mile limit in built-up areas and a limit of up to twenty miles in open terrain, with an extendable range via a community repeater. Channel bandwidth would be 30kHz with a transmitter output of 10W.

Radio Telefis Eireann

An updated list covering the RTE radio and television transmission network, dated November 1984, is available on request from Reception Investigation, Radio Telefis Eireann, Dublin 4, Eire.

Satellite Scene

ECS-2 has now moved to 7°E. Intelsat IV at 1°W, which operates in the 4GHz band and carries the AFRTS downlink amongst other services, has exhausted its station-keeping fuel and is now in an inclined orbit. The Australian "Homestead and Community Broadcasting Satellite Service" will carry the ABC TV service with stereo sound plus three ABC radio channels, one in stereo. The service is expected to start this year, using the B-MAC system. Receiver prices of around Australian $1,500 are expected.

FAI Propagation

The subject of FAI (Field Aligned Irregularities) scatter propagation was discussed in a recent RSGB publication. The E layer irregularities tend to align with the Earth's magnetic field and produce weak scatter signals at distances similar to SpE propagation. One characteristic is that the signal reflection can be from a direction other than the correct great circle direct path, another is that the reflected signals are generally of low level and provide fluttery reception, though they can be present for long periods. FAI propagation tends to occur during the SpE season, i.e. May to early September with an additional small mid-winter peak. The trop-like signals could be confused with distant (about 2,000 mile) single-hop SpE signals such as those received in the UK at times from the Middle East. Any comments/observations would be welcome.

New Products

There have been some changes to the Solent Scientific product range. The price (in kit form) of the u.h.f. f.m. receiver, which is ideal for use with 24cm ATV f.m. video or for satellite reception, has been reduced to £74·95 plus £2 post and packing. A 24cm ATV transmitter with 1W output, again in kit form, has been added to the range. It's easy to build, using a PCB, and the output can be preset anywhere in the 23-24cm (1·245-1·325GHz) ATV band. The output can be increased to 10W using a complementary power amplifier kit. The original 24cm ATV converter, with i.f. output at u.h.f., has proved to be very popular and has excellent weak signal performance. For full details of the complete range send a 9 × 4in s.a.e. to Solent Scientific, 75 Chalk Hill, Southampton, Hants.

RIC Capacitors Ltd., Budds Lane, Romsey, Hants SO5 0ZQ have introduced a new range of r.f. interference filters and suppressors. They're listed in a glossy catalogue that also describes types of mains-borne interference and the suppression required. If you have a problem of this sort, send 30p in stamps to RIC for a copy of the catalogue. As with all types of interference, suppression should be at source rather than at the receiving end.

TV Fault Finding

Reports from Steve Illidge, Mick Dutton, Philip Blundell, Eng. Tech. and Tony Thompson

Panasonic TC2203 (chassis U1)

We've had several of these sets in recently with the complaint no sound or raster. Having replaced the short-circuit BU208A line output transistor and the overvoltage protection diodes D812/D809 and checked the chopper control transistors Q802 and Q803 we would switch on. At best the result would be severe fluctuation in the picture size, at worst the BU208A and the protection diodes would suffer an early demise. The cause of the problem was in each case a bad spot on the preset h.t. control R810. We now replace R810 before commencing work, remembering to set it for minimum h.t. of course. It costs little and can save much time and expense. **S.I.**

ITT CVC5 Chassis

This set came in because the h.t. fuse had failed – a simple case of old age. With the set working we noticed that the colour lock was poor and that the colour would drop out from time to time. In the past we've found that this problem is often caused by mistuning of the ident coil L75d. A check with the scope showed that the tuning was correct though the output was low at 5V instead of 12V peak-to-peak. The ripple output from the burst detector was also low, and on checking back further to the collector of the burst amplifier transistor T34d we found that the output was well down. Close inspection showed that at some time a BC107 had been fitted instead of a BC171B. Fitting the correct type of transistor and adjusting L75d provided a cure. **M.D.**

Philips K30 Chassis

This set suffered from field roll with reduced height as soon as it warmed up. We decided to change all four transistors on the sync/timebase generator panel and this cured the problem. When we checked the transistors we found that one of them measured low gain. **M.D.**

Thorn TX9 Chassis

This portable suffered from line drift as it warmed up – the customer pointed out that the problem wasn't so bad when he was using his video recorder. We checked around the line oscillator department but everything remained stable, despite using freezer and a hairdryer. It occurred to us to investigate the AV switching to see if the AV channel was more stable. This turned out to be the case and a further check revealed that D916 in the W725 remote control receiver leaked as it warmed up. This didn't matter with the set switched to AV as the diode was then conductive. **M.D.**

Körting Skylab 1 (chassis 10)

This colour portable was slow to come on from cold: the picture flickered on and off with line collapse showing in between. After twenty seconds or so the set would operate normally. The power supply is of the discrete component self-oscillating chopper type and a visual check here drew attention to R623 which looked rather hot and bothered – it had fallen in value from 15Ω to 7Ω (2W). It's in the circuit on the earthy side of the chopper transformer's feedback winding. **P.B.**

Mitsubishi CT2630

When the weather was cold the line oscillator wouldn't start due to its supply voltage being only 6V. D501 which isolates the start-up supply from the 20V line was found to be short-circuit. **P.B.**

Thorn 9800 Chassis

The odd symptom with this set was that it would start up only when cold – if switched off then on again once warm it would remain obstinately dead for about half an hour. We've occasionally had to replace the transistor in the start-up circuit (VT810, a Thorn T6034V), so this was our first move. Doing this made no difference so we examined the inertia start panel more carefully. Whilst probing with a screwdriver there was a small flash which gave us a clue. A meter check then confirmed that the 4·7μF electrolytic capacitor C810 was unable to discharge because its shunt resistor R810 (390kΩ) was open-circuit. At switch-on C810 applies a start-up pulse to the gate of the mains rectifier thyristor W703: if it's charged it can't do this. **T.T.**

Luxor 90° Hybrid Colour Chassis

The width control of one of these sets got warm and had a short life. Replacing the PC92 valve in the width/e.h.t. regulation circuit cured that. The complaint with another of these sets was very intermittent lack of height. Not total field collapse we were told, more like a "cinemascope picture". We watched the set for hours – no days! Finally the raster did collapse to a fairly narrow band, but with perfect linearity. Almost immediately it returned to normal. No amount of prodding around would produce the fault condition, neither would heating and freezing every component in the field timebase circuit. The only thing we could do was to change parts, component by component, and await results. To cut a long story short, there are two 0·047μF capacitors between the blocking oscillator and output sections of the PCL805: one is the field charging capacitor, the other the coupling capacitor between the two sections of the valve. Replacing them both (to save time) cured the fault – we were not prepared to check further to find out which one was responsible! **T.T.**

GEC C2110 Series

The fusible resistor R60 in the h.t. supply was open-circuit and the protection zener diode D51, which is in series with the line output transistor, was short-circuit. The line output transistor itself seemed to be o.k., but rectifier diode D601 which produces the 40V supply from a winding on the line output transformer was short-circuit. It seemed prudent to check around for further possible damage after replacing these items. This led us to the pincushion distortion correction transductor T602 which, along with three associated resistors, was burnt up. Replacing these various items produced a good, stable picture. The set will function without the transductor but the vertical scan will be short and cramped – rather as if one of the field output transistors is defective.

The problem with another of these sets was vertical striations – the performance was otherwise very good. It looked like a simple case of an undamped line linearity coil, but the damping resistor was fine. While looking around for further suspects we came to the fifth harmonic tuning coil L604 which lives on a small panel mounted on top of the line output transformer. It too is damped, or should be – in fact the damping resistor R610 (33kΩ) was open-circuit, as were the nearby 1MΩ resistors R607/8 in the first anode supply circuit. Replacing these items restored correct operation – we can only suppose that they died of old age. **T.T.**

Video Servicing

Mike Phelan

As mentioned last month, two colour-separation techniques are used with single-tube domestic colour video cameras, based on either phase or amplitude. We'll start this month by looking at the second chroma processing method which is used with slightly more expensive cameras such as the Ferguson 3V06 and 3V20.

Step Energy Recovery System

This is known as the "step energy recovery" system and, like the arrangement described last month, starts with a stripe filter that's integral with the vidicon's faceplate. Unlike the phase/delay system however the stripes are vertical (see Fig. 1). As with the other system, the vidicon's output consists of a low-frequency luminance component plus a high-frequency colour component whose frequency is dependent on the pitch of the stripes in the filter – typically 4·1MHz.

Consider a signal containing no colour information. Maximum output will represent peak white. It will consist of steps however, as shown at A in Fig. 1, since the cyan stripes will remove the red component of the light while the green stripes will remove red and blue. After passing the signal through a low-pass filter the output will be evened out to give us a luminance signal.

Now let's consider the colour side of things. The stripes represent a carrier frequency of 4·1MHz. If we pass the output from the vidicon through a bandpass filter with a centre frequency of 4·1MHz we will get the signal shown at A in Fig. 2. Pass this through a pair of envelope detectors to recover the upper and lower sides of the envelope waveform and we get the signals shown at B. These are symmetrical, equal and opposite. Add them together and they cancel, which is what we want since the signal has no colour information. What happens when colour is present in the scene being viewed by the vidicon is that the outputs from the detectors are no longer symmetrical and no longer cancel. Because of the way in which the stripe filter is arranged we then get an R signal from one detector and a −B signal from the other.

A block diagram of the colour signal processing system is shown in Fig. 3. For PAL encoding we require R − Y and B − Y signals of course. Subtracting the luminance signal from R gives us R − Y, adding it to our −B signal gives us Y − B, which is the same thing as −B + Y or − (B − Y). Note that the luminance signal is passed through a second filter before being used to produce the colour-difference signals. This is done to reduce its bandwidth to that of the chroma channel in order to avoid spurious beat patterns.

The circuitry used in the 3V06 camera is shown in simplified form in Fig. 4. In this case the vidicon's colour signal frequency is 3·8MHz. The colour multiple signal (CMS) is applied to the base of the emitter-follower transistor X12. High- and low-pass filters then separate the luminance and colour components of the signal. After buffering by X43 the colour signal splits into two paths to go to the upper and lower envelope detectors. D51/D52 detect the part upper of the envelope while D61/D62 detect the lower part of the envelope. Because of the polarity of the signal D51/2 produce −B and D61/2 R. Both circuits include emitter-followers and X55 feeds an adjustable amount of the R signal into the B channel – VR53 acts as the −B gain control while VR52 provides

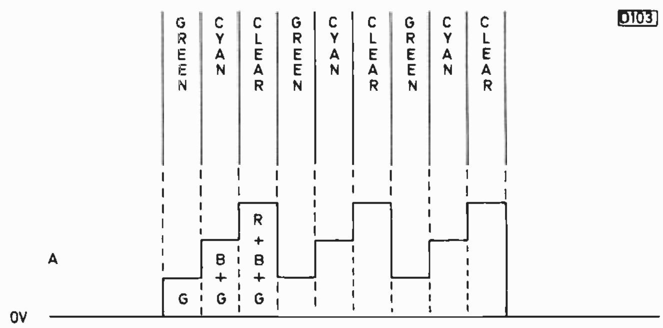


Fig. 1: Vertical colour stripe filter used with the step energy recovery colour-separation system.

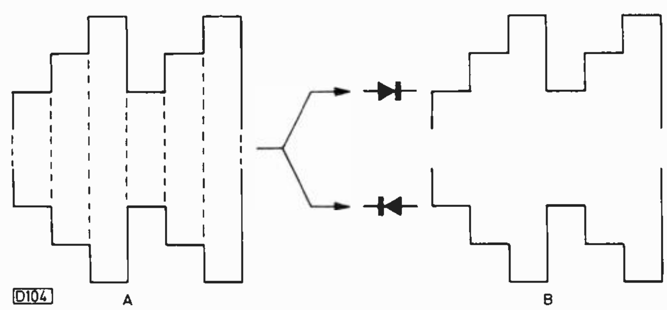


Fig. 2: Use of detectors to recover the two sides of the signal envelope.

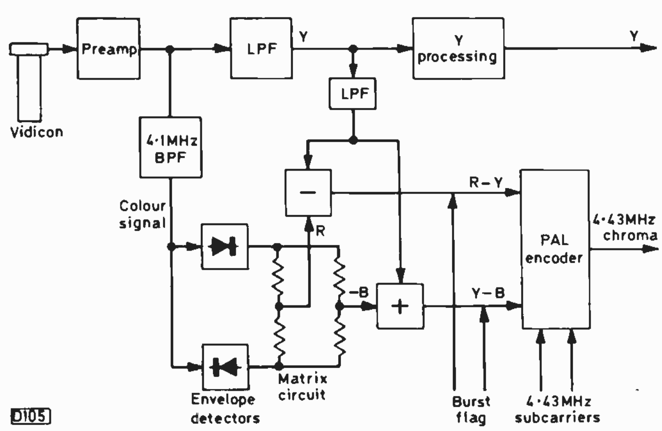


Fig. 3: Block diagram showing signal processing with the step energy recovery colour-separation system.

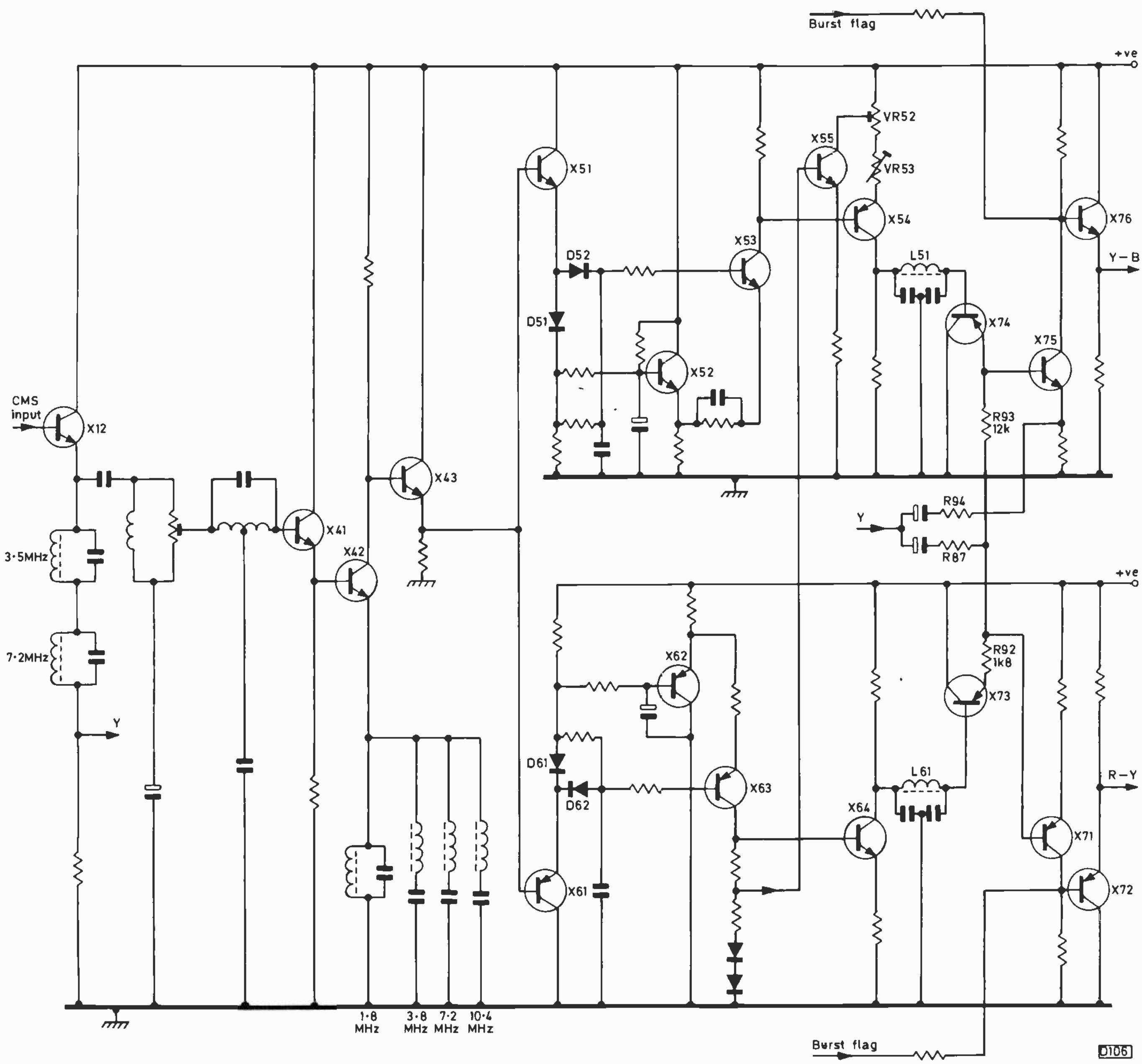


Fig. 4: Colour circuitry used in the Ferguson 3V06 camera – simplified.

phase adjustment. This is part of the matrixing process. Further matrixing is carried out by R92 and R93. The luminance signal is introduced at this point – applied to the base of X71 and the emitter of X75. Carrier rejection filters are present in each signal path. The net result of all this is that we get Y − B at the emitter of X76 and R − Y at the emitter of X72.

Linearity and Focus

To produce a correct colour display on the monitor, the vidicon's line scanning must be perfectly linear (to ensure that the colour carrier frequency is constant) and of the correct amplitude (to ensure that the carrier frequency is correct). Any carrier frequency errors will result in reduced amplitude outputs, due to the signal loss in the filtering circuits.

Similarly if the scanning spot isn't accurately focused no carrier will be produced at all, as the spot size will exceed the stripe width. Focus setting is in fact very critical. It's carried out by monitoring the colour carrier with a scope – colour is lost before any picture blurring is noticeable on the monitor.

The problem of making the line scan linear is solved by feeding a combination of sawtooth and parabolic currents to the deflection yoke. If this sounds familiar, yes the controls do have the same names as some of the convergence controls used with a delta-gun colour tube. Sometimes there are tilt and second harmonic controls too.

On cameras using delay line colour-signal processing (described last month) the vertical scanning is just as important, in order to maintain the correct spacing between the scanning lines. Errors lead to phase changes (coloured shading). So we have another set of potentiometers – for vertical shading correction.

The method of adjustment is to point the camera at an evenly illuminated peak white card and adjust for zero colour-difference signals at all parts of the raster. Adjustment is very long-winded, has to be repeated several times, and should not be undertaken lightly. For numbers

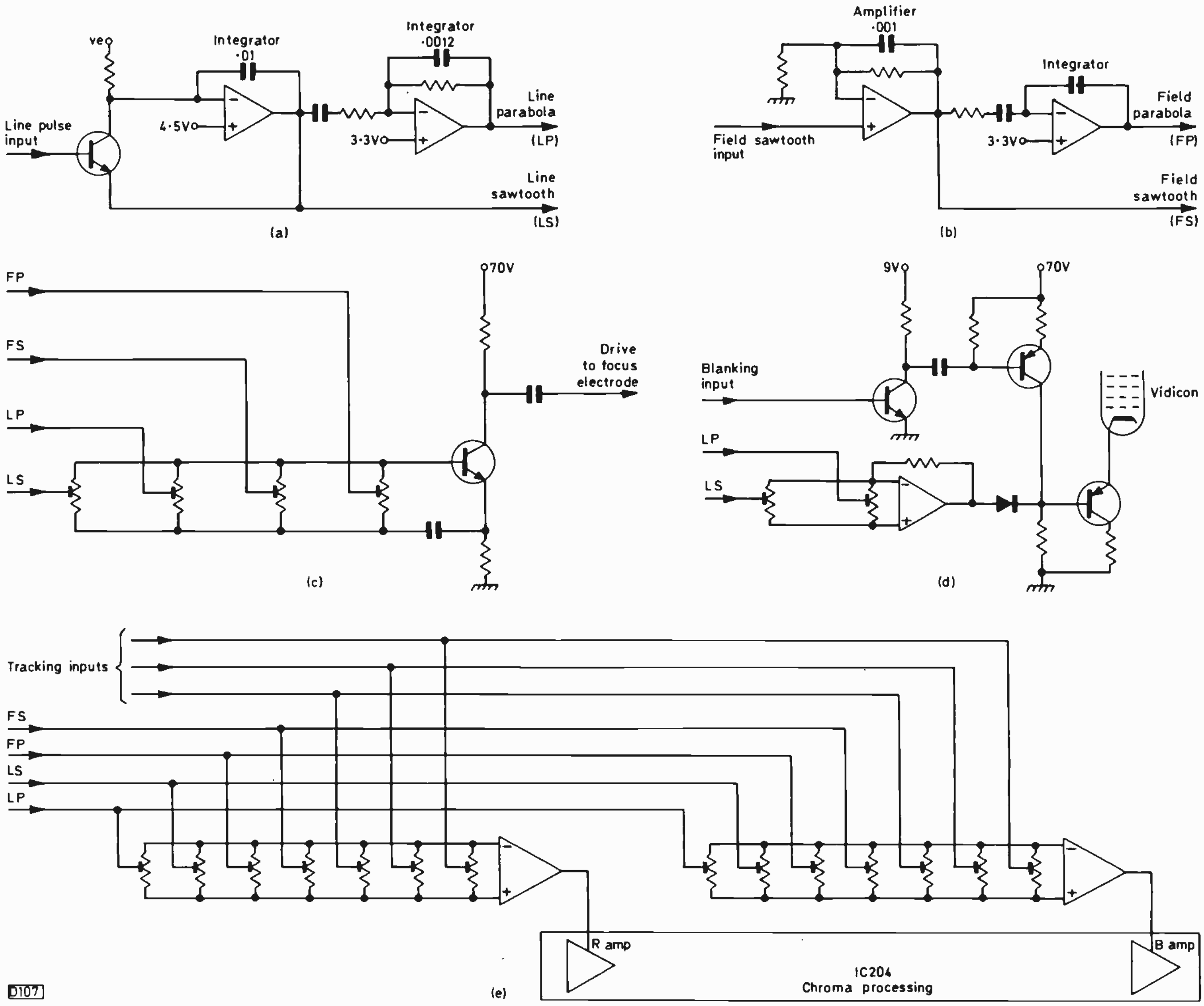


Fig. 5: Generating and using field and line frequency correction waveforms: (d) Shows dark current shading correction, (e) chroma shading correction.

of presets per square inch, video cameras must be top of the league.

