



COLOUR, UHF & TELEVISION SPARES NEW SAW FILTER IF PLUS TUNER COMPLETE AND TESTED £28:30 p.p. 95p. T.V. PORTABLE PROJECT LOPT, SCAN COILS, DRIVER £12.50; EHT RECT. 80p; ELC1043/05 £5.50, CONTROL UNIT £1.80; VIS GAIN, VIS SELECT (TESTED) £3.80; PACKS: I.C. £5.20, CAPS TANT £2.75, ELECTROLYTICS £3.20, CERAMICS £2.00, POLY-ESTER ETC. £1.35; PRESETS 90p, TRANSISTORS £3.90, RESISTORS £2.50, SEMICONDS £3.80, BRIDGE REC. £1.95, C106 90p; BYX71/600 (2) £2.40; RELAY £2.25, CONTROLS £1.18; 6MHz FILTER 68p; COIL £1.00; AERIAL £1.00; p.D. \$5p. MAINS TRANSFORMER £5.80 p.p. £1.00. OTHER PARTS AVAILABLE. WORKING MODEL ON VIEW AT 172 WEST END LANE, NW6. SPECIAL OFFER FOR SHOP CUSTOMERS, TOSHIBA 14" CRT BRAND NEW £12.50. SPECIAL OFFER FOR SHOP CUSTOMERS, TOSHIBA 14" CKI BRAND NEW £12.50. TV TEST GENERATOR UHF MODULATOR £3.50 p.p. 35p.* CROSS HATCH UNIT KIT, AERIAL INPUT TYPE, INCL. T.V. SYNC AND UHF MODULATOR. BATTERY OPERATED. ALSO GIVES PEAK WHITE & BLACK LEVELS. CAN BE USED FOR ANY SET £11.00 + 45p. p.p.* (ALUM. CASE £2.00 p.p. 75p.*). COMPLETE TESTED UNITS, READY FOR USE (DE LUXE CASE) £20.80 p.p. £1.00.* ADDITIONAL GREY SCALE KIT £2.90 p.p. 30p.* UHF SIGNAL STRENGTH METER KIT £16.80 (ALSO VHF VERSION* ALUM CASE £1.40, DE-LUXE CASE £4.80 p.p. £1.00.) VERSION" ALUM CASE 11.40, DE-LUXE CASE 14.80 p.p. £1.00.) CRT TESTER & REACTIVATOR PROJECT KIT £19.80 p.p. £1.30" "TELEVISION" COLOUR SET PROJECT. MARK II DEMONSTRA-TION MODEL WITH LATEST IMPROVEMENTS. WORKING AND ON VIEW, SPARE PARTS STILL AVAILABLE. SPECIAL OFFER I.F. Panel, leading British maker, similar design to "Television" panel. Now in use as alternative inc. circuit and connection data, checked and tested on colour £14.80 p.p. 95p. STABILISER UNITS, "add on" kit for either 40V or 20V, £2.80 p.p. 35p. PHILIPS 210 or 300 Series IF Panels £2.50 p.p. £1.00. PHILIPS 210, 300 Series Frame T.B. Panels £1.00 p.p. 65p. PHILIPS 19TG 170 Series Timebase Panels £2.50 p.p. 90p. BUSH A823 (A807) Decoder Panel £7.50 p.p. £1.00. BUSH A823 (A807) Decoder Panel £7.50 p.p. £1.00. HUSH A823 SCAN CONTROL PANEL £2.50, p.p. 75p. BUSH 161 TIMEBASE PANEL A634 £3.80 p.p. 90p. GEC 2040 Surplus Panels, ex-rental. Decoder £5.00 p.p. 90p. GEC 2040 Convergence Control Panel £2.50 p.p. 90p. DECCA Colour T.V. Thyristor Power Supply. HT. LT etc. £3.80 p.p. 95p. BUSH TV 300 portable Panel incl. circuit £5.00 p.p. 95p. BUSH TV 302 portable Panel (Single I.C.) incl. circuit £5.00 p.p. 65p. BUSH TV 312 IF Panel (Single I.C.) incl. circuit £5.00 p.p. 65p. BUSH TV Portable Eleven Volt Stab. Power Supply Unit £3.80 p.p. £1.00. PYE 697 Line T.B. P.C.B. for spares, £1.50 p.p. £1.00. MULLARD AT1022 Colour Scan Coils £6.00 p.p. £1.20. AT1023/05 Convergence Yoke £2.50 p.p. 85p. AT1025/06 Biue Lat. 75p p.p.35p. Delay Lines, DL1E 90p. DL20. DL50 £3.50 p.p. 75p. PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits £3.75 p.p. 85p. or incl. yoke, £5.00. G8 Decoder panels PHILIPS (66 single standard convergence panel, incl. 16 controls, switches etc., and circuits £3.75 p.p. 85p, or incl. yoke, £5.00. G8 Decoder panels ex Rental £5.00. Decoder panels for spares £2.50 p.p. 85p.
VARICAP, Mullard ELC1043/05 UHF tuner £5.50, G.I. type (equiv. 1043/05) £3.50 p.p. 35p. Control units, 3PSN £1.25, 4PSN £1.50, 5PSN £1.80, Special offer 6PSN £1.00, 7PSN De Luxe £2.80 p.p. 35p. TAA 550 50p p.p. 15p. Salv. UHF varicap tuners £1.50 p.p. 35p.
BUSH "Touch Tune" assembly, incl. circuit £5.00 p.p. 75p.
VHRICAP UHF/VHF ELC 2000S £8.50 p.p. 65p.
UHF/625 Tuners, many different types in stock. Lists available. UHF VARICAP UHF/VHF ELC 2000S £8.50 p.p. 65p. UHF/625 Tuners, many different types in stock. Lists available. UHF tuners transistd. incl. s/m drive, indicator £2.85; Mullard 4 position push button £2.50, 6 position push-button £4.50 p.p. 90p. AF ISOL 30p p.p. 20p. TRANSISTORISED 625 IF for T.V., sound, tested, £6.80 p.p. 65p. PHILIPS 625 IF Panel incl. circuit 50p p.p. 65p. TBA "Q" I.C.s. 480, 530, 540, £2.20, 550, 560C, 920 £3.20 p.p. 15p. HELICAL POTS, 100K, 4 for £1.20 p.p. 20p. PHILIPS 19TG170 Mains Droppers, two for 90p p.p. 50p UNE OUTPUT TRANSFORMERS. New suar on a 85p. LINE OUTPUT TRANSFORMERS. New guar. p.p. 85p. V guar. p.p. 85p. SPFC1AL OFFERS BUSH TV125 to 139....£2.80 EKCO 380 to 390.....£1.00 EKCO 407/417....£1.00 GEC 448/452....£1.50 KB VCI, VCII (003)...£2.80 MUR PHY 849 to 939...£2.80 RUCH OF 10-6, 10-17 etc...£1.00 SOBELL 195, 282 to 8...£1.50 MANY OTHERS STILL AVAILABLE COLOUR LOPTS and £100 DECCA DR1, 2, 3, 121/123, 20/24, MS1700, 2001, 2401 £6.80 DECCA MS2000, 2400 £5.80 COLOUR LOPTS p.p. £1.00.
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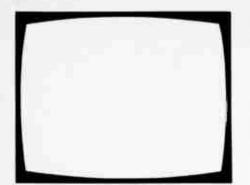
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TELEVISION