We haven't paid much attention to the luminance channel. It's usually fairly straightforward but there are a few other points that require explanation.

Vidicon Modulation

When all light is removed from the camera, say by putting the lens cap on, a small beam current still flows in the vidicon. This is known as the dark current and is adjustable by varying the grid-cathode bias. Unfortunately the dark current is not quite d.c. – it contains a line-frequency component that would cause shading at one or both edges of the display. Compensation is provided by driving the cathode with a correction circuit that has both sawtooth and parabolic line waveform inputs.

The need for accurate focusing has already been mentioned. Vertical and horizontal waveforms are used to modulate the focus electrode so that the effect of changing beam length on spot shape is corrected.

Fig. 5 shows the generation and use of the various correction waveforms in the Panasonic 3000 camera. My previous comment about presets will be appreciated! Excluding the six controls labelled tracking, the rest of the circuit should be self-explanatory. We'll come to tracking later.

Dark Current Offset

As mentioned last month, there's an opaque optical black (OB) section on the front of the vidicon. The current produced when this is scanned corresponds to the vidicon's dark current – the OB is actually outside the active area of the target, so there's a difference between OB current and the normal dark current (OB offset). As the dark current is temperature dependent, this offset must be monitored and corrected to zero. Yet another adjustment!

AGC

As the colour carrier in effect rides on the edge of the luminance signal, excessive luminance amplitude will cause peak white crushing and loss of the colour carrier – the effect being green burnt-out highlights. To minimise this effect we need some form of beam current limiter and an a.g.c. system to provide a linear gain reduction in the luminance channel. The auto iris does this to a certain extent, but the usual arrangement is to provide gain reduction while the iris is in operation and remove this when the iris is wide open, thus giving increased gain for low light conditions. The result is a much wider dynamic range. There are three user accessible coarse a.g.c. settings on the Sony 3000.

Gamma Correction

Both the vidicon and the monitor's c.r.t. are non-linear devices in converting light to current and vice versa. To correct for this it's necessary to amplify the luminance signal in a non-linear manner – and the non-linearity must also be adjustable. The colour carrier amplitude is for the same reason reduced at low light levels.

For camera setting up a double grey-scale wedge, which is a rather expensive and accurately produced test chart, is used – see Fig. 6. Three tracking signals are produced by processing the luminance signal with successive low-pass filters and employing level detectors. The tracking range corresponds to roughly a third of the luminance range. By modulating the gains of the R and B channels with these three signals the colour carrier amplitude can be kept fairly constant – this system is used by Panasonic. Further gamma correction is required in each colour channel, also white balance.

Colour Temperature

It's necessary to correct for the different colour temperature of light from different sources – tungsten lighting and an overcast sky, to give the two extremes. Nearly all cameras have a built-in filter, of yellow-orange colour, which is moved into the optical path when the daylight setting is selected. This lowers the colour temperature of the daylight to something like 3,000°K. We could just as easily insert a blue filter for the indoor setting, but filters reduce the image brightness by an amount called the filter factor and we generally have a greater amount of light to spare when operating outside. Between these two settings we have to compensate for small differences within the shift of 2,000°K that the filter gives. Simpler cameras achieve this by means of a hue control that usually varies the gains of the R and B channels differentially. This is adjusted until the colour looks about right. The disadvantage of this system is that a colour monitor isn't always handy.

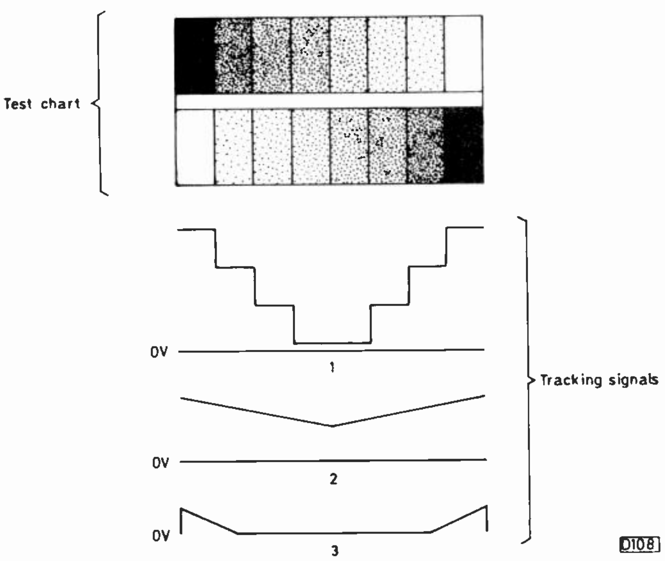


Fig. 6: Double grey-scale wedge and tracking signals.

It's useful to be able to adjust the hue until a white subject produces no colour signal – the balance between R and B must then be correct. In some cameras this is done by capping the lens with a translucent polythene diffuser and pointing the camera at a light source. The result should be an output devoid of colour information. The peak amplitude of the CMS signal from the tube is lower when there's no colour carrier, so a peak detector can be used to monitor the CMS signal, the output from the detector being used to move a line on the EVF display. This system is used in the Sony 3000 camera, which also has a four-position light-source switch – the four positions switch a series of resistors into the gain-controlled sections of the R and B channels, two of the positions inserting a filter.

Other cameras carry out the white balance adjustment automatically by storing the amplitudes of the colour-difference signals produced by the neutral light source via the diffuser lens cap whilst in the "set white" mode. In subsequent use these two values determine the gains of the R and B channels.

This business of colour temperature might puzzle you: after all we don't ourselves see any difference in colour when the colour temperature of the light source is changed. If the image is recorded however then the difference in overall colour becomes evident. Why this should be so is not fully understood. Recent theories suggest that although the eye sees a scene in similar fashion to a camera tube – or colour film – the brain adjusts the results so that the image we actually "see" depends on the colour difference between adjacent elements rather than their actual colours. When we record an image, the photograph or monitor picture is only a part of the total scene we see, so we see it as it was recorded without mental correction.

Servicing Hints

We'll close with a few quick servicing hints.

No results, camera "dead", zoom motor not working: check the camera lead which may be open-circuit near the plug, the fuse in the camera, and the regulator which may be producing no output.

No monitor picture, sound o.k.: check the vidicon's high-voltage supplies – if missing the converter or line output stage is probably at fault, though failure of the field timebase might result in the protection circuit stopping the line oscillator.

Green picture with no chroma: adjust the electronic focusing.

Very faint display with vague, moving vertical bars: the camera's field timebase has failed.

Image or bright marks on the picture, remaining when the lens is capped: vidicon target has a burn caused by pointing the camera at a bright light. Try pointing the camera at a white card for fifteen minutes. If this produces no improvement the vidicon will have to be replaced. It's a long and expensive job – don't undertake it without the manual and all the equipment specified in the manual.

What Next?

That's it for now. Next time we'll look at something new, nothing to do with either VCRs or cameras but an item that many TV shops are now selling and which many service engineers will be called upon to repair – yes, the home computer!

Sony KV1820 GCS Conversion

Keith Cummins

Recently I bought a Sony KV1820UB from a colleague: the set was a non-worker and had caused several headaches during attempts to get it to work. It turned out that the line output transformer was defective, with a shorted turn, and that this had caused the line output gate-controlled switch Q901 (SG613) to fail. I rewound the transformer, which was a tedious task but not costly as I was doing the job myself. The next step was to ring my ex-colleagues in the TV trade to see whether they could supply an SG613. The conversation went along the lines:

"Oh, we don't service those sets any more. They're too much trouble: you can easily blow up the line output device and they're fifteen quid a throw. In any case we've not got one, though we could order one for you. Are you sure you want to risk fifteen quid? How come you're getting yourself involved with one of those sets anyway? – I'd keep clear of it if I was you."

So I said I'd think the whole thing through. What I meant was that I couldn't see why the line output device had to be a GCS – most other manufacturers at the time used a perfectly ordinary line output transistor that costs much less. A perusal of the ads in *Television* showed that the BU208A is available for around £1·65. That's more like it! All I had to do now was to investigate the possibility of fitting one.

From the mechanical point of view the BU208A in its TO3 can won't fit where the SG613 lives: there's plenty of room just above the SG613's site to drill the holes necessary to mount a BU208A however. In fact the top SG613 mounting hole can be used as the bottom hole for the BU208A. The TO3 mounting kit washer can be used as a template to mark out the drilling centres.

Electrical Considerations

The idea appeared to be practical from the mechanical point of view therefore. What about the electronic aspects? Fig. 1 shows the original circuitry involved. The two 33Ω parallel resistors R809/10 limit the gate drive current in the positive direction while diode D805 provides a solid negative turn-off for the SG613. This circuit is not suitable as it stands for driving a BU208A: the base drive requirements for a switching transistor are stringent – and are not too well understood.

A line output transistor must be switched on and off rapidly to minimise dissipation, which can rise to a dangerous level if the switching action takes too long. The main difficulty arises with the switch-off stage of the cycle. Driving the base negatively will reverse bias the base-emitter junction, cutting off the flow of emitter current, but a considerable charge will remain in the base region and the transistor will not cease to conduct until this has been removed. This process occurs while the collector voltage is swinging positively due to the flyback pulse. There are two problems here: high dissipation, aggravated by switch-off delay since the base-collector junction is reverse biased, behaving as a slow-recovery diode. As the current falls and the collector voltage increases, heating occurs at the base-collector junction. The reverse recovery time increases with temperature, so the effect is cumulative and can result in destruction of the transistor.

During the transitional turn-off phase of the transistor's switching the base current must not be optimised to minimise the charge storage time: the requirement is for minimum current fall time, which occurs when the collector and emitter currents fall to zero simultaneously. One way of achieving this result is to place a small inductance in series with the base (in practice the driver transformer

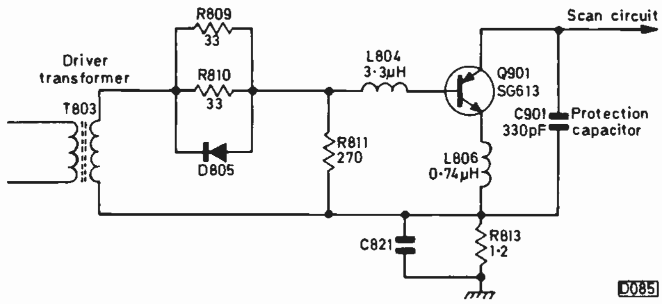


Fig. 1: Original circuit used in the Sony KV1820.

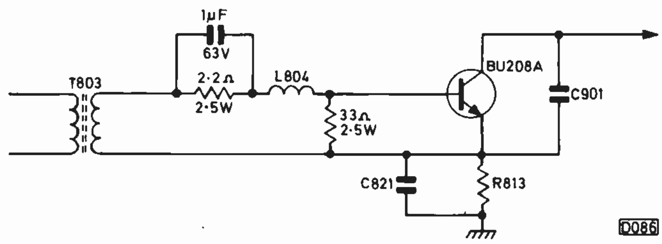


Fig. 2: Modified circuit with a BU208A transistor as the line output device. L806 is replaced by a link; R809 is removed; R810 is replaced with a 2·2Ω, 2·5W resistor; D805 is replaced with a 1uF, 63V non-polarised electrolytic; R811 is removed; the 33Ω, 2·5W resistor is added across the pins of the BU208A (see Fig. 4).

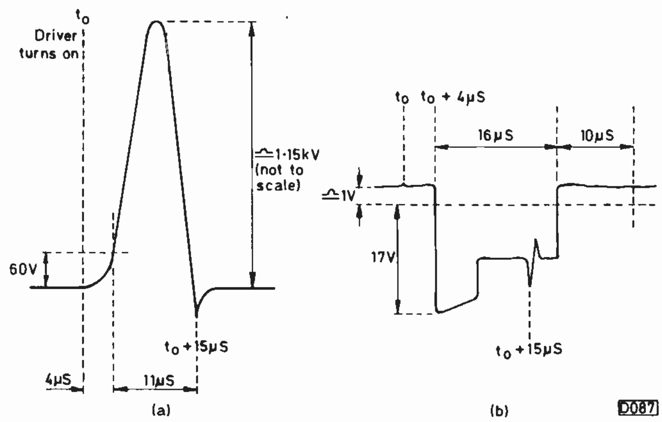


Fig. 3: Waveforms. (a) BU208A collector; (b) BU208A base. Scope – Philips 3212 with X10 probe.

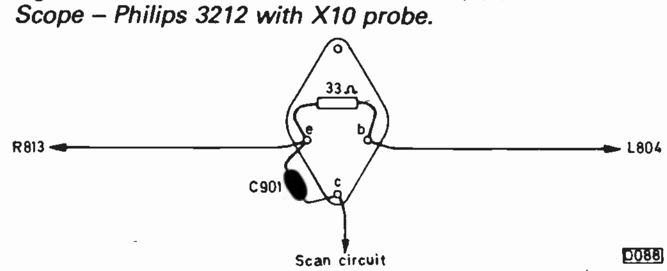


Fig. 4: Component layout around the BU208A.

is generally designed so that its leakage inductance serves this purpose) and to include resistance to limit the reverse base current during this critical part of the cycle.

During the turn-on phase the current must rise steeply, preferably with overshoot, to a level at which the transistor is held saturated for the on period of the cycle.

Practical Circuit

The drive circuit adopted is shown in Fig. 2. The 2·2Ω resistor in series with the base limits the current for both forward and reverse base drive. The 1μF capacitor provides overshoot by its shunting effect on the resistor. The 3·3μH choke is already present in the form of L804 and appears to be satisfactory as the inductance required. The 33Ω base-emitter resistor is fitted directly across the transistor's pins while the small choke (L806) in series with the GCS's cathode in the original circuit is shorted out.

An oscilloscope and variac were essential to enable the conditions to be monitored and thus ensure that the transistor's operating conditions are satisfactory. Fig. 3(a) shows the collector voltage waveform. The critical area lies in the 4μsec period during which the voltage starts to rise: lack of squareness here shows that energy is being dissipated while the transistor is turning off. There's only a slight rounding in the corner however, indicating that the dissipation has been minimised – and by considering the earlier remarks about base drive it will be seen that some of this dissipation is distributed in the base circuit resistors. High-voltage switching transistors are very reliable – provided they are driven correctly. The peak voltage of approximately 1·15kV is well within the device's quoted maximum collector-emitter voltage rating (1·5kV).

Fig. 3(b) shows the voltage waveform at the base of the BU208A, which requires greater drive than the original SG613 device. There appears to be plenty of drive available however and the driver transistor seems to cope easily. The losses in the driver transformer T803 are greater: this didn't appear to cause a problem and a small heatsink was added to the top, using Araldite. The transformer now runs cooler.

Conclusions

What can we conclude from all this? The line output device acts as a switch, and we can substitute one sort of switch for another. The suggested replacement is cheap and has a good track record for reliability compared with the SG613. The modifications are quite simple – the most demanding bit being to drill the heatsink to take the BU208A (this task can hardly be classed as a mind bender!). We can take heart from the fact that if an accident does occur it's not likely to be expensive. The parts required are generally available, not Sony specials. Good engineering practice is essential of course – plenty of heatsink compound on both sides of the BU208A's insulating washer and good soldered joints. Fig. 4 shows the layout at the BU208A.

It seems to me that this modification would also work for the KV2000UB. The KV1820UB I modified was a Mk. II version. Remember that when carrying out any repairs in the chopper and line output stages of these receivers a variac is essential – as mentioned in previous trouble-shooting articles in the magazine. I found David Botto's articles in the August/September 1984 issues very helpful during my investigation.

ECONOMIC DEVICES, PO BOX 228, TELFORD TF2 8QP

16029	1.58
16181	1.13
16182	1.13
16334	0.88
16335	0.72
16446	0.89
16600	1.25
16799	2.16
16801	0.86
16802	1.03
16803	4.81
16905	1.35
17074	6.00
17127	3.91
17376	1.43
1N4001	0.05
1N4002	0.05
1N4003	0.05
1N4004	0.06
1N4005	0.07
1N4006	0.07
1N4007	0.07
1N4148	0.03
1N4448	0.12
1N5401	0.12
1N5402	0.13
1N5403	0.14
1N5404	0.15
1N5408	0.18
1N914	0.05
1S44	0.06
1S5012A	0.73
1S921	0.09
2582	1.94
2N1302	0.24
2N1303	0.34
2N2218	0.38
2N2219A	0.29
2N2222	0.34
2N2646	0.75
2N2904	0.32
2N2905	0.39
2N2906	0.34
2N3053	0.24
2N3054	0.90
2N3055	0.55
2N3055H	0.77
2N3442	1.05
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.12
2N3706	0.12
2N3707	0.14
2N3711	0.14
2N3771	1.85
2N3772	1.55
2N3773	1.65
2N3819	0.28
2N3823	1.06
2N3904	0.56
2N3908	0.56
2N4101	1.10
2N4240	3.00
2N4443	1.35
2N4444	1.12
2N4914	0.65
2N5064	0.64
2N5293	0.45
2N5294	0.45
2N5296	0.40
2N5297	0.45
2N5298	0.55
2N5490	1.35
2N5496	0.45
2N6107	0.53
2N6109	1.43
2N6122	1.60
2N6130	0.65
2N6133	0.57
2N6178	0.66
2N6180	0.66
2N696	0.39
2N698	0.39
2N707	0.39
2SA1027	1.15
2SA1076	1.78
2SA329	0.36
2SA351	1.06
2SA489	1.06
2SA490	1.51
2SA493	0.95
2SA628	1.03
2SA637	1.32
2SA673	1.11
2SA683	1.46
2SA684	1.33
2SA748	0.68
2SA818	1.65
2SA835	2.27
2SA940	1.64
2SA951	1.23
2SA966-Y	0.54
2SB325	3.51
2SB337	1.65
2SB375	3.51
2SB400	0.36
2SB407	2.94
2SB411	3.00
2SB511	1.48
2SB54	1.26
2SB56	1.26
2SB618A	1.40
2SB681	2.44
2SB695	1.70
2SB75	0.94
2SB861	0.68
2SC1034	5.61
2SC1050	3.66
2SC1061	0.54
2SC1096	1.05
2SC1104	2.60
2SC1106	4.12
2SC1114	5.61
2SC1124	1.10
2SC1151A	4.29
2SC1152	4.25
2SC1157	4.12
2SC1162	0.95
2SC1172	1.92
2SC1195	2.83
2SC1213	0.75
2SC1226	1.32
2SC1306	0.85
2SC1307	1.35
2SC1316	3.40
2SC1364	0.49
2SC1383	1.39
2SC1398	0.51
2SC1410	2.17
2SC1413	3.68
2SC1505	0.56
2SC1578	6.67
2SC1617	3.35
2SC1670	2.84
2SC1678	1.25
2SC1810	1.40
2SC1815	0.41
2SC1829	2.01
2SC1875	4.77
2SC1891	3.35
2SC1929	2.25
2SC1942	5.70
2SC1945	4.11
2SC1953	1.75
2SC1957	0.86
2SC1959	0.36
2SC1962	1.75
2SC1969	2.92
2SC2027	2.67
2SC2028	1.91
2SC2029	1.49
2SC2057	1.07
2SC2073	1.40
2SC2078	1.25
2SC2091	0.59
2SC2122A	4.65
2SC2141	1.69
2SC2166	1.35
2SC2216	0.62
2SC2233	2.20
2SC2271	3.64
2SC2278	1.03
2SC2335-KIT	7.61
2SC2526	1.70
2SC2551	0.95
2SC2570	1.80
2SC2570A	0.95
2SC264A	4.38
2SC2671	1.99
2SC2728	0.95
2SC372	1.27
2SC373	1.05
2SC383	1.20
2SC388	0.45
2SC41	1.99
2SC458	0.55
2SC495	0.83
2SC508	3.36
2SC515A	1.28
2SC537	0.49
2SC558	3.35
2SC605L	1.05
2SC620	1.32
2SC643A	1.40
2SC673	1.11
2SC681	4.00
2SC684	1.50
2SC685A	2.62
2SC693	0.69
2SC710	0.62
2SC717	1.92
2SC734	1.30
2SC735	1.05
2SC782	2.24
2SC790	1.15
2SC806	10.26
2SC814	1.26
2SC828	0.25
2SC867A	2.49
2SC926A	1.29
2SC930	0.49
2SC935	3.75
2SC936	1.58
2SC937	3.25
2SC940	4.25
2SD1138	0.78
2SD198	3.51
2SD234	0.42
2SD235	0.54
2SD257	2.67
2SD291	2.67
2SD292	2.35
2SD313	2.59
2SD315	2.67
2SD325D	1.36
2SD350	7.03
2SD350A	2.08
2SD353	3.25
2SD389	2.19
2SD401	1.57
2SD551	2.20
2SD588A	1.25
2SD621	8.88
2SD657	2.54
2SD731	1.72
2SD811	3.86
2SD869	2.40
2SD898B	2.67
40408	0.45
40594	1.39
40595	1.39
40636	0.86
40871	1.39
40872	1.39
60857	1.10
74LS132	0.72
74LS138	0.85
74LS157	0.79
74LS161AN	1.18
74LS196	1.25
74LS20	0.25
74LS244	1.65
74LS30	0.29
74LS367	1.05
74LS373	1.55
74LS47	1.05
74LS73	0.39
74LS74	0.39
74LS75	0.52
74LS86	0.49
74LS90	0.75
74LS92	0.75
74LS93	0.75
74LS95B	0.85
7805 TO-220	0.63
7805 TO-3	1.05
7806	0.66
7808	0.54
7812 TO-3	0.54
7812 TO-220	1.05
7815	0.55
7818	0.55
7824	0.55
AC107	0.66
AC117	0.39
AC123K	0.39
AC128	0.28
AC138	0.08
AC141	0.26
AC142K	0.39
AC151	0.25
AC153	0.30
AC153K	0.36
AC176	0.17
AC176K	0.40
AC179	0.25
AC183	0.65
AC186	0.30
AC186K	0.50
AC187	0.35
AC187-01	0.40
AC187K	0.39
AC188	0.33
AC188-01	0.40
AC188K	0.39
AC193K	0.59
AC194K	0.59
AD140	0.96
AD142	0.96
AD143	0.96
AD145	1.45
AD149	0.81
AD161	0.30
AD162	0.30
AD262	0.95
AF114	2.24
AF115	0.79
AF116	0.79
AF117	0.75
AF118	0.75
AF121	0.50
AF124	0.36
AF125	0.36
AF126	0.36
AF127	0.36
AF139	0.48
AF178	0.75
AF179	0.50
AF180	0.50
AF181	0.48
AF182	0.50
AF186	0.48
AF239	0.48
AF279	0.80
AL100	3.66
AL102	1.75
AL103	2.43
AL113	1.80
AN208	3.22
AN210	2.07
AN214	2.05
AN214Q	2.05
AN231	5.56
AN234	5.02
AN235	4.84
AN236	3.02
AN238	4.98
AN239	3.95
AN240P	1.88
AN241	1.55
AN245	2.54
AN247P	2.62
AN252	2.33
AN253	2.70
AN262	1.58
AN272	5.36
AN281	5.52
AN295	5.01
AN301	3.30
AN302	3.62
AN303	3.25
AN305	8.07
AN313	3.10
AN315	2.12
AN316	5.58
AN318	4.75
AN320	4.97
AN322	4.38
AN331	2.99
AN337	3.99
AN340P	1.06
AN355	3.36
AN362	1.47
AN5111	2.34
AN5132	3.99
AN5250	3.33
AN5435	2.80
AN5610	6.75
AN5613	3.72
AN5620X	4.63
AN6320N	3.89
AN6342	1.36
AN6344	4.68
AN6363	10.20
AN6551	0.56
AN6552	0.52
AN7145	2.04
AN7150	2.22
AN7151	2.05
AN7156	2.05
AN7158	2.34
AN7218	1.49
AP58076	4.25
AS560S	1.43
AU106	1.96
AU110	1.96
AU113	2.15
AY102	2.62
AY105K	1.89
AY106	1.98
BA102	0.30
BA1310 (IC)	1.72
BA1320 (IC)	1.22
BA1330 (IC)	1.82
BA145	0.17
BA154	0.08
BA155-01	0.12
BA156	0.12
BA157	0.17
BA159	0.12
BA182	0.17
BA222 (IC)	1.26
BA284/2	0.15
BA301 (IC)	0.92
BA302	0.90
BA311 (IC)	1.06
BA312 (IC)	0.98
BA313 (IC)	1.28
BA316	0.07
BA317	0.07
BA318	0.08
BA328 (IC)	0.80
BA333 (IC)	1.24
BA401 (IC)	0.58
BA511 (IC)	1.98
BA521 (IC)	1.81
BA532 (IC)	1.88
BA536 (IC)	2.72
BA6304A (IC)	2.65
BA843 (IC)	3.60
BAV10	0.10
BAV18	0.10
BAV19	0.10
BAV20	0.10
BAV21	0.17
BAX12	0.10
BAX13	0.10
BAX16	0.10
BB105B	0.22
BB119	0.15
BC107	0.13
BC107B	0.14
BC108	0.12
BC108A	0.12
BC108B	0.15
BC109	0.11
BC109B	0.13
BC113	0.12
BC114	0.17
BC115	0.14
BC116	0.20
BC116A	0.53
BC117	0.18
BC118	0.18
BC119	0.30
BC125	0.18
BC126	0.18
BC132	0.12
BC135	0.12
BC136	0.15
BC137	0.16
BC138	0.30
BC139	0.32
BC140	0.33
BC141	0.28
BC142	0.30
BC143	0.28
BC147	0.10
BC147A	0.42
BC148	0.11
BC148B	0.11
BC148C	0.11
BC149	0.10
BC149B	0.11
BC153	0.12
BC154	0.12
BC157	0.14
BC158	0.09
BC159	0.14
BC160	0.36
BC161	0.36
BC167	0.32
BC168	0.32
BC169C	0.14
BC170	0.14
BC171	0.10
BC172	0.09
BC172B	0.24
BC173	0.15
BC174B	0.24
BC177	0.18
BC178	0.23
BC179	0.23
BC182	0.08
BC182B	0.23
BC182L	0.09
BC182LB	0.12
BC183	0.09
BC183L	0.09
BC183LB	0.23
BC184	0.09
BC184L	0.09
BC184LB	0.23
BC186	0.24
BC187	0.18
BC204	0.14
BC207	0.12
BC212	0.10
BC212B	0.23
BC212L	0.09
BC212LB	0.23
BC213	0.09
BC213L	0.09
BC213LB	0.23
BC214	0.09
BC214L	0.12
BC214LB	0.23
BC225	0.24
BC237	0.09
BC238	0.09
BC238A	0.11
BC239B	0.08
BC251A	0.15
BC252	0.12
BC258	0.22
BC261A	0.20
BC262	0.20
BC287	0.45
BC294	0.45
BC301	0.36
BC302	0.30
BC303	0.34
BC307	0.09
BC307A	0.14
BC308	0.12
BC308A	0.09
BC309	0.15
BC317A	0.11
BC323	0.92
BC327	0.15
BC328	0.10
BC337	0.08
BC338	0.10
BC360	0.30
BC368	0.23
BC440	0.99
BC441	0.40
BC454	0.32
BC455	0.32
BC460	0.38
BC461	0.42
BC462	0.27
BC463	0.58
BC464	0.58
BC465	0.58
BC477	0.25
BC478	0.29
BC479	0.29
BC532	0.25
BC546	0.15
BC547	0.09
BC548	0.09
BC549	0.09
BC550	0.36
BC556	0.12
BC557	0.09
BC558	0.09
BC559	0.09
BC560C	0.10
BC635	0.18
BC636	0.18
BC637	0.18
BC638	0.18
BC639	0.18
BC640	0.18
BC879	0.28
BC880	0.28
BCX32	0.33
BCX33	0.24
BCX34	0.36
BCX37	0.60
BCY70	0.27
BCY71	0.19
BCY72	0.18
BD115	0.29
BD116	0.63
BD124	1.19
BD124P+KIT	0.62
BD131	0.38
BD132	0.38
BD133	0.48
BD135	0.32
BD136	0.32
BD137	0.32
BD138	0.41
BD139	0.27
BD140	0.33
BD144	1.30
BD150	1.08
BD157	0.60
BD159	0.48
BD160	1.45
BD163	0.64
BD165	0.56
BD166	0.38
BD168	0.66
BD175	0.39
BD177	0.39
BD179	0.44
BD181	0.90
BD182	0.90
BD183	0.90
BD184	1.10
BD187	0.48
BD189	0.35
BD190	0.59
BD201	0.54
BD202	0.54
BD203	0.54
BD204	0.54
BD207	1.00
BD208	1.00
BD222	0.44
BD225	0.44
BD228	0.57
BD229	0.63
BD231	0.45
BD232	0.44
BD234	0.38
BD235	0.43
BD236	0.45
BD237	0.38
BD238	0.29
BD239	0.44
BD240	0.36
BD240D	0.47
BD241	0.45
BD242	0.45
BD243	0.44
BD243A	0.50
BD244	0.44
BD244A	0.77
BD245C	0.68
BD246C	0.74
BD253	0.95
BD278A	0.60
BD317	1.96
BD318	2.08
BD375	0.38
BD377	0.23
BD379	0.69
BD380	0.69
BD410	0.44
BD412	5.70
BD418	0.76
BD433	0.33
BD434	0.39
BD435	0.42
BD436	0.42
BD437	0.41
BD438	0.44
BD441	1.29
BD442	0.56
BD507	0.54
BD508	0.54
BD509	1.29
BD510	0.45
BD518	1.36
BD519	1.36
BD529	0.38
BD530	0.60
BD533	0.60
BD534	0.36
BD535	0.44
BD536	0.55
BD537	0.60
BD538	0.60
BD544B	0.75
BD580	1.06
BD590	1.06
BD598	1.13
BD645	3.62
BD677	0.55
BD680	0.69
BD681	1.34
BD695	2.09
BD696	2.24
BD697	3.27
BD698	1.68
BD699	3.17
BD700	3.36
BD702	2.94
BD707	0.55
BD709	0.72
BD710	0.72
BD807	0.60
BD809	0.60
BD810	0.60
BD879	0.64
BD880	0.65
BD895	1.98
BD899	2.25
BD901	0.55
BDV64B	1.14
BDV65B	1.14
BDX32	1.50
BDX53	0.80
BDX53A	3.68
BDX54B	2.37
BDX62A	1.92
BDX63A	1.95
BDX64A	2.37
BDX65A	2.37
BDX76	0.53
BDY20	1.10
BDY62/01	4.20
BDY81	1.87
BF115	0.36
BF117	0.36
BF118	0.60
BF121	0.22
BF123	0.11
BF127	0.11
BF137	0.11
BF152	0.28
BF153	0.52
BF154	0.23
BF157	0.23
BF158	0.16
BF159	0.16
BF160	0.28
BF167	0.34
BF173	0.30
BF177	0.50
BF178	0.36
BF179	0.32
BF180	0.32
BF181	0.29
BF182	0.30
BF183	0.35
BF184	0.39
BF185	0.35
BF194	0.15
BF195	0.12
BF196	0.15
BF197	0.14
BF198	0.15
BF199	0.15
BF200	0.33
BF216	0.32
BF218	0.32
BF222	0.50
BF224	0.15
BF237	0.59
BF240	0.15
BF241	0.15
BF244	0.23
BF245A	0.33
BF255	0.18
BF256	0.25
BF256LC	0.38
BF257	0.30
BF258	0.29
BF259	0.30
BF262	0.51
BF263	0.51
BF264	0.33
BF271	0.30
BF273	0.18
BF274	0.18
BF324	0.16
BF336	0.27
BF337	0.36
BF338	0.36
BF355	0.36
BF362	0.54
BF363	0.54
BF371	0.45
BF391	0.36
BF393	0.90
BF417	1.20
BF418	1.70
BF422	0.26
BF423	0.26
BF435	0.49
BF450	0.30
BF451	0.26
BF457	0.37
BF458	0.35
BF459	0.35
BF460	0.54
BF469	0.27
BF470	0.28
BF471	0.28
BF472	0.28
BF479	0.55
BF480	0.54
BF495	0.58
BF506	0.39
BF509	0.37
BF523	0.18
BF594	0.24
BF595	0.24
BF596	0.16
BF597	0.24
BF617	0.95
BF618	0.95
BF694	0.20
BF757	0.59
BF758	0.59
BF759	0.30
BF760	0.59
BF762	0.30
BF870	0.27
BF871	0.84
BF900	0.68
BF907	1.62
BF959	0.38
BF970	0.55
BFR39	0.36
BFR52	0.45
BFR62	0.36
BFR79	0.29
BFR81	0.45
BFR86	0.98
BFR89	0.39
BFT41	0.27
BFT42	0.39
BFT43	0.39
BFT84	0.36
BFW10	0.79
BFX29	0.30
BFX30	0.59
BFX84	0.33
BFX85	0.25
BFX87	0.50
BFX88	0.30
BFX89	0.36
BFY50	0.24
BFY51	0.24
BFY52	0.24
BFY90	0.96
BLY49	2.00
BR100	0.20
BR101	0.37
BR103	0.45
BR88B	0.58
BRC-M-300	1.58
BRC116	0.60
BRC1330	1.60
BRC300	1.82
BRC4443	1.12
BRC4444	1.12
BRC5296	0.70
BRC6109	0.75
BRC82	0.98
BRC83	0.98
BRC84	0.98
BRX44	0.54
BRX49	0.45
BRY39	0.50
BRY55	0.60
BRY56	0.38
BSR59	1.17
BSS38	0.30
BSTBD1409	2.48
BSTBO1405	4.37
BSTC0146	2.25
BSTC0233	2.25
BSTC0246	4.51
BSTC1233	3.91
BSTC3146	0.71
BSTCC0143	2.79
BSTC0643	3.06
BSV57B	2.66
BSW68	0.38
BSX19	0.30
BSX20	0.30
BSX21	0.45
BSY52	0.45
BSY79	0.46
BT100A	1.46
BT106	1.20
BT108	1.31
BT109	1.31
BT112	2.25
BT113	2.25
BT116	1.52
BT119	1.60
BT120	1.60
BT121	2.25
BT122	2.25
BT123	1.80
BT125	2.25
BT126	2.25
BT128	2.25
BT128P	2.79
BT129	2.25
BT151-800R	1.47
BT151 500R	1.25
BTT6018	2.20
BTT6218	2.20
BTT8024	4.02
BTT8124	4.44
BTT8214	5.44
BTT8224	2.70
BU105	1.66
BU106	2.25
BU108	1.90
BU109S	1.90
BU110	2.52
BU111Y	3.78
BU124	1.25
BU126	1.11
BU134S	4.15
BU204	1.29
BU205	0.98
BU206	1.20
BU207	1.50
BU208	0.98
BU208/02	0.98
BU208A	0.98
BU208D	1.43
BU209	1.60
BU226	2.08
BU312	2.16
BU326	0.75
BU326A	1.40
BU326S	2.25
BU406	1.35
BU407	0.74
BU4070	1.29
BU412	4.80
BU426	1.95
BU426A	1.67
BU427	2.67
BU500	1.61
BU508A	1.33
BU526	1.65
BU608D	1.42
BU806	1.29
BU806D	1.35
BU807	1.40
BU826A	2.79
BUV46	1.13
BUV84	1.12
BUN81A	3.15
BUN84	1.56
BUX84	1.47
BY126	0.11
BY127	0.11
BY133	0.11
BY164	0.50
BY176	1.38
BY179	1.13
BY182	0.95
BY184	0.42
BY187	0.70
BY189	1.20
BY198	2.38
BY201/2	1.36
BY203/20	0.18
BY206	0.17
BY207	0.22
BY210-400	0.24
BY210-600	0.27
BY210-800	0.30
BY223	0.85
BY224-400	0.90
BY225-100	0.79
BY226	0.28
BY227	0.44
BY228	0.54
BY255	0.97
BY298	0.25
BY299	0.25
BY476A	0.76
BYW56	0.30
BYX10	0.26
BYX55-350	0.48
BYX55-600	0.25
BYX71-350	0.67
BYX71-600	0.85
BYX94	0.18
BYY56	1.09
BZV15-C12	0.72
BZV15-C12R	0.72
BZV15-C24	0.72
BZV15-C24R	0.72
BZV15-C30R	0.72
BZX61 Range	0.16
BZX70-C11	0.54
BZX70-C12	0.54
BZX70-C15	0.54
BZX70-C30	0.54
BZX70-C47	0.54
BZX79 Range	0.09
BZY88 Range	0.09
BZY93-C12	0.99
BZY93-C18	0.99
BZY93-C24	0.99
BZY93-C24R	0.99
BZY93-C30	0.99
BZY93-C47	0.99
BZY93-C68	0.99
BZY93-C7V5	0.99
ZTK33	0.39
ZX18	2.47
C106D	0.46
C1129	0.52
CA1310E	2.45
CA3044	3.18
CA3046	2.23
CA3060	1.50
CA3065	1.17
CA3089	3.35
CA3089E	1.30
CA3090	1.25
CA3094	2.00
CA3131EN	2.83
CA3132EN	2.83
CAH76023N	6.00
CBF16848N-07	1.41
CD4001	0.24
CD4002	0.24
CD4008	0.96
CD4011	0.23
CD4012	0.24
CD4013	0.37
CD4016	0.37
CD4017	0.74
CD4020	0.92
CD4021	0.24
CD4023	0.25
CD4025	0.54
CD4028	0.76
CD4047	0.96
CD4049	0.52
CD4050	0.50
CD4052	0.68
CD4053	0.72
CD4069	0.23
CD4081	0.26
CD4093	0.72
CD4511	1.00
CD4517	1.06
CP5521	16.20
CV-12E	2.49
CX034	10.75
CX095D	2.85
CX104	8.49
CX108	6.92
CX109	6.92
CX121	10.75
CX130	4.90
CX131	10.75
CX134	10.75
CX136	10.75
CX137	10.75
CX139	10.75
CX157	4.40
CX158	3.44
CX170	6.92
CX177	5.99
CX506	8.48
CX507	6.92
CX758	6.92
D1693	2.35
DEC1	1.52
DEC2	1.52
E1222	0.36
E5024	0.25
E5386	0.22
E5529	0.22
E8021	1.17
E9003	0.41
E9005	0.45
ER1400	10.12
ESN310BP	3.86
ESM432C	4.18

IF YOU DON'T SEE IT LISTED ASK FOR QUOTE. GIVE MAKE MODEL LOCATION. REMEMBER TO ADD 0.60p POST & HANDLING. ADD 15% VAT TO TOTAL

ECONOMIC DEVICES, PO BOX 228, TELFORD TF2 8QP

ESM532C	4.18	LM1303P/N	1.50	MPSU05	0.78	SAA5010	4.90	SN74190	1.81	T6029V	4.41	TBA395	1.35	TDA1230	2.93	TDA9503	2.60
ESM632C	4.18	LM1310P/N	1.25	MPSU10	0.78	SAA5012	6.50	SN7420N	0.30	T6032V	0.89	TBA395Q	1.00	TDA1235	3.52	TDA9513	2.40
ESM732C	4.18	LM3065N	0.77	MPSU55	0.90	SAA5020	5.25	SN7430	0.28	T6033V	0.73	TBA396	1.80	TDA1270	2.64	TE527	1.25
ETT6016	2.65	LM317CKC	1.30	MPSU56	0.30	SAA5030	7.50	SN7440N	0.24	T6035V	0.66	TBA400	2.17	TDA1327A	1.65	TE538	0.36
ETTR6016	2.16	LM339N	0.68	MPSU60	1.20	SAA5040A	14.75	SN7473	0.56	T6036	0.44	TBA440P	1.55	TDA1327B	1.65	TE626	1.35
FND500	5.25	LM3407	1.29	MR510	0.30	SAA5050	8.50	SN7474N	0.72	T6037	1.91	TBA480	1.42	TDA1330	1.60	TEA1002	3.15
FT3055	1.05	LM340T5	0.75	MR812	0.60	SAA661B	1.80	SN7490AN	0.93	T6041V	0.66	TBA480Q	1.67	TDA1365	6.35	TDA1009	0.96
GF758	0.82	LM340T12	0.75	MR914	0.46	SAA700	3.00	SN75110N	0.75	T6044V	0.86	TBA500PQ	4.95	TDA1412	0.95	TEA1020SP	5.34
GF759	1.02	LM340T5	0.75	MSSD7002	0.65	SAB1009B	4.53	SN76001ANQ	2.25	T6045	1.09	TBA510	1.55	TDA1420	1.48	TEA1087	0.46
GF761	0.78	LM342N	0.56	MVS240	0.52	SAB1046P	3.66	SN76003N	2.81	T6049	1.10	TBA510S	6.39	TDA1470	2.63	TIC106C	0.55
GH3F	1.65	LM384N01	1.84	MVS460	0.30	SAB3011	7.34	SN76013N	3.63	T6052V	0.76	TBA520	1.67	TDA1512	2.20	TIC106M	0.55
HA11211	2.30	LM567CN	1.30	MVS460-02	0.55	SAB3012	5.34	SN76013ND	2.25	T6058	0.46	TBA520Q	1.35	TDA1670	3.65	TIC116D	0.80
HA11215	4.60	LM748	1.65	ME545B	2.95	SAB3013	3.28	SN76013NDG	8.07	T6059	1.05	TBA530	0.86	TDA1770	5.56	TIC44	0.65
HA11225	3.90	LM8360	2.78	ME545B	3.80	SAB3021	7.18	SN76023N	2.35	T9001V	1.09	TBA530Q	0.85	TDA1905	1.25	TIC45	0.70
HA11226	7.56	LM8361	2.78	ME5534N	1.48	SAB3022B	12.34	SN76023ND	1.04	T9003V	0.86	TBA540	0.98	TDA1908	2.95	TIC47	0.70
HA11229	2.51	M1024	2.55	ME555	0.34	SAB3023B	11.18	SN76033N	2.33	T9005V	2.16	TBA540Q	1.15	TDA1910	2.38	TIP120	0.96
HA11235	3.60	M1025	4.70	ME556	0.75	SAB3024	4.77	SN76105N	2.36	T9010V	0.87	TBA550	1.95	TDA1940	2.54	TIP110	0.48
HA1124	4.70	M1124	2.54	ME5560N	3.16	SAB3209	4.75	SN76110N	1.13	T9011V	1.27	TBA550Q	2.25	TDA1950	2.54	TIP112	0.80
HA11244	4.32	M1130	4.86	ME565N	1.20	SAB3210	2.93	SN76115AN	1.46	T9013V	5.81	TBA560C	0.86	TDA2002	1.20	TIP117	0.86
HA1125	3.90	M191	5.74	ME645BN	3.80	SAB4209	12.75	SN76131	1.74	T9014V	1.52	TBA560CQ	1.15	TDA2003	1.05	TIP120	0.73
HA11251	3.38	M193	18.55	ME646N	3.80	SAF1031	2.30	SN76226DN	1.20	T9016	0.92	TBA570	1.55	TDA2004	2.52	TIP121	1.08
HA1137W	2.57	M51102L	4.02	ME650N	3.94	SAF1032	5.60	SN76227N	0.68	T9022N	0.39	TBA570A	1.55	TDA2006	1.25	TIP126	0.96
HA1138	3.56	M5115P	4.34	ME645BN	3.80	SAF1039	11.66	SN76228N	2.97	T9034V	1.25	TBA570Q	1.35	TDA2010	2.79	TIP127	1.30
HA11414	2.50	M51231P	2.79	MP1106	4.80	SAS5010	7.62	SN76231	2.31	T9035V	1.26	TBA625A	1.97	TDA2020	2.75	TIP2955	0.78
HA1144	6.38	M5124P	4.38	OA200	0.10	SAS560	1.68	SN76242	4.75	T9038V	6.15	TBA625B	1.97	TDA2030	1.65	TIP29A	0.41
HA1156	1.23	M5134-9341	3.75	OA202	0.10	SAS560S	2.97	SN76243	4.75	T9051	2.55	TBA625C	1.97	TDA2140	1.44	TIP29B	0.57
HA11580	7.80	M51394P	6.25	OA47	0.10	SAS560T	2.85	SN76322	2.51	T9053V	1.03	TBA641A12	3.75	TDA2150	5.63	TIP29C	0.40
HA1160	3.45	M5142P	4.38	OA90	0.07	SAS570	1.61	SN76360	1.97	T9054V	0.92	TBA641BX1	2.07	TDA2151	1.75	TIP3055	0.65
HA1166	3.08	M5143P	6.66	OA91	0.08	SAS570S	0.00	SN76390	2.80	T9057V	0.63	TBA651	1.60	TDA2160	3.64	TIP30A	0.41
HA1167	5.13	M5144P	3.42	OA95	0.08	SAS570T	2.50	SN76396	2.63	T9063V	2.94	TBA673	2.35	TDA2161	1.68	TIP30B	0.63
HA11711	16.13	M51513L	2.06	OC28	0.96	SAS580	4.41	SN76510N	0.95	TA5814	1.35	TBA700Q	2.19	TDA2190	3.11	TIP31B	0.35
HA11713	6.70	M51515BL	3.10	OC29	1.95	SAS5800	2.62	SN76530P	1.90	TA7020P	4.36	TBA720	2.85	TDA2510	1.82	TIP31C	0.63
HA11714	7.05	M51516L	3.40	OC35	0.96	SAS590	4.55	SN76532N	1.80	TA7027	4.36	TBA730	1.75	TDA2520	2.15	TIP32B	0.35
HA11715	7.05	M51517L	2.90	DC36	1.16	SAS5900	2.32	SN76533N	1.56	TA705C	1.58	TBA750Q	1.46	TDA2521	2.15	TIP32C	0.66
HA11718	6.79	M5152L	1.00	OC44	0.40	SAS660	2.50	SN76540N	1.80	TA7051	1.58	TBA760	1.55	TDA2522	2.81	TIP33C	1.25
HA11724	15.60	M51522	4.90	OC45	0.40	SAS6600	1.20	SN76544	1.60	TA706CAP	0.60	TBA780	3.00	TDA2523	2.75	TIP34	1.07
HA11725	16.60	M5191P	4.49	OC75	0.40	SAS660S	1.20	SN76545	4.55	TA7061AP	0.78	TBA800	0.00	TDA2524	4.50	TIP41A	0.39
HA1180	4.68	M5192	2.00	ON188	1.70	SAS6610	1.20	SN76546	3.15	TA7069	2.84	TBA810AS	1.46	TDA2525	2.96	TIP41B	0.28
HA1203	1.56	M53273P	0.92	ON236	2.90	SAS670	2.50	SN76546N	3.15	TA7070P	1.52	TBA810S	1.46	TDA2530	2.19	TIP41C	0.44
HA1306	1.74	M53274P	1.20	OT112	0.98	SAS6700	1.20	SN76549	2.35	TA7071	3.35	TBA810T	1.46	TDA2532	2.51	TIP42A	0.39
HA1322	1.74	MA06	0.97	OT121	0.70	SAS670S	1.20	SN76550	0.30	TA7072P	1.35	TBA820	0.83	TDA2533	2.09	TIP42B	0.71
HA1339	1.76	MA8001	0.74	PD144	2.03	SAS6710	1.20	SN76551	1.35	TA7073P	4.05	TBA820M	1.65	TDA2540	1.95	TIP42C	0.44
HA1342	1.80	MB3705	1.62	PT1017	2.43	SAS6800	2.30	SN76570	2.80	TA7074P	1.95	TBA890	1.85	TDA2541	1.95	TIP47	0.65
HA1350	2.97	MB3712	2.65	PT2014	2.76	SAS6810	1.30	SN76600	1.10	TA7076P	4.95	·TBA900	2.25	TDA2545Q	3.16	TIP48	0.83
HA1365	3.65	MB3713	1.30	PT6042	1.82	SBA550B	1.95	SN76611	2.35	TA7089N	1.41	TBA920	1.50	TDA2560	1.97	TIP49	3.28
HA1366WR	1.62	MB3730	2.94	R1038	1.99	SBA750	1.46	SN76620	2.35	TA7089P	1.36	TBA920Q	2.10	TDA2571A	2.81	TIS43	1.21
HA1367	3.20	MC13002	4.66	R1039	1.99	SC9488P	1.90	SN76622	1.50	TA7092P	3.85	TBA940	1.70	TDA2575A	2.95	TIS90	0.22
HA1368	1.69	MC1303P	1.96	R2008B	1.20	SC9503	1.50	SN76623	0.62	TA7093P	1.64	TBA950	1.55	TDA2576A	2.58	TIS91	0.26
HA1368R	1.66	MC1307P	1.90	R2009	1.20	SC9504P	1.46	SN76630	2.31	TA7102P	5.34	TBA970	2.08	TDA2577	5.31	TL071CP	2.02
HA1370	2.97	MC1310P	1.25	R2001B	1.20	SC9511P	1.90	SN76640	3.85	TA7108P	1.40	TBA970Q	2.98	TDA2581	1.95	TMS1000NL	10.78
HA1377	2.68	MC1327P	1.20	R2029	1.20	SCR957	1.20	SN76650N	1.24	TA7109	3.37	TBA990	1.65	TDA2582	1.98	TMS3748NS	11.66
HA1389	1.62	MC1330P	1.23	R2030	1.20	SG264A	4.38	SN76651	1.35	TA7120P	0.58	TBA990Q	1.95	TDA2590	2.80	TMS4116	1.87
HA1389R	1.74	MC1349P	1.20	R2257	2.16	SG613	7.88	SN76660N	2.25	TA7122B/P	0.54	TBA231	2.33	TDA2591	2.80	TV106	1.20
HA1392	2.68	MC1350P	1.10	R2265	1.95	SG629	6.28	SN76665N	1.35	TA7124P	2.00	TC4001	1.29	TDA2591Q	2.80	TY6010B	2.70
HA1397	2.97	MC1351P	0.75	R2305	1.07	SG6533	9.37	SN76666N	0.98	TA7130P	1.15	TC4053BP	3.94	TDA2593	2.24	U05G	1.03
HA1398	2.68	MC1352P	1.01	R2306	1.23	SI-1020N	4.76	SN76705	3.38	TA7136AP	1.15	TCA150	1.62	TDA2594	2.80	U143M	2.80
HA1406	1.80	MC1357P	1.95	R2322	1.26	SI-1125HD	10.70	SN76705N	3.99	TA7137P	0.85	TCA160B	1.62	TDA2600	5.00	U3700	0.55
HA17723	5.40	MC1358P	1.55	R2323	1.23	SI-1130N	6.30	SN76707N	3.99	TA7141AP	3.51	TCA270Q	1.55	TDA2610	2.53	U37003	0.44
HBF4030AF	2.25	MC14001	7.15	R2348	1.82	SKB2/08	0.70	SN76709	4.65	TA7146P	8.04	TCA270S	1.95	TDA2611A	1.25	UA723CA	5.02
HD4480	15.60	MC14011	0.23	R2354A	1.82	SKE2F 1/04	1.26	SN76709N	4.95	TA7148P	1.51	TCA270SQ	1.65	TDA2611AQ	2.55	UA758PC	3.06
HD44801A05	15.90	MC14013	0.37	R2354B	1.82	SKE2G 2/04	0.95	SN76730	4.23	TA7149P	2.10	TCA290A	2.05	TDA2612Q	4.25	UA783P3C	1.07
HM6231	8.50	MC14016CP	0.37	R2441	1.23	SKE2G 3/04	0.95	SN76810N	0.62	TA7153P	4.53	TCA420A	1.90	TDA2620	1.96	UAA170	2.14
HM6232	7.71	MC14025	0.54	R2443	0.80	SKE4F 1/02	1.26	SN76920N	2.63	TA7161P	5.66	TCA440	1.65	TDA2630	2.34	UAA180	2.14
HM9102	2.92	MC14049UBC	0.52	R2461	2.10	SKE4F 1/06	0.66	SN94041	3.45	TA7162P	4.25	TCA4500A	1.95	TDA2631	2.48	ULN2165	1.35
HM9104	2.94	MC1438R	0.95	R2477	0.92	SKE4F 2/06	2.10	SN94042	3.95	TA7169	4.80	TCA530	1.80	TDA2640	2.25	ULN2204	7.00
HT4207	15.60	MC14493P	2.56	R2501	1.16	SKE4F 2/08	0.60	SP8385	0.50	TA7171P	2.53	TCA640	2.63	TDA2643	6.93	ULN2216F	1.95
IS689	1.87	MC14510BAL	3.15	R2540	1.80	SKE4G 2/02	0.87	STA441C	2.27	TA7172P	1.28	TCA650	1.85	TDA2651	2.95	UPC1001H	2.50
IS751	1.87	MC14556BCP	3.15	R2540X	3.00	SKE5F 3/10	1.45	STK0029	3.42	TA7176P	2.25	TCA660B	2.63	TDA2652	7.05	UPC1009C	5.74
ITT2003	0.20	MC1712	3.52	R2615	0.60	SL1310	2.85	STK0039	4.00	TA7193P	4.44	TCA730	3.84	TDA2653	2.95	UPC1020H	2.12
K174YP	2.95	MC7724CP	3.17	RC4195NB	1.96	SL1327E	1.20	STK0050	4.96	TA7201P	3.25	TCA740	2.25	TDA2654	2.91	UPC1025H	2.49
KA2101	2.65	MC7818C	1.98	RCA16029	1.82	SL1430	1.26	STK0059	6.48	TA7202P	2.24	TCA750	1.75	TDA2655B	3.15	UPC1026C	1.24
KC581C	5.47	MC7824CP	4.25	RCA16083	4.81	SL1430T	2.10	STK0080	8.32	TA7203P	1.95	TCA760B	2.79	TDA2660	2.24	UPC1028H	0.90
KC582C	3.45	MC78M12	0.75	RCA16334	0.92	SL1432	2.25	STK011	3.86	TA7204P	1.95	TCA800	1.65	TDA2661	2.24	UPC1030H	2.06
KC583C	4.80	MC78M24	0.85	RCA16335	1.23	SL414	3.35	STK013	7.04	TA7205	1.25	TCA800Q	2.25	TDA2670	2.50	UPC1031H	8.05
L129V	1.78	MCR101	0.60	RCA16600	1.25	SL432A	3.12	STK014	7.14	TA7206P	1.95	TCA830S	1.94	TDA2670A	1.76	UPC1031H2	6.00
L200CV	1.68	MCR106/5	1.17	RCA16799	2.16	SL437	6.00	STK015	5.12	TA7210P	3.25	TCA900	1.85	TDA2680	2.30	UPC1032H	0.94
LA1111AP	0.80	MCR220/7	1.34	RCA16801	0.86	SL439	2.25	STK016	4.82	TA7214P	2.90	TCA910	1.50	TDA2690A	2.40	UPC1154H	1.75
LA1201	0.90	ME0402	0.27	RCA16802	0.98	SL480	5.00	STK022	4.77	TA7215P	2.09	TCA940E	1.68	TDA2780AQ	2.18	UPC1156H	1.45
LA1210	1.38	ME0404	0.23	RCA17028	2.25	SL490	1.78	STK025	7.20	TA7217AP	1.36	TCE330	3.53	TDA2790Q	5.92	UPC1181H	1.25
LA1320	1.46	ME0404/2	0.42	RCA17074	6.00	SL901B	6.08	STK040	7.09	TA7222	1.95	TCE527	1.37	TDA2791	2.50	UPC1182H	1.82
LA1352	1.40	ME0411	0.45	RCA17376	1.43	SL917B	7.95	STK043	7.09	TA7227P	1.69	TCE82	0.98	TDA2795	2.95	UPC1185H	2.94
LA1357N	5.90	ME0412	0.21	RCA60857	4.50	SL918A	5.63	STK054	6.48	TA7229P	4.10	TCE83	0.98	TDA2800	6.12	UPC1186H	0.95
LA1364	2.74	ME4102	0.45	RGP10	0.45	SN6848	8.82	STK070	20.28	TA7310P	1.95	TCE84	0.98	TDA3000T	2.31	UPC1212C	0.95
LA1365J	2.79	ME545B	9.10	RT402	1.40	SN16861N-07	1.59	STK077	7.00	TA7313AP	1.36	TCEP100	4.80	TDA3030A	10.44	UPC1213C	0.95
LA1385	1.70	ME6002	0.23	RT905A	2.00	SN16862N-07	1.68	STK078	5.52	TA7314	5.10	TCEP100Q	9.31	TDA3190	1.75	UPC1217C	2.24
LA1387	4.57	ME6102	0.45	S0280	1.94	SN16880N	3.30	STK082	7.54	TA7609	3.00	TD190	0.54	TDA3300B	7.75	UPC1350C	1.75
LA3155	0.90	ME8001	0.26	S0281	1.94	SN16965	8.13	STK086	9.90	TA7611AP	3.54	TD3F700H	6.00	TDA3500	5.95	UPC1351C	1.64
LA3300	1.40	MJ2501	4.95	S041P	1.26	SN16966N	5.49	STK2101	5.74	TA7676P	3.05	TD3F800H	2.25	TDA3501	10.99	UPC1353	6.75
LA3301	1.28	MJ2955	1.34	S042P	1.46	SN29715N	5.49	STK2110	6.66	TAA300	2.99	TD3F800R	3.21	TDA3506	10.12	UPC1360C	4.10
LA3350	1.30	MJ3000	2.15	S1299	4.30	SN29716N	3.32	STK2230	6.66	TAA310A	0.27	TD3F900H	3.78	TDA3510	5.95	UPC1362	7.95
LA3361	1.30	MJ3001	1.30	S175	18.95	SN29717N	6.53	STK415	6.04	TAA320A	1.15	TD3F900R36	3.78	TDA3520	8.82	UPC1365	5.79
LA4030P	2.37	MJ3028	2.40	S2062D	1.88	SN29722	10.65	STK433	9.35	TAA350A	1.62	TDA1001A	2.10	TDA3521	12.17	UPC1366	4.23
LA4031P	3.00	MJ481	1.39	S2800	5.25	SN29723AN	6.95	STK435	5.44	TAA435	1.65	TDA1003A	2.15	TDA3560	6.87	UPC1458	7.87
LA4032P	1.48	MJ802	4.95	S2800D	2.55	SN29744N	2.08	STK436	5.70	TAA550	0.33	TDA1004A	2.15	TDA3561	7.50	UPC2002	1.48
LA4050P	1.42	MJE2955	1.71	S2802	3.15	SN29764AN	3.38	STK437	8.10	TAA570	1.58	TDA1005A	2.15	TDA3571Q	2.25	UPC30C	2.22
LA4051P	1.62	MJE3055	0.78	S3702S	4.73	SN29767	3.61	STK439	6.26	TAA611B12	1.50	TDA1006A	2.15	TDA3571A	5.67	UPC32C	4.49
LA4100	1.62	MJE340	0.44	S3703F	4.73	SN29770AN	2.04	STK441	8.96	TAA621AX1	2.00	TDA1010	2.43	TDA3576	4.76	UPC41C	3.72
LA4101	1.18	MJE520	0.44	S3707	3.92	SN29771BN	4.23	STK443	9.35	TAA630S	3.31	TDA1011	2.60	TDA3950	2.81	UPC554C	1.68
LA4102	2.55	ML231	2.28	S40W	7.99	SN29772BN	4.21	STK459	6.56	TAA640	3.85	TDA1028	2.22	TDA3950B	1.40	UPC558C	3.67
LA4112	4.35	ML232B	3.30	S551	4.12	SN29773	2.28	STK460	5.78	TAA661B	1.59	TDA1029	4.44	TDA4050A	3.15	UPC566H	2.78
LA4125	2.46	ML237B	2.28	S552	4.12	SN29791	1.51	STK461	7.14	TAA700	2.35	TDA1034B	2.20	TDA4180P	1.74	UPC572	3.51
LA4138	2.00	ML238	4.02	S6080B	2.75	SN29798N	3.89	STK463	8.06	TAA840	2.27	TDA1035T	1.83	TDA4260	1.40	UPC575C2	3.72
LA4140	0.80	ML741CS	0.36	S6087AR	4.45	SN29845	2.14	STK465	7.32	TAA930	4.42	TDA1037	1.45	TDA4280	6.45	UPC576H	2.60
LA4192	2.88	ML923	2.18	SAA1020	4.32	SN29848	1.66	STK466	10.70	TAA970	2.57	TDA1041	1.96	TDA4290	4.06	UPC577H	0.64
LA4220	1.34	ML0926	3.25	SAA1021	4.32	SN29861	2.08	STK501	5.74	TAD100	1.91	TDA1044	1.61	TDA440	1.95	UPC587C2	2.34
LA4400	2.04	MM5314N	3.72	SAA1024	2.55	SN29862	2.08	STK502	5.74	TAG232-600	0.66	TDA1047	2.14	TDA4400	2.06	UPC592H	1.02
LA4420	1.56	MM5316N	3.72	SAA1025	4.70	SN72709	0.40	STR441	6.34	TAG626-600	0.84	TDA1054M	1.10	TDA4420	4.25	UPD1514C	7.56
LA4422	1.56	MM5318N	2.82	SAA1050	3.78	SN7400N	0.24	STR453	6.75	TBA120	0.95	TDA1059B	0.98	TDA4422	5.63	UPD851	14.39
LA4430	1.48	MM5369N	1.82	SAA1051	5.30	SN7401N	0.24	STR6020	7.20	TBA120A	0.95	TDA1060	2.01	TDA4430	4.34	UPX27C	1.98
LA4460	1.92	MM5387AA/N	11.50	SAA1061	3.28	SN7402N	0.59	T6007V	0.69	TBA120AS	0.95	TDA1082	2.65	TDA4431	2.06	X0022CE	3.67
LA4461	2.00	MM5841N	5.90	SAA1075	4.41	SN7404N	0.21	T6007N	0.62	TBA120S	0.95	TDA1104	5.95	TDA4432	2.06	X0035TA	4.35
LA5112N	1.62	MP8112	1.35	SAA1082	8.04	SN7408N	0.24	T6016	0.36	TBA120SB	0.95	TDA1151	0.65	TDA4440	2.52	X0056CE	3.90
LA7020	6.66	MP8113	1.35	SAA1121	4.32	SN7410N	0.24	T6017	0.65	TBA120T	0.95	TDA1170	2.15	TDA4600	2.58	X0062CE	4.95
LA7025	7.31	MP8512	1.23	SAA1124	2.55	SN74121	1.20	T6018V	0.65	TBA120U	0.95	TDA1170S	1.85	TDA4610	2.42	X0065CE	3.48
LA7800	2.12	MPF256C	0.54	SAA1130	4.86	SN74122	0.95	T6021	0.36	TBA120UB	3.47	TDA1180	2.25	TDA4620	4.50	X0109CE	6.10
LA7801	3.60	MPS6570	0.43	SAA1174	5.75	SN7413N	0.33	T6022V	3.56	TBA1440	2.08	TDA1190	1.91	TDA5500	2.48	X1074AF	6.36
LD3120	1.20	MPSA42	0.59	SAA1250	3.78	SN74141	1.41	T6026	0.89	TBA1440G	3.40	TDA1190Z	2.25	TDA5600	2.68	XC949P	1.20
LM1011N	2.95	MPSA56	0.24	SAA1251	5.30	SN74151AN	1.51	T6027	0.73	TBA1441	1.59	TDA1200A	1.30	TDA5700	2.10	Y730	0.24
LM1017N	1.96	MPSA92	1.11	SAA5000	3.65	SN74154N	1.15	T6028V	0.35	TBA240A	3.42	TDA1220	2.25	TDA9403	2.90	Y969	0.60

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Letters

A DEMANDING JOB

When I joined the trade fourteen years ago my job was very clearly defined: I was a radio and TV engineer. Then came the increase in the number of colour sets (more training) and the introduction of VCRs (yet more training). We're now servicing videotex equipment, microcomputers, microwave cookers, music centres, audio recorders and laser video disc players.

Despite all this increase in what we're expected to be able to deal with, several things have not changed.

(1) We don't have our own union. Most people are lumped together in the EETPU with the plumbers and power workers. In my six years of being a member I can't recall a single relevant article in the quarterly magazine.

(2) Large firms seem to be unwilling to give time off for further education. During my fourteen years in the trade I've been to college night classes every year (one year on my day off), all in my own time. This is in sharp contrast to organisations such as British Telecom and the armed forces, where time off for education is given.

(3) Our professional image remains that of the valve tapper.

(4) Colleges don't arrange the courses for higher qualifications, e.g. H.N.C., T.E.C., etc., so that they can be completed at night class.

It would be nice to have a correct job title, and for people to be aware of the training we have to undergo.

William G. Lockitt, M.I.S.M., L.C.G.,
Rhyl, Clwyd.

PRICE COMPARISONS

A ten per cent increase in the price of *Television* is announced in the January issue. The magazine will be hit that much harder should VAT have to be added to this after the budget. You also report that the BBC is asking for a 41 per cent increase in the licence fee. Yet the price of the equipment required for reception has remained roughly the same over the years – despite considerable increases in the features offered, e.g. colour and improved definition. I've not been able to discover what the licence fee was in 1956, but the other prices compare as follows:

	1956	1985	Increase
Practical Television/Television	£0.0625 (1/3d)	£1.10	1,760%
State of the art receiver chassis, as advertised	£32.40	£41.25	27%
CRT as advertised	£11.00	£29.75	270%
TV licence	?	£65*	?

*If proposed increase is implemented.

The 1956 chassis was the Premier Radio 13-channel design advertised on the back page of the August issue. The 1985 chassis was an ITT colour one, complete from Sendz, advertised on page 176 of the January issue. Both chassis were less tube, but VAT has been added to the 1985 advertised price (why do advertisers insist that we do this arithmetic every time?). The CRT comparisons are between a 16in. monochrome type with ion trap from Laskys (page 1, August 1956) and an 18in. PIL tube with scan coils advertised by Sendz. Neither type necessarily goes with the chassis quoted.

In the shops a 12in. colour portable sells for around £150 compared to about £50 for a 12in. table model in 1956, an increase of 300% – comparing monochrome sets however the price remains much the same, but with a dramatic decrease in weight and power consumption – also two extra channels, improved definition and the option of battery operation.

John de Rivaz,
Porthtowan, Cornwall.

Editorial comment: Setmakers have been able to keep prices down because of highly automated plants, large production runs and the economies of scale generally. Even so their achievement is remarkable – you won't find such price stability in the face of inflation in many other fields. The price of surplus equipment is a law unto itself of course. To make a comparison with magazines is not to compare like with like. Printing can and has been made more efficient, but editorial, advertising and distribution productivity cannot be improved by employing mass production techniques! *Television* is larger in size and in the number of pages than in 1956, while the production quality has been much improved.

THE MIGHTY RGDs

Chas E. Millers's article on The Mighty RGDs gave me great pleasure. You will quickly understand why when I tell you that I was the assembly foreman in the late forties, in charge of production of the B2351T and subsequent 1700/1800 series. And what sets they were! They weighed a ton – even the power unit in the B2351T required two chaps to hoist it into the cabinet, with its massive Woden transformers and chokes.

Each set was assembled on a trolley which was pushed up a ramp to bring the assembly of the tube and control panels to eye level. All this to produce a little 12in. picture on a CRM121/3 tube with a rubber mask to give the correct aspect ratio – the price of one of these sets was nearly £300. As Chas says, the name RGD is now almost forgotten.

W.H. Bate,
Bridgnorth, Salop.

THE THORN 1400 CHASSIS

Brian Renforth (letters, January) made some very fair comments on the Thorn 1400 chassis. I still have a few in the field, working with their original tubes – in fact I've put tubes from several 1400s into later 1500s and got further useful life from them. The main reason for scrapping 1400s has been holes burnt in the board, either due to the system switch jamming or a massive burn-up in the line output stage area.

The rental companies didn't like these sets very much when new. It didn't seem possible to get good results on both systems. Without the need for 405, and with a bit of care, superbly crisp 625-line pictures can be obtained however. Thorn Rentals issued pages of suggested modifications, mainly to cure caption buzz which could be deafening. Nowadays ceramic filters would be cheaper and quicker. One or two modifications are still relevant however. To centralise the line hold change R70 to 33kΩ and R62 to 2·7kΩ. To cure the width circuit burn-up problem, change the control to 2·2MΩ and R143 to 680kΩ.

I note the comments about reconnecting the earthing strips to the chassis. Thorn Rentals advised removing the strap between the u.h.f. tuner and chassis and the one between the on/off switch bracket and chassis to cure hum on 625 lines. This hum and/or ripple is noticeable if C52 is still 4μF – change it to 12μF.

All in all it's a very nice chassis once the troubles have been ironed out. Quite a few people changed to later monochrome sets for no other reason than fashion, when the tube still had years of life in it, and got poorer value for money. Also, what a pleasantly accessible layout!

Roger Burchett,
Hythe, Kent.

THORN 950/1400 CHASSIS

May I offer the following comments on Brian Renforth's letter in the January issue?

(1) While the Thorn 1400 chassis is capable of giving good results, I can also recommend the earlier 950 Mk II chassis which is rather more solidly constructed. It has much in common with the 1400 electrically but one area of difference is the vision i.f. strip, which produces much better results (assuming the c.r.t. is in good order). The reason for this would appear to be a much superior group delay performance, providing crisp transitions on vertical edges and resolution (just) of all the frequency gratings on the IBA ETP1 electronic test pattern (Channel 4). The gain and selectivity are also excellent and 625-line v.h.f. operation is just as easy.

Most of these sets were fitted with rotary u.h.f. tuners of the two-speed variety, though some had push-button tuners. The choice is dictated by the use to which the set is to be put, i.e. DX-TV or domestic viewing.

I've yet to come across a mass-produced monochrome TV chassis that gives better results than the 950.

(2) Many modifications were made to the 1400 chassis during its long production run, mainly to improve the a.g.c. operation and to reduce severe intercarrier buzz. The a.g.c. modifications are: C13 0·33μF; C40 0·015μF; R4 5·6MΩ; R7 3·9MΩ; R43 1MΩ, 0·5W; R46 deleted. Intercarrier buzz modifications: R36 8·2kΩ, 0·5W; R74 and R75 both 10kΩ; R35 taken to the junction of an added potential divider consisting of R176 180kΩ (top) and R175 22kΩ (bottom), both 5% 0·5W, connected across the 625-line contrast control R6, instead of to the junction of R3/Z1. I can thoroughly recommend these modifications. See the schedule E service manual supplement for further modification details.

(3) I've also encountered the problem with the 30FL14/PCF808 valve, which was only ever used in these Thorn chassis. The secret is to specify only a Mazda UK manufactured version of the valve – this can be readily identified by the bright, circularly perforated pentode section screen. When Thorn closed the Rochester valve factory several years ago they continued to market Mazda branded valves obtained from other sources. These never performed as well as the originals – the main problems were with the 30FL14/PCF808 and the 30C18/PCF805.

(4) Another useful modification on both the 950 and 1400 chassis is to fit a modern 6MHz sound section using the familiar ceramic filter/TBA120 combination. This greatly reduces the severe intercarrier buzz that plagued the original design.

(5) I've been using a restored 950 Mk II receiver for the last couple of years as a DX set, both on u.h.f. and v.h.f. (405 and 625), with excellent results.

Finally, a point to note was the abysmal state of the IBA's 405-line v.h.f. broadcasts over the final couple of years – the pictures were so poor they couldn't be used for normal viewing. The cause was mainly defects in the 625/

405-line standards converters. It was quite a revelation to compare the quality of the IBA and BBC 405-line broadcasts. The BBC maintained a high standard to the very end. Sigh of nostalgia . . .
D.J. Hazell,
Witney, Oxon.

COLOUR BAR PROGRAM

I would like to suggest the following changes to the computer colour bar program (January):
(1) Alter line 10 to read "MOVE 0,1023". This will fill in the missing portion of the white bar.
(2) Add line 8, reading "VDU23;8202;0;0;0;". This will switch off the flashing cursor.
(3) Alter line 100 to read "A=GET". This makes the computer wait at line 100 until a key is pressed: whilst it's waiting the prompt does not appear on the screen.
(4) Alter line 110 to read "MODE 7". Amongst other things this will switch the flashing cursor on again when one of the keys is pressed in line 100.

Finally the BBC Model B's BNC video output socket gives monochrome only. It can be converted to colour simply by closing link 39 on the computer's main circuit board (see page 488, Advanced Uses Guide).
Brian Wheatley, T. Eng.,
Spalding, Lincs.

VINTAGE SET ON OFFER

Amongst my recently deceased father's possessions is a completely intact Philips Model 1100U TV set dating from 1951, though I don't know whether it's in working order. The model was described by Vivian Capel in your April 1980 issue. Perhaps a collector or museum might be interested in this vintage TV item? Anyone interested should write to me at the address below – it'll have to be collected of course.
Alastair G. Pink, M.Sc., 98 Manor Road,
Borrowash, Derbyshire DE7 3LN.

STREAMLINED FAULT FINDING

For some time I've been toying with a similar idea to that outlined by Colin Guy in the January issue. What I have in mind to do is to use computer storage in conjunction with information from manufacturers' technical departments in order to provide an up to date service on fault problems. Subscribers would have direct access by telephone, with a fixed charge per call. This all depends of course on obtaining permission from various sources to use information. I feel that there's a promising market here and would like to ask the opinions of engineers generally on the idea. If enough interest is shown I might give it a try, which I'm sure would be of benefit to many people.
Robert Easton,
131 Rose Avenue, Upton,
Pontefract, W. Yorks WF9 1DS.

I was very interested to read Colin Guy's letter in the January issue. I've compiled an extensive fault list based mainly on reports in *Television* from January 1983 to the present day, covering dozens of makes and chassis types. Each fault is recorded on a card giving the manufacturer, model/chassis, where the information came from and the symptoms. Both common faults and obscure ones that have caught engineers out from time to time are listed, including some from our own workshop experience – not wishing to get caught out again!

I feel that the information could be expanded in three ways. First, which would be the bulk of the file, would be more common faults. Secondly there could be modifications provided by manufacturers, mainly on troublesome problems and ways around them. Lastly, a boon to every engineer (I wish I had more information of this kind), there would be step-by-step guides to get a set in the trip or shutdown state going. For example, the first time I was confronted with a Rank T20 chassis that gave no results though the 200V h.t. line was present I was exasperated until a friendly engineer told me about adding a resistor across the start-up capacitor etc. Such information on various chassis would be a valuable time saver and would take the pain out of many a long, frustrating day.

It's taken me a long time to write these cards out but, as Colin Guy says, employers should welcome the prospect of having access to information of this type. For the engineer who might think that consulting a file is taking the easy way out I'd say that the information is not intended to take over from thinking about fault conditions but rather as an extra tool when the going gets tough.

If someone could get going with the provision of a service of this sort I'd say great, hurry up!!
Geoff Fardon,
Station Television, Llanelli, Dyfed.

PROGRAM WANTED

Having contemplated the purchase of a colour bar generator for some time, but been put off by price and uncertainty about which model to choose, I was most impressed by the microcomputer colour bar program in the January issue. The only problem is that I own a Sinclair Spectrum, not a BBC B! Has anyone devised a colour/monochrome test pattern program for the Spectrum?
Oliver J. Bowry,
Southall, Middx.

PLUGTOP HINTS

The plugtop mystery has been discussed at length in recent months. Although we may not have come to firm conclusions as to why the terminal screws become loose and why the neutral pin in some cases gets burnt, there are some ways in which the various problems can be cured. The following methods have proved to be very successful over a period of time.

The problem of loose terminal screws can become worse if the manufacturer's soldered cable ends are not cut off. Remove these and, as Keith Cummins suggests (January), strip the conductors back so that they can be bent over to make a double thickness. To cure loose screws once and for all, obtain a small tube of Loctite Torque Seal. Apply a very small amount to the upper half of the screw thread then tighten the screw into the conductor. When the seal dries the screw will remain tight, though loosening it with a screwdriver is simplicity itself!

Remember to check the plug's fuseholder to see that it's tight. This is a weak point in some cheap plugtops.

The above points are all worth checking and trying. And next time you have a Sony KV1810 in for repair with both GCSs blown, check the plug!

Finally a safety point. Always connect the live wire properly when wiring a standard 13A plug. Cut to the correct length and connect. All too often the live wire is left the same length as neutral, with the surplus wire looped back. The reason for cutting the wire to the correct length is that if the cable is pulled with such great force (it does happen!) that even the cable grip can't hold, the live wire will be pulled from its terminal while the neutral and earth leads will usually be left connected. Thus with the neutral wire connected to chassis the risk of the chassis becoming partially live as a result of no common return when the neutral wire has been yanked out is avoided.
Simon D. Tredinnick,
Penzance, Cornwall.

Adding a Second Reflector

Ivor Nathan

An existing u.h.f. aerial system may need to be upgraded for several reasons. The usual one, mainly in fringe areas, is that new buildings erected between the transmitter and the receiver interrupt the line-of-sight path required for satisfactory reception. This results in either signal attenuation or, depending on the position of the new buildings in relation to the receiving site, severe ghosting. Another reason for upgrading an aerial system is that whilst the existing array might provide sufficient signal for general family viewing it may not be good enough for teletext reception or for producing good video cassette recordings.

A further consideration relates to fringe areas where there's a choice of more than the four local channels. The use of diplexers and splitters to combine the outputs from two or more aerials to provide extra channels can introduce sufficient insertion loss to mar the picture quality on one or more channels. Similarly, attempts to use a single aerial array without a preamplifier to feed two separate TV sets can result in poor picture quality.

Where problems are experienced the first thing to do is to check for corrosion and damage to the aerial system and feeder. If these are in order, a simple and efficient method of providing extra forward gain while vastly reducing ghost images is to add an extra, larger reflector to the array.

Reception of the four Crystal Palace u.h.f. transmitters at the author's location in Southgate, N. London, tends to be sporadic because of the distance and the hilly nature of the surrounding terrain. The nearest local relay is at Alexandra Palace. This station is not receivable locally due to the low output power and again the local topography.

Some months ago reception of BBC-1 from Crystal Palace using a Yagi array in the loft became unsatisfactory because of the construction of a new tall building near the top of a nearby hill and directly in the signal path: the building and the giant cranes used during its construction resulted in an extremely sooty picture that was very smeary and accompanied by several ghost images. BBC-1 viewing was in fact quite intolerable. As a first, temporary measure a preamplifier was added. The BBC-1 pictures were still poor, so the preamplifier was removed.

The next step was to raise the aerial to as high a position as possible in the roof space. This gave better BBC-1 reception but the ITV picture was now smeary. Reception of Channel 4 and BBC-2 remained good throughout these experiments – even with the aerial in its original position. I then decided to try adding an extra reflector to the aerial array: this improved reception on all channels dramatically, bringing ITV up to standard and providing near-enough uniform reception of the four Crystal Palace transmissions.

Since the aerial is mounted indoors, a simple method was used to make the second reflector. A section of aluminium foil (baking foil is ideal) was cut as a single piece measuring about 20 by 30in. so that when folded and stretched smoothly over a piece of rigid plastic sheet it would, with the edges folded and overlapped, form a rectangle measuring 9 by 13in. (group A). The arrangement is shown in Fig. 1. Two flat plastic lids from empty ice-cream containers were found to be ideal: taped together side by side, they formed a rigid surface measuring 9 by 13in. After covering the entire surface, back and front, with the single piece of aluminium foil the new reflector was enclosed in a plastic bag to provide protection. A round plastic ice-cream container was used to support the reflector and secure it to the end of the boom. The six-inch lid was bolted to the reflector while the body of the container was fixed to the end of the boom by driving a wood-screw through its centre into the plastic bung in the end of the boom. The two were then simply clipped together. The body of the container, 3¼in. deep, placed the extra reflector at a suitable distance behind the existing reflector (observe correct polarisation).

This wouldn't do for an outside aerial of course. A piece of aluminium sheet 9 by 13in. would be suitable, mounted rigidly at the rear of the boom.

Adding an extra reflector has given me perfect reception at this difficult site, with no need for a preamplifier. A second reflector that's larger than the existing one will give greatest improvement at the low-frequency end of the band. The design of a wideband Yagi aerial is something of a trial-and-error business since the Yagi is basically a narrow-bandwidth system. The addition of a second reflector along the lines described here cannot fail to help in difficult conditions however.

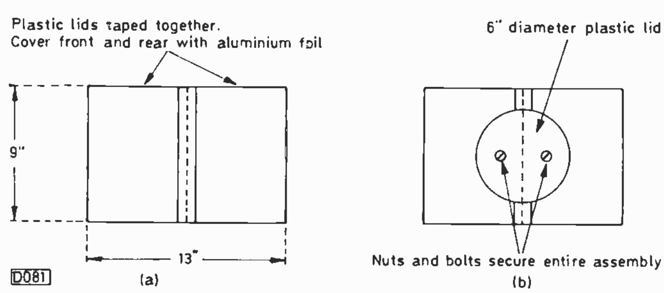

Fig. 1: Extra reflector. (a) Forming the reflector from plastic lids and aluminium foil. (b) Mounting arrangement.

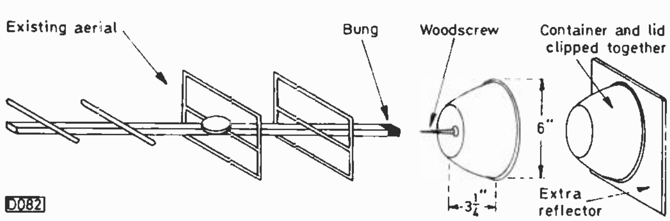

Fig. 2: Assembling the extra reflector on the boom.

Dynamic Width Control

George R. Wilding

To produce the flyback, the line output stage in a TV set is arranged as a resonant circuit. Fig. 1 shows the basic transistor line output stage. At the end of the forward scan, when the c.r.t.'s beam has reached the right-hand side of the screen, the output transistor Tr1 is switched off by the drive waveform. Capacitor C1 then tunes the output transformer and scan coils to produce a half cycle of oscillation, the flyback pulse. At the end of the pulse the beam has been returned to the left-hand side of the screen. We don't want the oscillation to continue, so when the circuit tries to swing negatively the efficiency diode D1 conducts, damping the tuned circuit and providing a current path to give the initial part of the forward scan. In large-screen sets the collector-base junction of the transistor may be used to provide the efficiency diode action.

Timing

It follows from all this that from the timing point of view the important thing is the exact time when the output transistor is switched off to initiate the flyback. The resonant circuit then produces the flyback and the point at which the transistor is switched on during the forward scan could be adjusted to control the width, i.e. the power in the circuit.

Generating the EHT

An advantage of this basic scheme is that the flyback pulse can be stepped up across an overwinding on the transformer and fed to a rectifier to produce the e.h.t. for the tube.

Valve Circuit

A simple valve line output stage is shown in Fig. 2. No tuning capacitor is shown because in a valve line output stage the output transformer's self-capacitance is used to tune the flyback. Dynamic width control can be achieved by feedback to adjust the bias at the output pentode's control grid. This is done by feeding the flyback pulse to a v.d.r. which acts as a rectifier, producing a bias voltage to add to the self-bias produced by the pentode itself (grid current charges the coupling capacitor negatively when the valve saturates). Preset width control is achieved by feeding an offsetting positive voltage to the circuit – the control is often labelled "set boost". Since the amplitude of the flyback pulse depends on the conditions in the line output stage, dynamic width control is achieved, i.e. the operation of the stage is stabilised to counter supply voltage and load variations.

Problems with Transistors

This arrangement is possible because although a line output valve is used as a switch it doesn't have to be switched on and off all that sharply. So the drive can consist of a steep sawtooth or a pulse with a sloping leading edge, the point along the positive-going edge of the drive waveform at which the pentode switches on being controlled by the bias voltage at its control grid. This sort of thing will not do for a transistor, which must be switched from off to on and from on to off very rapidly to minimise power dissipation in the device. To provide dynamic width control with a transistor line output stage we can vary the mark-space ratio of the drive waveform, vary the effective h.t. voltage applied to the stage, or add

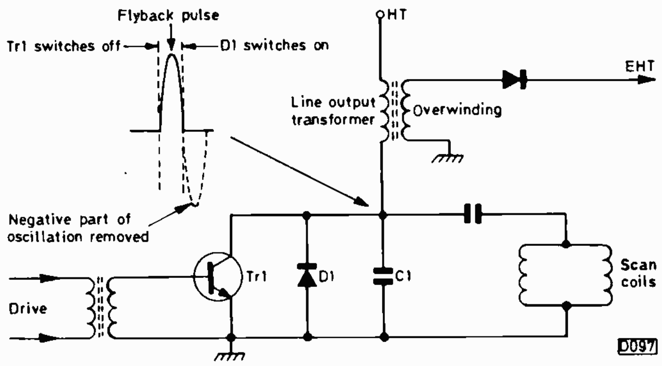

Fig. 1: Basic transistor line output stage.

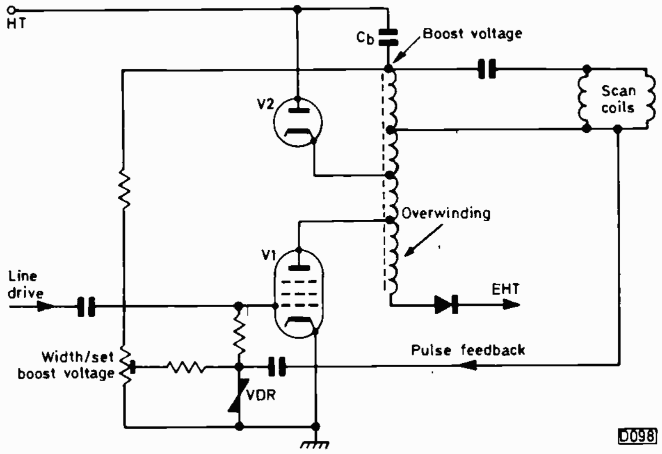

Fig. 2: Valve line output stage with pulse feedback to stabilise the operating conditions. The VDR acts as a pulse rectifier, producing a negative bias voltage proportional to pulse amplitude.

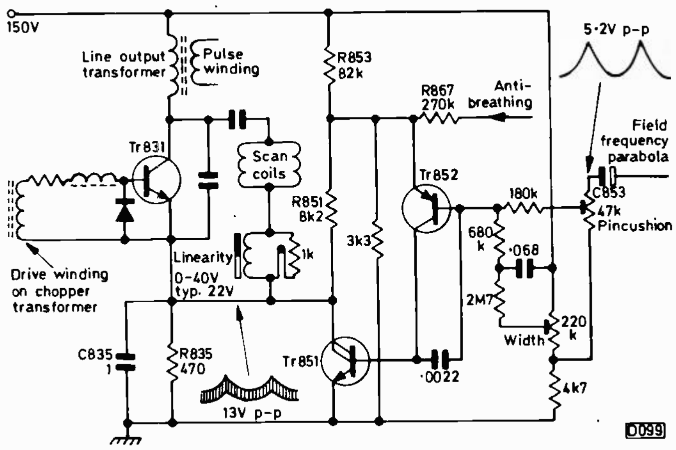

Fig. 3: Line output stage circuit, Thorn TX10 chassis.

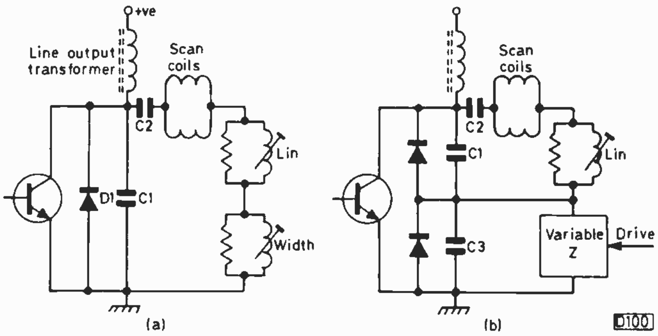

Fig. 4: Basic transistor line output stage with inductor to provide width control (a). Modified arrangement with high-level EW diode modulator circuit (b).

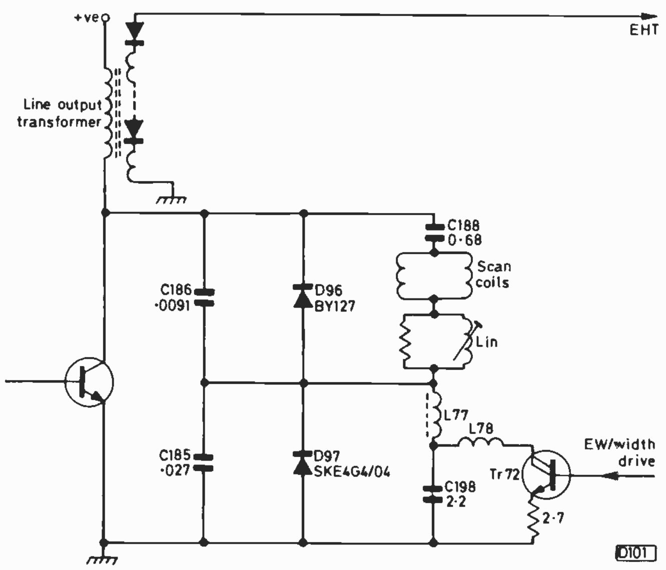

Fig. 5: Line output stage circuit used in the Thorn TX9 chassis – simplified to show basic operation.

a controlled variable impedance in series with the scan circuit.

The technique of varying the mark-space ratio of the drive waveform is used in chopper circuits, which operate in much the same way as a line output stage. The Syclops combined chopper/line output stage used in the Thorn 9000 chassis employed the technique. The other two methods have the advantage that the circuitry used for the purpose can also be used for EW raster correction. In most chassis varying the h.t. voltage applied to the line output stage is not a practical proposition since the e.h.t. is obtained from the line output transformer – and we don't want it to vary with the EW correction. In some chassis however the e.h.t. is generated elsewhere. An example is the Thorn TX10 chassis, where the e.h.t. is generated in the chopper circuit which employs a diode-split type of transformer. The TX10 chassis makes use of the technique of varying the h.t. applied to the line output stage to provide dynamic width correction.

Thorn TX10 Chassis

The TX10's line output stage circuit is shown in Fig. 1. Tr831 is the line output transistor whose emitter is returned to chassis via R835 and the Darlington transistor Tr851 which provides the dynamic width control action. The d.c. voltage across Tr851 can be varied between 0 and 40V and is typically 22V. Thus the effective h.t. applied to the line output stage is reduced from 150V to typically 128V.

The base of Tr851 is driven by the pnp transistor Tr852 whose d.c. base voltage is set by the width control. For EW correction a field frequency parabola derived from the field scan circuit is applied to Tr852's base via the pincushion control. The d.c. conditions in the dynamic width control circuit are stabilised by R851 which applies negative feedback from the collector of Tr851 to the emitter of Tr852.

Now no matter how good the e.h.t. regulation there will be some e.h.t. variation with brightness changes, causing slight width and height variations. This is known as breathing. To minimise the effect feedback is applied to the emitter of Tr852 from the earthy end of the e.h.t. circuit via R867. Breathing correction is also applied to the field timebase.

Thorn TX9 Chassis

In the Thorn TX9 chassis the e.h.t. is derived from the line output transformer in the conventional way and width control/EW correction is effected by inserting a variable impedance in series with the scan coils. The problem of keeping the e.h.t. constant despite the application of EW correction remains. It's resolved by using a diode modulator.

Before looking at the actual circuit, let's see how the basic line output stage is modified by the use of a high-level diode modulator. Fig. 4(a) shows a basic transistor line output stage with impedances in series with the scan coils to provide width and linearity correction. Tuning capacitor C1 controls the resonant frequency of the flyback. Fig. 4(b) shows the arrangement with a high-level diode modulator added. The tuning capacitor C1 is now connected in series with a second capacitor C3: since the value of this capacitor is much larger than that of C1, the main flyback tuning is still provided by C1. The modulator diodes are connected in series in the efficiency diode position and the width control is replaced by a variable impedance to which a parabola for EW correction, superimposed on a d.c bias for width setting, is applied.

Fig. 5 shows a simplified circuit of the TX9's line output stage. It can be seen that the variable impedance consists of C198 and the Darlington transistor Tr72. L78 simply filters out the line frequency component so that this doesn't affect Tr72. The input to the base of Tr72 consists of a parabola plus a d.c. component set by the width control, supplemented by an anti-breathing voltage. It's important to appreciate that in addition to the flyback tuning the scan coils are resonant with the coupling/S-correction capacitor C188. With the diode modulator circuit included, the energy in the scan circuit is divided between C188 and C198: the Darlington transistor represents a variable shunt across C198 to modify the width, which is maximum when Tr72 is fully conductive, shorting out C198. The combined action of the tuning inductor L77 and C185 maintains the correct flyback tuning/e.h.t.

Thorn TX90 Chassis

Many of the latest generation of colour tubes are pincushion distortion free, so that EW correction is not required. Thus when Thorn came to design the small-screen TX90 chassis an entirely different approach to width control, i.e. stabilising the voltage conditions in the line output stage, could be adopted. The circuit used (see

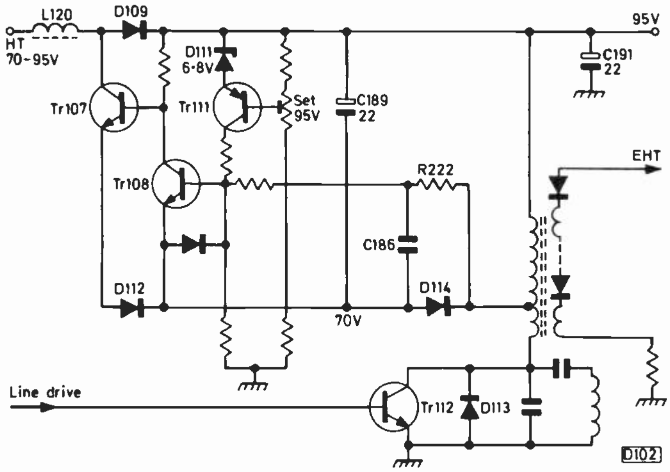

Fig. 6: Line output stage circuit – again simplified – used in the Thorn TX90 chassis, with chopper-controlled boost supply.

Fig. 6) provides an interesting contrast to those just described.

The line output stage is operated from a boosted h.t. rail of 95V. Compare the circuit with the valve circuit shown in Fig. 2: D114 is the boost diode, equivalent to V2, and C189 the boost reservoir capacitor, equivalent to Cb. Here the comparison ends! The unstabilised 70-95V h.t. supply is obtained from a transformer-fed mains rectifier circuit. Stabilisation is achieved by a chopper circuit that regulates the boost voltage: Tr107 is the chopper transistor which is controlled by Tr108/Tr111 – these two transistors generate a variable mark-space ratio drive for Tr107. The line output part of the circuit, Tr112 etc., is conventional.

The extreme conditions are with an h.t. input of 95V or 70V. If the h.t. reaches 95V D109 conducts and C191 is charged to 95V: the whole chopper/boost circuit is shorted out. With the h.t. at 70V Tr107 remains switched on and the boost diode charges C189, generating 95V across C191. At voltages between 70V and 95V Tr107 acts as a chopper whose reservoir is L120. When Tr107 switches off, the voltage at its collector swings positively and D109 conducts, supplying energy to the boost rail. Thus Tr107/L120/D109 supplement the action of D114 to maintain the boost voltage at 95V. The subtlety of the action is that the energy stored in L120 depends on Tr107's on/off times which are in turn dependent on the boost voltage.

The variable mark-space ratio chopper drive waveform is produced by Tr108 which acts as a pulse-width modulator. The d.c. bias at the base of Tr108 is set by the error detector transistor Tr111 which samples the boost voltage at its base. The other input at the base of Tr108 is a line-frequency sawtooth which is produced by the integrating circuit R222/C186. Thus Tr111 sets the point, depending on the boost voltage, at which Tr108 switches on along the positive-going slope of the sawtooth.

Perhaps we could call it a dynamic boost/width circuit!

Problems with Peritel

Harold Peters

You've got to hand it to the French. If they don't want oriental goods imported into their country they make it so difficult that the entrepreneurs give up. The most recent example was when foreign VCRs were routed through a small, inland customs post capable of clearing only a handful of machines per day.

In the "golden age" of TV they used the moribund 819-line system as a deterent. "No 819 lines, no entry" was the rule, which worked for quite a time till something else had to be thought up. The new obstacle hit upon was the SCART socket, a 21-way connector that's been a mandatory feature on all TV sets sold in France since 1980. It served its purpose well enough until recently, when with the coming of home computers etc. people (you've guessed it!) actually started to use the thing. It began giving trouble, culminating in a wave of complaints when the pay TV programme Canal Plus started just before Guy Fawkes night and three per cent of the initial subscribers (about 6,000 families) had their opening night spoilt by technical problems with the connector, through which the new programmes have to come.

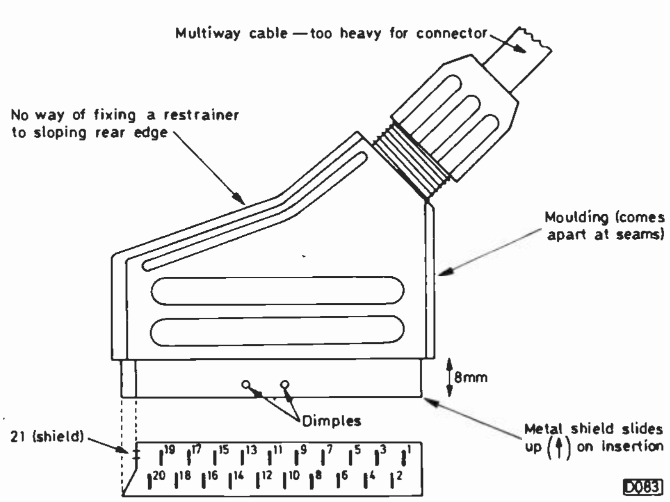

Fig. 1: Physical details of the SCART socket, showing the pin numbering and some of the weak points in the mechanical construction of the connector.

Now that we here are using the SCART connector to an increasing extent, let's take a detailed look at it and consider some of the problems.

SCART stands for Syndicat des Constructeurs d'Appareils Radio Recepteurs et Televisieurs. In practice most people nowadays seem to use one of the alternative names for the device – Euroconnector or Peritel (peripheral television) socket.

The SCART Connector

The non-reversible plug has twenty spade-shaped contacts in an insulated block surrounded by a near-rectangular metal skirt protruding from a wedge-shaped moulding. Its wrap-round construction is held together by the cable clamp alone (see Fig. 1). The flat pins come in the form of stamped ribbon (like Amp connectors), the idea being that you fit only as many as you need. The socket is complementary and is moulded to fit either directly or at

Table 1: SCART socket connections.

Pin	Function	Signal
1	Right audio out	0.5V/1kΩ
2	Right audio in	0.5V/10kΩ
3	Left audio out	0.5V/1kΩ
4	Audio earth	—
5	Blue earth	—
6	Left audio in	0.5V/10kΩ
7	Blue in*	0.7V/75Ω
8	Source switching	varies/10kΩ
9	Green earth	—
10	Intercom. line	—
11	Green in*	0.7V/75Ω
12	Intercom. line	—
13	Red earth	—
14	Intercom. earth	—
15	Red in*	0.7V/75Ω
16	Fast RGB blanking	varies
17	CVBS earth	—
18	Fast blanking earth	—
19	CVBS out	1V/75Ω
20	CVBS in	1V/75Ω
21	Socket earth	—

*RGB inputs from computers often need attenuation since they are usually TTL (0-5V). For BBC etc. use circuit shown in Fig. 2 in each leg, fitted as close to the computer as possible.

right-angles on to a standard PCB. Three dimples in the plug's metal skirt (which is chassis, and is called pin 21) click into the socket moulding as a retainer.

The electrical possibilities opened up by the connector are many (see Table 1). At the square end of the connector, pins 1-4 and 6 are allocated to stereo sound in and out. At the pointed end, pins 19 and 20 give video in and out (if yours are labelled CVBS don't worry – this stands for composite video, blanking and sync, the pedant's definition of video). In between are pins for RGB inputs and various control lines, which don't appear to be standardised and are used by different setmakers in different ways. The circuits have separate chassis return pins (seven in all) and sets incorporating the connector must be mains isolated to provide a dead chassis.

Mechanical Problems

Although the reported Canal Plus trouble was attributed to loose sockets, especially with sets of Japanese and W. German origin, the writer has yet to experience such a socket fault. Paradoxically the socket tension with UK sets is if anything too tight – you get the impression that your plug was the very first to enter the socket, and you're probably right. The effort needed to push the plug home and click it in can easily bend back or push connecting pins up into the plug housing: if you decide to unplug as a check, the chances are that the second time you plug it in the click dimples will have become a slack fit. The metal skirt can also easily be pushed back, and because it's the main chassis connection the result can be buzzes and crackles: it should be 8mm proud of the plug moulding.

The leadout cable may be as thick as your finger – very heavy and stiff in cold weather, containing as it does up to twelve individual screened leads. As no provision is made for a retaining clip, it makes good engineering sense to support the cable using a purse clip through a ventilation hole in the TV set's back cover.

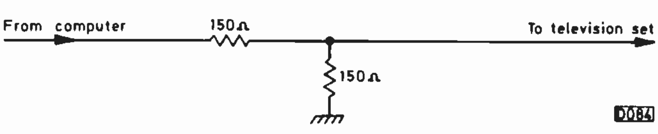

Fig. 2: Simple potential divider to reduce the amplitude of a TTL video signal from a computer to a level suitable for feeding to a TV set via the SCART connector.

Electrical Problems

The electrical problems are interrelated with the mechanical ones inside the plug. If one spade contact has moved back, the chances of it shearing off its wire on the other side are pretty good. Hum loops due to earth connections touching can also be a problem, and continuity checks won't help much. You can get "open base" hum from the TV set's loudspeaker when using this with a microcomputer that has its own inbuilt sound system. This can of course be controlled by the TV set's (or should we say monitor's?) volume control.

Compatibility

Another problem is that not all SCART cables contain a full set of leads, nor do all TV sets accept the full set of feeds. Instruction books don't generally tell you what's been left out. The Philips group have made a start at clarifying matters with their products by calling their connectors Euro*, Euro** and Euro***, but to date this information is to be found only in service data summary charts. The system is as follows:

Euro* has stereo sound in and out plus video in and out.

Euro** has the above plus an RC5 control line linked to pin 8.

Euro*** has all the above plus RGB on pins 15, 11 and 7 respectively.

RC5 is the current Philips group remote control code, the purpose of the link to pin 8 being to permit remote control of the SCART inputs via the TV set. A simple way of checking for RGB inputs is to put a 1, using a 1·5V battery, on pins 15, 11 and 7 and look for a coloured screen.

In General

Things should improve as more connectors come into use, but until then it's sound advice to leave a connector alone once it's making good contact. Do all your switchcraft at the other end of the lead. Some sets boast two sockets, which are switchable, and since what goes in one comes out of the other video "daisy chains" are possible. Buffer amplifiers are interposed, making feedback loops possible.

Because of the use of better modulators in the newer VCRs, the improvement in picture quality obtained by using the SCART socket is barely perceptible – the only advantage is the ability to get stereo sound off a tape. Even this is of questionable merit. The EBU standard viewing distance is 6H (six times picture height), at which distance the eye doesn't move to follow movement across the screen. Get any closer (like the kids do) and you're struck by the dreaded vertical and temporal aliasing. So if you sit back far enough to avoid undue eye strain what's the point of having moving sound to accompany a stationary picture? Or have I got it wrong again?

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THORN TX9 CHASSIS

From new this remote control set (U725 system) has switched from standby to on, from any selected channel to channel one, and from higher to lower volume levels without using the remote control handset. Switching any electrical appliance in the vicinity on or off does the trick.

The symptom suggests that random noise is being generated in the IR receiver section. Check the supply decoupler C921 (4·7μF) by substitution, also filter resistor R972 (1kΩ) and R970 which is in series with the detector diode – its value should be 120kΩ. If the fault persists suspect the SL480 preamplifier i.c.

TYNE 5221

On monochrome there are faint vertical striations all over the screen. Tuning for colour is extremely critical and when achieved there's a peculiar chequerboard effect due to the presence of the striations. Also the set tends to overload at maximum brightness, the a.g.c. preset control making little difference.

This sort of fault is never easy to diagnose. It's probably due to some form of instability in the vision i.f. strip. First, carefully check the a.g.c. and l.t. line reservoir/smoothing capacitors – C4 (10μF), C3 (0·22μF) and C12 (10μF) in this case. The tuner could just be responsible, but before condemning it check the earthing of the chassis print on the i.f. panel.

DECCA 100 CHASSIS

After the set has been running for a while a white strip about an inch wide appears across the bottom of the screen. Are there any stock faults that might cause this?

It sounds as if the problem is field foldover – the usual culprit is the lower transistor in the field output stage, Tr803 (BD278A). If necessary check its driver Tr309 (BC327), R371 (2·2kΩ) which tends to change value, and the 32V line – if ripple is present here, C505 (2,200μF) or the jointing on the convergence panel is suspect.

MITSUBISHI CT202B

The problem with this set is lack of width, about an inch to an inch and a half on each side of the screen. There doesn't seem to be a width control.

Check the h.t. from the series regulator circuit. There should be 105V across C902, adjustable by means of VR901. If the h.t. voltage cannot be set correctly, check the 12V zener diode D901. If the h.t. is normal, check the current consumption through terminal 5 of the regulator panel. It should be 1A. If it's excessive, progressively unload the line output transformer, starting with the tripler and the first anode supply rectifier D571. The width should be correct with the right h.t. voltage and flyback tuning.

THORN 1690 CHASSIS

The set works o.k. to start with but after about a quarter of an hour the tuning becomes unstable and sporadic.

First check by substitution C39 (1μF) which decouples the slider of the tuning potentiometer. Then if necessary make sure that the tuning calibration control R21 is clean and sound and that R41/2 (both 6·8kΩ) which feed the stabiliser i.c. are o.k. If all these items are in order the tuner is suspect.

GRUNDIG 6010

The remote control works only when the transmitter is within five-six inches of the set. Should I start by checking the transmitter or the set?

One or other of the ultrasonic transducers often looses sensitivity but it's impossible to say which. In our experience the one in the transmitter is the most likely culprit. First check the 10MΩ resistor R183 in the transmitter unit.

THORN TX9 CHASSIS

This set has suffered from sibilant sound since new. Have there been any modifications?

Slight, careful adjustment of the quadrature coil L62 should cure the sibilant sound effect. If not, try altering the value of the de-emphasis capacitor C114 – select a value between 0·0022 and 0·01μF.

PHILIPS TX CHASSIS

The problem is lack of supplies from the line output stage. The 10·8V l.t. line is present and the diodes in the line output stage all read correctly. I suspect the line output transistor or transformer.

While there could be a fault in the line output stage it's more likely that the line output transistor is not being driven. Check the BC337 line driver transistor (TS410) and particularly the print in this area – the print in this chassis is prone to dry-joints and hairline cracks.

THORN 9000 CHASSIS

The set goes out of focus now and again. Each time this is preceded by flashing on the screen. After a further flash the picture becomes very good again.

First check for contamination or discharge at the focus spark gap on the tube base, and examine the c.r.t.'s focus pin and its socket for green corrosion. If all is well and the series resistor R906 (100kΩ) measures all right a new focus control will probably be required. In very rare cases the e.h.t. tripler can be responsible for this fault.

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TELEVISION MARCH 1985

VCR Clinic

Reports from Steve Beeching, Tech. Eng., Derek Snelling and Philip Blundell, Eng. Tech.

Mitsubishi HS306

A number of faulty HS306s came in over the Christmas period. Well we do have a lot of them out on rental, but the number that fail in one way or another during the first few weeks is in my experience greater than with any other machine we've handled. Several more have had the squeaking problem due to the head earthing spring (see last month), though the sticking cassette door problem seems to have gone. The problem of fuse blowing has started to occur with this machine, though not yet to the extent that it did with the Toshiba V31B. Both 400mA fuses blow (completely blackened) for no apparent reason, replacement resulting in a perfect working VCR. Incidentally fuse blowing tends to be associated with the use of two-way plug adaptors, but more on that at a later date. The capstan motor drive i.c. seems to be a weak link. We've had four failures already: two gave no rewind or eject with fast forward and play o.k.; the other two gave no operation at all. Intermittent E-E and playback on one machine was traced to dry-joints in the booster/converter, while tuning problems were traced to dry-joints/loose plug-socket connections to the front panel on several others.

A colleague may have had one of these machines with a faulty head. The drum in question couldn't be removed however, neither could that on another of these machines. The fit over the centre spindle was too tight, so it's going back to the manufacturers. Only once before have we had a drum stuck on in this way – that was also a Mitsubishi VCR, though an earlier model. **D.S.**

Mitsubishi HS700

The HS700 has also been giving us a bit of trouble lately. A colleague had one that produced no output due to a faulty r.f. converter. The problem with several of them was vertical lines on playback, most noticeable on dark scenes. The Mitsubishi technical representative drew my attention to a modification for this problem, which seems to show up only in certain batches of the machines. The cure is to fit a 100μH choke across R6G3 on the reverse side of the luminance/chrominance board. This modification had in fact been mentioned in one of their technical bulletins: it's just that I hadn't made the connection. **D.S.**

Mitsubishi Rewind Modification

Those with a Mitsubishi HS303, HS320 or HS700 will know that these machines tend to be rather slow on rewind. This is a deliberate design point to prevent damage to four-hour tapes. Other machines seem to be able to do it much more quickly however, without any problems.

Mitsubishi say that provided the machine rewinds an E180 cassette in less than four minutes, ten seconds it's working all right. If yours takes longer than this the first thing to do is to check for faults – one of the two motors (supply or take-up) is usually the cause. If all is well the following (unofficial) modification may be of interest.

First, how does the rewind circuit work? Fig. 1 shows the arrangement used in the HS320 – the other models are similar, just with different component reference numbers. During rewind the supply reel drive motor is driven by Q575, under the control of Q5D8 etc. The take-up motor is not driven and freewheels, acting as a generator that produces a negative voltage proportional to its speed – the faster it goes, the greater the voltage produced. This voltage is fed via D5E6 and R5B4 to the reel revolution detector transistor Q5E0, which adjusts the drive via D5E1. As the tape nears the end the take-up motor revolves more quickly and the drive to the supply motor is reduced, slowing down the rewind. A similar thing happens on fast forward, using D5E7, R5M4 and D5E3.

To speed up the rewind and fast forward all that's necessary is to reduce the voltage generated by whichever motor is freewheeling by increasing the values of R5B4 and R5M4. On one machine I increased the value to 4·7kΩ, but it's best to fit a 10kΩ preset in series with a 1kΩ fixed resistor temporarily, adjusting the speed for whatever is best in the particular case. Remember that if you use four-hour tapes the speed will have to be a little slower than if you use only three-hour tapes. With three-hour tapes the rewind time can be reduced by a minute without undue worry. The resistors to change in the HS303 and HS700 are R5K6 and R5K5. **D.S.**

Mitsubishi HS306

This machine employs an unusual arrangement in which the cassette loading mechanism is powered by the capstan motor. The first of these machines to come my way wouldn't load a cassette, though if you loaded one by hand the machine would eject it when asked. When an attempt was made to load a cassette the supply to the capstan motor drive i.c. would rise from 11V to 17V but none of this was supplied to the motor. Replacing the i.c. (type STK6962) restored normal operation. **P.B.**

Grundig 2 × 4 Super

It started off with a dead machine – no operation at all. The power relay didn't operate and a tape had been left in the machine. The report read "stopped in playback". Response to the keyboard was nil. A check around showed that there were no key-scan output pulses from the microcomputer control i.c. (IC220) so a new one was sent for.

After fitting this key-scan operation was restored but the machine insisted on selecting search even when there

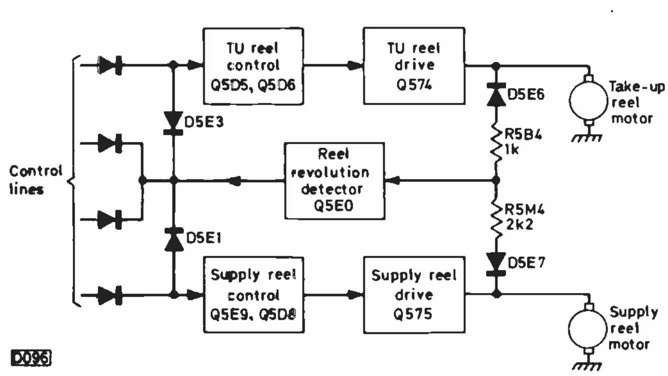


Fig. 1: Mitsubishi rewind modification.

was no cassette in it. Everything was checked, even to the point of removing all the PCBs except for the DTF panel (this was done on the advice of a certain person from Grundig!). Another IC220 was tried, then the clock microcomputer i.c. (IC280) was changed. Still the power relay refused to budge (it could be operated by connecting one pin to chassis – this feature had been used to unload and remove the cassette).

It was decided between Grundig Pete and myself that there was no reset. Pete asked me if there was an extra reset subpanel on the keyboard: no there wasn't. So what i.c. did I put in for IC220? An SDA2010-B316 like it says on the circuit diagram. Ahaa!! – that's the problem. You need an SDA2010-E316. What's the difference? The B316 suffix i.c. requires additional reset circuitry consisting of IC160 on a subpanel whereas the E316 has the circuitry built in. Try an E316. I did.

At least some operations were restored. But when a cassette was inserted the tape was almost chewed due to lack of threading tension and the drum revolved like something possessed. Pulses were missing from the DTF microcomputer i.c. (IC2640, an SM591), as a result of which the drum servo had no reference. A new SM591 was fitted to cure this and full operation was then restored. A new 5V regulator i.c. was fitted to protect the new micros – just in case. **S.B.**

Manual Lace-up for the N1500

John de Rivaz, B.Sc.(Eng.)

Because the price of spare parts for the Philips N1500 series of VCRs is rising steeply while the cost of the cassettes is relatively high per hour, N1500 VCRs are now being scrapped at a much greater rate. As a result, they are available at very low prices, making it possible for the knowledgeable experimenter to get into video very cheaply indeed. Taking inflation into consideration, it can be said that the cost of buying a few scrap machines to make into one good one is comparable with the early fifties hobby of building television receivers from war surplus parts.

One of the most unreliable sections of the N1500 is its tape threading mechanism. This uses a thin cord prone to wear and a fragile mechanism of contacts and levers, all driven by gearwheels that can fracture and break. The lot can be removed and replaced with a manual lace-up system that's one hundred per cent reliable. The system described in this article has been in use for well over a year without giving any trouble.

The new arrangement has two disadvantages. With the original system, the pressure roller is not brought into contact with the capstan in the timer mode until a recording starts. This feature is lost when the modification has been made, so there's the theoretical possibility that the capstan will be deformed if a lot of timed recordings are made. The machine used as the test bed has only occasionally been employed for timed recordings and no ill effects have been noted to date.

The second disadvantage is that Philips employed what looks like a bit of a bodge to reduce the servo's settling time during threading – a signal was sent to the servo system during lace-up to provide a "shake up" action. This feature has to be removed – if the slower servo settling time proves to be a problem, an electronic equivalent could no doubt be made and added.

Dismantling

Let's assume that you're faced with a thoroughly snarled up lacing system and that the choice is either to modify or scrap the machine. A second assumption we must make is that a full service manual for the machine is to hand.

The first step is to remove the video head drum and set it aside somewhere safe – a new one will now cost you just under £100! Next remove the threading motor and lacing cord and the small chassis with the contacts. Remove all wiring from this chassis back to the point of origin, except for the leads to the threading motor and those to the mains switch SK7. Finally remove wire D/E184 between E169 and D229 (the servo speed-up connection).

Mains Circuit

This leaves points 160, 161, 166, 168 and 187 on the rectifier panel free. Connect 160 to 166 and 161 to 168: it can be seen from the circuit in the manual that this will provide a 20V supply when the on button is pressed. Connect a 24V relay capable of switching the mains voltage at an Amp (at least) to the wires that previously went to the motor, with the contacts connected to the wires that previously went to SK7.

Thus when the on button is pressed 20V is supplied via relay Re151 to the new 24V relay which should apply the mains to transformer T1 and the motors. When the off button is pressed Re151 is de-energised, also the new relay, shutting off the machine. In the case of timer operation the solenoid will still remove the pinch roller from the capstan when the machine is shut off.

Cassette Unlock

In normal operation the cassette is unlocked by a small rod that moves back as the threading process starts. Remove this rod and take out the linkage that operates it. Make a small bracket as shown in Fig. 1 – adjust by experiment so that the locking levers are pushed back as a cassette is inserted. Bolt it to the main chassis through a small hole.

Pinch Roller Linkage

Lock the pinch roller linkage by means of a 4BA or similar nut and bolt inserted through a convenient hole left by the threading chassis, so that when the play button is pressed the pinch roller is brought to bear against the capstan.

Interlock

In this condition it would be possible to switch the machine on and attempt to play a cassette without it being laced up – which would be disastrous. To overcome this problem solder a small piece of copper to the interlock bar to prevent the play key being pressed until the tape has been laced. The cam on the video head drum assembly remains in position, providing the displacement of the interlocking mechanism. The tape has to be hand-laced first when a timed recording is to be made.

Drum Modifications

In order to accommodate this modification my machine is permanently run without the head drum cover. It might well be possible to cut holes in the cover for the new controls to protrude.

Fit a 5mm diameter, 40mm long rod to the head drum top support. This is used to rotate the drum by hand when lacing. Make an L-shaped piece of aluminium to the pattern shown in Fig. 2 to hold the drum in the threaded position. Bolt this to the cassette holder as shown in Fig. 3. Looking at the right-hand rear of the cassette holder you can see that there's a piece that stands proud of the level of the support brackets. Bend the top 5mm of this

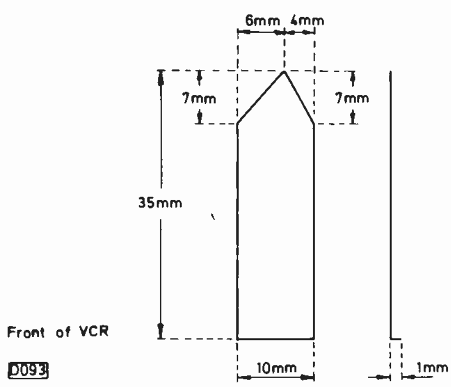


Fig. 1: Cassette unlock bracket.

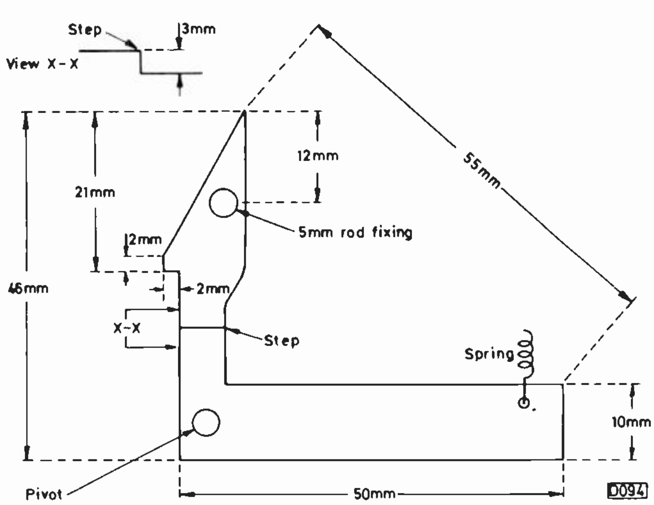
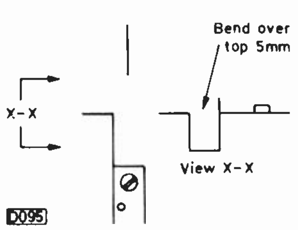


Fig. 2: L-shaped crank for holding the drum in the laced position. It may be necessary to adjust on assembly – what has to be done should be clear when the actual machine is on the bench.



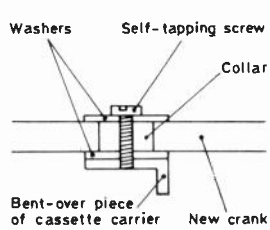


Fig. 3 (left): Connecting the crank to the rear right side of the cassette carrier.
Fig. 4 (right): Crank bearing.

over and make a hole in the centre to take a small self-tapping screw.

Make a bearing for the crank, from washers, as shown in Fig. 4. Tighten the screw so that the washers are held firmly – their thickness is chosen so that the crank will move freely. Install a spring between the crank and the rear of the VCR. When the cassette is laced, the crank holds the head drum in place by latching against the vertical part of the top head drum support. Fix another 5mm, 40mm long rod to the crank to move it to one side when unlacing.

Servo Link

Finally, if the servo fails to work you've forgotten to remove wire D/E184.

Articles on the N1500

The following list of articles that have appeared in *Television* on the N1500 may be of interest to experimenters.

(1) October/November 1975, Inside the Philips VCR by M.P. Riley (contains rare diagram of N1500 track arrangements).

(2) February 1977, miscellaneous modifications by John de Rivaz. Includes metering the servo system, which is well worth doing.

(3) July 1977, a DIY picture sharpener by John de Rivaz.You may want this if Philips sharpeners are no longer available at a reasonable price.

(4) September 1977, an add-on timebase for receivers that work badly with VCRs, by John de Rivaz.

(5) October 1977, adding the Philips sharpener and notes on cassette salvage, by John de Rivaz.

(6) February 1978, modifying the N1500 for skip-field operation. With N1700 heads available this modification is somewhat out of date. With head prices soaring however the modification may come into use again to make use of old N1500 heads at slow speeds.

(7) May 1978, notes on adding N1700 heads to N1500s to obtain increased playing time, by John de Rivaz – basically, fit new head, install a second capstan servo head and turn down the drive motor pulley to half the original size. This is fine for own recordings, but further work is required for N1700 compatibility, i.e. fit new sound/sync head and turn capstan down to 1312/1429ths of original size.

(8) January 1980, a rewind machine by John de Rivaz. Thoroughly recommended to rewind cassettes on an otherwise dud machine, saving a lot of head wear. The article describes how to use a stripped down machine for rewinding only.

(9) July 1980, a step-by-step guide to converting an N1500 machine to full N1700 standard by G. Beard, with several photographs of a converted machine and many line drawings.

(10) April 1983, N1700 speed reduction by M. Phelan. This may show the way to further speed reduction with N1500s, although there will be severe mechanical problems due to the mains motors used.

(11) May 1984, VCR clock repair by John de Rivaz – rewind your burnt out clock coil with thick wire and wind a few turns of thick wire around the transformer to get your clock going again. Note that excessive noise may arise if you don't position the worm gear correctly when reassembling the clock.

TEST CASE

267

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

A surprising number of sets that bear the names of UK manufacturers are fitted with chassis of W. German origin. Recent ITT receivers are produced in W. Germany and such homespun firms as Doric (Rediffusion), Ferguson, GEC and the now defunct Rank Radio International have all at various times used European designed and made chassis. The internal appearance of these sets is unmistakably continental, while the multi- or bilingual service manuals usually leave a lot to be desired. We've not had much luck servicing these "step-chassis" in our workshop, principally because of the lack of information on circuit operation in the manuals. This month's patient is a small-screen GEC colour set (Model C1401H) of continental ITT origin – the chassis is much the same as that used in the CVC800 series.

The set had been working quite well until its owner moved home. The little set then seemed very unhappy, even though it had a good aerial signal and pride of place in the dining room. The picture had shrunk all round, and performance was very dependent on the settings of the controls. At high brightness and contrast levels the picture broke up horizontally, finally disappearing into a short horizontal line across the middle of the screen.

We soon discovered that the cause of these failings was a low and poorly-regulated h.t. line. The chassis uses a discrete component chopper circuit, with the line output transistor driven from a secondary winding on the chopper transformer. The outputs provided by the chopper circuit are 106V and 15V: both were down some 50 per cent. Concentrating on the 106V h.t. line, we found that the set h.t. control R746 varied the output between 40-80V. The output was very dependent on tube beam current, and at some settings of the customer controls the vertical lines in the test pattern would "twin" in a way we'd not seen for years.

The h.t. is smoothed by C757 (10μF), and we've known

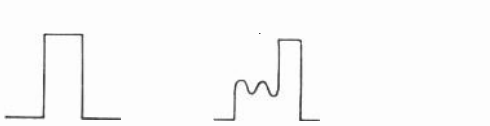


Fig. 1: Waveforms at the emitter of the chopper transistor in the small-screen GEC colour set. (a) The correct waveform. (b) Waveform found in the faulty set.

such symptoms to be caused by the capacitor in this position in power supplies of this type. We jumped on C757 and soon had a replacement installed. This made no difference at all. The input (290V) to the chopper circuit comes from a mains bridge rectifier with a 300μF reservoir capacitor. This supply measured 300V and as there was no excessive ripple we turned to the chopper control circuit.

The main items here are an oscillator, an emitter-coupled pulse-width modulator and the chopper driver stage. The oscillator and pulse-width modulator are powered by a 20V supply that's produced at the driver transistor's emitter. There are also a couple of trip transistors. The 20V supply was present and correct, and the trip circuit was simply disconnected to eliminate it from the list of suspects. We started at the oscillator, whose output waveform was correct. The mark-space ratio of the pulse-width modulator's output waveform had widened in an attempt to correct the low h.t. output. So far so good. The waveform at the collector of the driver transistor was much as it should have been, but that at the emitter of the BU126 chopper transistor was strange indeed – see Fig. 1. Having made this discovery we turned the chassis over and found the cause of the trouble straight away – and no replacement components were needed! What had happened? See next month.

ANSWER TO TEST CASE 266
– page 227 last month –

The Ferguson TX90 featured last month had a little auxiliary, and continuous, degaussing system that affected the lower left-hand corner of the display only. The immediate cause was a very hot and bothered mains transformer that became too hot to touch after a short run. In all other respects the set seemed to be working satisfactorily, and we'd proved by substitution that the transformer's distress was not of its own making.

Turning to the main panel, we made a start by investigating the rectifier diodes fed from the transformer's secondary winding, expecting to find leakage in one of the three diodes we'd not replaced when the chassis had originally been in the workshop. There was no leakage, but one of the full-wave h.t. rectifier diodes, D123, was completely open-circuit – probably blown internally when its companion D120 died on the wild night of rain and tempest. This of course made the rectifier circuit into a half-wave system, with the result that excessive current was being drawn from the transformer on alternate half cycles of the mains supply – and none on the other half cycles. Hence the overheating and excessive magnetic field.

The surprising aspect of all this is that the self-regulating line output stage, with its switch-mode boost circuit, was able to operate normally despite the half-cocked h.t. input. Had it not been for the effect of the fault on the mains transformer the trouble might well have gone unnoticed – a tribute to the effectiveness and tolerance of the design.

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BF337	20p
BF338	20p
BF362	30p
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BF458	19p
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OA202	7p
IN914	2p
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IN4006	4p
IN4007	5p
IN4148	2p
IN5400	9p
IN5401	10p
IN5402	10p
IN5403	11p
IN5404	11p
IN5405	12p
IN5406	13p
IN5407	13p
IN5408	13p
LOW PROFILE SOCKETS	
8pin	6p
14pin	8p
16pin	9p
18pin	12p
20pin	14p
22pin	16p
24pin	18p
28pin	20p
40pin	25p
ZENERS	
400MV BYZ88 Range 2V7 to 39V	6p
1.3W Zeners BZX61 Range 2V7 to 39V	12p
VOLTAGE REGULATORS	
7805	35p
7812	35p
7815	35p
7818	35p
7824	35p
7905	35p
7912	40p
7915	40p
7918	40p
7924	40p
78L05	28p
78L12	28p
78L15	28p
78L18	28p
78L24	28p
79L05	40p
79L12	45p
79L15	48p
LM309K	100p
LM317K	220p
LM317T	180p
LM323K	420p
LM723	32p
78HGKC	570p
78HO5KC	520p
78GU1C	190p
79GU1C	215p
79HGKC	670p
VALVES	
DY87	53p
DY802	45p
ECC82	40p
ECC83	43p
ECC84	40p
ECC85	40p
ECH81	49p
ECH84	52p
ECL80	57p
ECL82	59p
ECL84	57p
ECL85	57p
ECL86	49p
EF80	31p
EF85	34p
EF89	43p
EF183	45p
EF184	53p
EL34	190p
EY86	31p
EY87	31p
PC97	100p
PCC85	42p
PCF80	58p
PCF200	135p
PCF801	110p
PCF802	57p
PCF806	115p
PCH200	100p
PCL81	54p
PCL82	63p
PCL84	50p
PCL85	55p
PCL86	55p
PCL805	55p
PFL200	85p
PL36	80p
PL504	95p
PL508	190p
PL519	460p
PY81	70p
PY88	48p
PY500A	160p
CMOS	
4000	27p
4001	27p
4002	27p
4006	80p
4007	27p
4008	65p
4009	50p
4010	50p
4011	27p
4012	27p
4013	50p
4014	60p
4015	60p
4016	45p
4017	65p
4018	60p
4019	60p
4020	75p
4021	58p
4022	58p
4023	27p
4024	47p
4025	26p
4026	80p
4027	38p
4028	48p
4029	55p
4030	36p
4032	67p
4034	145p
4035	70p
4038	71p
4040	57p
4041	40p
4042	58p
4043	57p
4044	56p
4047	65p
4048	49p
4049	40p
4050	40p
4051	62p
4052	61p
4053	61p
4054	85p
4055	90p
4056	85p
4060	72p
4066	42p
4068	25p
4069	27p
4070	27p
4071	27p
4072	27p
4073	27p
4075	27p
4076	70p
4077	27p
4078	27p
4081	27p
4082	27p
4093	45p
4094	85p
4098	85p
4099	82p
4501	40p
4502	55p
4503	52p
4504	75p
4506	110p
4507	45p
4508	125p
4510	57p
4511	57p
4512	57p
4513	120p
4514	110p
4516	65p
4518	65p
4520	65p
4522	60p
4526	60p
4527	60p
4528	65p
74 SERIES	
7400	22p
7401	16p
7402	18p
7403	22p
7404	18p
7405	10p
7406	100p
7407	80p
7408	25p
7409	20p
7413	35p
7414	45p
7417	32p
7420	22p
7421	25p
7425	15p
7430	25p
7437	28p
7442	45p
7447	60p
7450	22p
7451	10p
7454	25p
7470	30p
7473	30p
7475	25p
7481	90p
7482	70p
7485	45p
7486	28p
7489	100p
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	55p
74145	70p
74153	45p
74155	45p
74157	45p
74160	50p
74164	50p
74167	35p
74173	50p
74174	75p
74175	65p
74176	45p
74180	50p
74182	45p
74192	40p
74196	40p
74197	45p
74393	70p
74LS00	40p
74S04	45p
74LS08	20p
74LS09	18p
74S10	35p
74S11	18p
74S14	40p
74LS20	25p
74LS30	35p
74LS32	60p
74LS38	40p
74LS73	28p
74LS74	35p
74LS75	38p
74LS76	30p
74LS86	38p
74LS112	40p
74LS113	32p
74LS125	45p
74LS138	50p
74LS139	45p
74LS151	45p
74LS153	60p
74LS157	35p
74LS161	65p
74LS163	70p
74LS164	30p
74LS174	60p
74LS192	50p
74LS197	52p
74LS221	30p
74LS240	95p
74LS241	130p
74LS244	130p
74LS245	180p
74LS247	50p
74LS248	50p
74LS251	30p
74LS257	55p
74LS266	25p
74LS290	30p
74LS293	30p
74LS367	52p
74LS399	85p
74LS670	130p
LINEAR IC'S	
LM324	30p
LM380	60p
LM381	100p
LM709Dil	30p
LM723	32p
LM741Dil	15p
LM741 Met	45p
LM3900	25p
NE555	20p
NE556	40p
AN-214P	200p
AN-240P	150p
AN-360	120p
AN-7110	150p
AN-7114	170p
AN-7115	180p
AN-7120	150p
AY3-1270	680p
AY3-1350	300p
AY3-8910	360p
AY3-8912	400p
AY5-3600	570p
CA270	40p
CA3046	60p
CA3048	190p
CA3060	280p
CA3080E	70p
CA3086	25p
CA3089E	150p
CA3090AQ	300p
CA3130E	80p
CA3130S	100p
CA3140E	45p
CA3189E	250p
CA3240E	90p
HA-1156W	160p
HA-1197	180p
HA-1306W	220p
HA-1319	250p
HA-1339	220p
HA-1342	200p
HA-1366WR	200p
HA-1368	190p
LA-1201	120p
LA-1365	170p
LA-3301	180p
LA-3350	150p
LA-4031	140p
LA-4032	190p
LA-4051	250p
LA-4101	140p
LA-4102SK	140p
LA-4420	150p
LA-4430	150p
MB3712	150p
MC1327	70p
SAS560	110p
SAS570	110p
SN76003N	140p
SN76013N	140p
SN76023N	140p
SN76033N	150p
SN76110N	70p
SN76115	70p
T2800D	52p
TA-7120	100p
TA-7137P	110p
TA-7200	200p
TA-7201	200p
TA-7203	240p
TA-7204	110p
TA-7205P	90p
TA-7210	200p
TA-72222AP	250p
TA-7310P	100p
TAA550	16p
TBA120S	45p
TBA395	60p
TBA396	60p
TBA520	75p
TBA530	80p
TBA540	75p
TBA560	80p
TBA750	100p
TBA800	35p
TBA810S	60p
TBA820	75p
TBA920	80p
TBA950	80p
TBA990	80p
TCA270	40p
TCA800	80p
TCA940	85p
TDA1170	90p
TDA1412	60p
TDA2002	80p
TDA2003	150p
TDA2020	140p
TDA2030	140p
TDA2522	90p
TDA2530	90p
TDA2532	90p
TDA2540	75p
TDA2560	75p
TDA2593	100p
TDA2690	80p
UPC-555H	60p
UPC-556H	80p
UPC-575C2	100p
UPC-577H	150p
UPC-592H2	120p
UPC-1025H	300p
UPC-1026C	140p
UPC-1028H	160p
UPC-1031H2	180p
UPC-1032H	70p
UPC-1156H	200p
UPC-1181H	120p
UPC-1182H	150p
UPC-1185H2	250p
MEMORIES	
2114	200p
2716	300p
2516	200p
2532	400p
2732	400p
2764	700p
4116	75p
4164	380p
6116	600p
6802	220p
6809	600p
6821	150p
6840	320p
6850	130p
8116	80p

Please add 50p P&P and VAT at 15%. Govt, Colleges, etc. Orders accepted. Quotations given for large quantities. Please allow 7 days for delivery. All brand-new Components. All valves are new and boxed.

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TV TUBE POLISHING
AT
Your Own Premises
with our DIY Polishing Kit

The Kit includes:
Everything you need to polish approx. 25* tubes to a high standard. Detailed instructions on how to do the polishing. All you require is an Electric Drill.

Kit Price £45 inc P&P and VAT.
Available from Luton only.
**Depends on depth and area to be polished.*

TV TUBES TUBE POLISHING
FREE DELIVERY*

Quality, High Temperature Reprocessing

Colour Tubes	One year guarantee (optional extension up to three years)	Two year guarantee (optional extension up to four years)
Delta		
90° up to 20"	£26	£29
90° up to 22"	£30	£33
90° up to 26"	£32	£35
110° 26"	£33	£36
(fast heat, narrow neck)		
In Line & PIL		
Up to 20"	£36	£42
Up to 22"	£38	£44
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All tubes exchange glass required.

Your good, working tubes with scratches or small chips, can be **POLISHED** with our purpose built polishing equipment. **Only £7 per tube.**

Delivery charge on colour tubes: Within 40 miles of Luton. 1 tube £4. 2 or more tubes FREE DELIVERY ★
Nationwide delivery available, charges on application.

Please add 15% VAT to all prices. Callers welcome. Please phone first.

WELL VIEW
114-134 Midland Rd, Luton, Beds.

Open Mon-Fri 8am-6pm, Sat 9am-5pm. Tel. 0582-410787

Your Local Tube Stockist:
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Retach Ltd., Northwood, Middx. Tel. 09274-27019
West One Distributors Ltd., Gt. Missenden, Buckinghamshire. Tel. 024 06 3609
Rushden Rentals Ltd., Rushden, Northants. Tel. 0933-314901
Daventry Rentals, Daventry, Northants. Tel. 03272 77436
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WANTED A56/A66-510X/540X Old glass for cash

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WORKING COLOUR TVs

PHILIPS 550 .... **£35.00**
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BUSH 2718 .... **£45.00**
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THORN 8-800 .... **£45.00**
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GEC ......ITT...... DECCA ...... etc!

DISCOUNT FOR QUANTITY
WIDE RANGE OF MAKES AND MODELS ARRIVING DAILY — ALL WITH GOOD CABINETS — MANY TO CLEAR FROM *'ONLY'* **£5.00**. MIXED LORRY LOAD OF SETS DELIVERED TO YOUR DOOR DIRECTLY FROM SOURCE!

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COLOURTRADE
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QUALITY SETS from Cornwall. Workers/non workers. Spares, panels etc. Details: Ring 0726-81-5389.

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GRUNDIG SETS, PANELS, MANUALS. Nordmende and Telequipment spares, manuals. Ochre Mill. Tel. 0785 814643.

KM

* **Britain's most reliable source of quality TVs.**
* **Hundreds of working polished TVs.**
* **GEC Starline**
* **Decca 80**
* **Decca 88**
* **Decca 100**
* **Pye G11**
* **Thorn 8800**
* **Pye 222 Series**

All working and polished. These are not from major companies. A lot are from hotels and have had very little use.
Excellent reliable sets for rental.

Krystal Marketing Ltd,
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Phone 021-471 3023
Telex 335540-G
Ask for Les

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. . . V.H.S. VIDEOS . . .

FERGUSON . . . Working to a High Standard
Min of 3 hrs soak test per machine
£140 inc. Min of 5

Off the pile, as seen, **£95 inc.** Min of 5

PLUS OUR USUAL RANGE OF TVs WORKING OR NOT.
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Your Friend in the TV Business

NEW YEAR CLEARANCE
26" SOLID STATE 3 ASSORTED ONLY £28.00
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MONO'S . . . 1500/1600/MISCELLANEOUS 5 FOR ONLY £19.00
STANDS, AERIALS, ACCESSORIES ETC.

PANELS BY POST
RECONDITIONED AND PRE-CALIBRATED FOR THORN/PHILIPS ETC.
WORKING SETS TO ORDER (UNBEATABLE PRICE)
CHOICE! – WEEKLY DELIVERIES OF DIVERSE STOCK.
PHONE US NOW FOR A STRAIGHT ANSWER.
OPEN 6 DAYS 10-6.30pm/10-5.00pm SAT.

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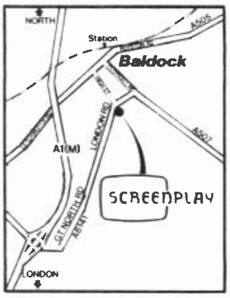

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£29.00 INCLUSIVE, REGUNS TWO YEAR GUARANTEE, QUANTITY DISCOUNTS
£14.50 SIX MONTH GUARANTEE SLIGHTLY USED
A56-120 A56-140 A51-110 A49-191 A47-342 or 343
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No need to spend £5 returning old delta tube.
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DE GAUSSING COILS £19.50
INCLUSIVE
FREE DELIVERY
COILS AND BOOKS FREE DELIVERY
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All sizes from **£66** INCLUSIVE 1 year Guarantee

Some in stock send old glass later. Other **in-lines from £30.** 99.9% of tubes we have a new gun for, plus new 16" tubes **£66.** Other in-lines in stock. 56 500-10 51-161 51-570 66-540

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Panels from **£10.00**
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Callers ring first, open every day including Sunday

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(minimum 12 words), box number 70p extra. All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Dept., Television Room 2612, IPC Magazines Limited, Kings Reach Tower, Stamford Street, London SE1 9LS. (Telephone 01-261 5846).

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*Please specify prefix A or Z.

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Hybrid panels do not include valves. *Terms cash with order.*

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RANK BUSH MURPHY
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Line Ouput
Z718 (T703A, T706A)

New (Complete)	£20.50
Less Focus Module and Rectifier	£10.50
T20, T22 (T705A)	**£11.00**
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Genuine RBM Units.

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UHF Aerials P & C Wideband 4 Bay Bowtie (12.5 dB) **£20.00**
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Plus many more makes & sizes in stock, inc. Tanburg, Nordmende, Thorn.

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on all your transistor, semi conductor, thyristor, etc requirements.
Also Teletext XM £40k+ all I.C.s for same.

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TIP 34A	50p
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TIP 49	50p
TIP 110	30p
TIP 2955	40p

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BURLINGTON TV & AUDIO
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Telephone: 0262 673374.

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(Cheques and Postal Orders should be crossed Lloyds Bank Ltd and made payable to Television)

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100's of good class HP Repos and Ex Rental Colour TV's reduced to ROCK BOTTOM PRICES!

Bush T20 (Excellent Cabs)	was £60	NOW **£40**
Bush 718 P.I.L. Tube	was £30	NOW **£25**
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Philips G8	was £28	NOW **£23**
Philips G11	was £70	NOW **£55**
GEC 2010	was £25	NOW **£20**
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Hybrids £5 all makes! Many more inc Pye KT30, Ferguson TX etc.

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No cheques.

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	I.F.	DECODER	LINE O/P	POWER	CONVERG.	VIDEO	FRAME T3
BUSH 2 CHIP	3.00	8.00	6.00	3.00	3.00	—	5.00
3000/3500	2.00	4.00	8.00	8.00	5.00	5.00	6.00
G8	5.00 with sound panel	7.00	14.00	8.00	5.00	—	5.00
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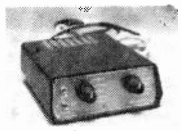

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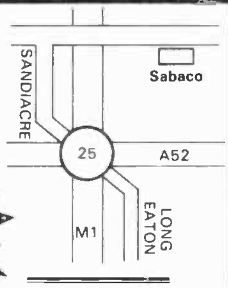

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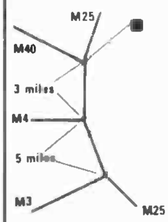

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T 6032	30p
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Burglar Alarm
& Powerful
Flashlight
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12 Volt Aerial Changer over Relays 144 Mc/s 45 watts **50p**

GEC Hitachi
V/Cap tuner, after 1979 Series £8
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Replacement for Touch Button Unit £8

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GEC Dynamic 20AX Convergence C2233H-R223GH
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BLW60 **£5.00**
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Mullard Broadband R.F. power modules
VHF. BGY33 **£15.00**
UHF. BGY22E **£15.00**
£5 PT4236C
£5 PT8706C
£5 PT9783

Various Tools and Accessories

3 Video Leads	£1.00
Xcelitr cutter	£3.90
T/V loop aerial	75p
Radio Telescopic Aerial	£1.00
Philips Neon Lamps for TV sets	5p
Freeze	£1.20
Foam Cleaner	£1.20
Contact Cleaner	£1.20
Push Button Mains	75p
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Mains timer. 13 amp — up to 2 hours: easy to use, plugs into socket	£3.00
Sellotape PVC Electric Insulation 50mm × 20M	70p
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20 GEC Service Manuals & Rank	£5.00
Red E.H.T. LAED and Anode Cap	£1.00
10 × G11 Cap 470/250	£15.00
Soldering iron 6v/23w	£2.50
TX 10 Focus Units	£6.00
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2 way baby alarm/intercom with long leads	£5
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Eisenmann NICAD CHARGER 5.5V/150 ma	£2
12V Nicad pack. "AA"	£2.50
Hitachi 7.2v/1.8A Nicad pack	£6.00
Hitachi TP 007 Battery pack 7.2v/1.6A	£7
Hitachi Silver Oxide Battery G13 UCC357 IEC SR44 1.5V	60p
70ML Silicone Sealer (clear)	£1
100 Coax Plugs	£10.00
De-solder pump + 2 nozzels	£5.20
Plastic box for i.c.s 6"×3"×½"	50p
Can of handy oil 'mobil'	40p
Flat Red LED	12p
500gm 60/40 solder reel	£7
Clearweld glue pack	30p
Dual v/u meter -20 – +10db	£1
K30 thermistor 232266298009	75p
GEC Mains Power Supply R.E.G.	£3.00
1Kg reel of solder	£8.00

75R/25 Watt	25p
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Front End Music Center. VHF/MW/LW 13"×3½"	£3
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SONY 1400KV Tuner unit	£3.50
SONY 1400KV Touch button unit	£3.50
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Texas Viewdata Decoder VDP 12/80 Issue 3 with all IC's	£10.00

Quantity Reductions

BY204/4	25 for £1.00
BY206	25 for £1.00
W005 bridge	20 for £2
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
BD239	20 for £2.00
	25 for £1.50
BU126	10 for £6.00
BU205	10 for £8.00
BU105	10 for £6.00
2SC2122A	10 for £8.00
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BD136	10 for £1.25
BF224	20 for £1.40
OA90	40 for £1.00
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KT3 multicaps	10 for £7.50
50 Ceramic Condensers	£1.50
Mixed Mounting Kit for Power Transistors	50p
300 Condensers	£1.50
300 Resistors	£1.50
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15 Bulbs	40p
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100 Diodes	£1.50

Plastic Boxes 4¾ × 4 × 1 × ¾	50p
100 Fuses	£2.00
100 W/W Res.	£1.50
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10 × 20 Turn 100k pots. Rank	£2
Thorn 9 volt power supply regulated	£3.00
BF 470	20 for £2
20 Slider Knobs	70p
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
50 Mixed AC series Transistor	£4.50
15 Panel mount rocker switch 250V/10A	£1.50
25 Panel Mount Bulbs & Neons	£1.50
10A	£1.50
Mixed ribbon cables	£1.00
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
100 Transistor	£2.50
20 Convergence Pots	80p
100 Sticks	£1.00
10 Thermistors	50p
20 Slider Pots	£1.00
30 Presets	50p
15 VDR + thermistors, degaussing, HT, etc.	£1.00
40 glass reed switch	£1
10 press to make switch	70p
40 Pots	£1.50
10 Gun Switches	50p
5 Tube Bases	£1.00
1,000 Diodes, Condensers, Resistors on Bandolier	£2.00
Lucky Dip 600 gram	£1.00
Jungle Bag 5Kg	£5.00
20 Knobs	£1.00
40 Pots, ¼"+6mm spindles for audio/TV	£3
20mm Fuse Holders Chassis Mount	20 for £1
IN4001/6 100 mixed	£2.50
EHT Diodes, small	20 for £1
20 Mixed Switches	£1

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