October 1978

Vol. 28, No. 12 Issue 336

A. Coont

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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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Binders (£2.85) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 OPF. Prices include postage and VAT. In the case of overseas orders add 60p to cover despatch and postage.

BACK NUMBERS

Some back issues, mostly those published during the last two years, are available from the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 OPF at 70p inclusive of postage and packing to both home and overseas destinations.

QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.

Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved". Send to the address given above (see "correspondence").

this month

623 Leader

626

640

624 Teletopics News, comment and developments.

> Never Knock a Neck
> by Les Lawry-Johns
>
>
> Otherwise, if you've got difficult customers with you (two ignoramuses, Grace and Sid) complications can arise. Plus various sorties into the field and so on.

- 631 Next Month in Television
- 632 Colour Receiver Project, Part 1 by Luke Theodossiou An easy to build set with an up to the minute specification. This opening article describes the overall design and technical features and gives constructional details for the small power supply module.
- 638 Faults Encountered . . . by Dewi James A summary of fault conditions experienced on a variety of sets, with the emphasis on foreign receivers.
 - Video Notebook by D. K. Matthewson, B.Sc., Ph.D. Modifications to give improved VCR operation, and a summary of the various VCRs that used the original Philips standard.
- 642 Diagnostic Pattern Generator Board and component layout details for Malcolm Burrell's design featured in the August issue.
- 643 Readers' PCB Service
- 644 Notes on the Sanyo CTP370 by Hugh Cocks and David Martin Quite a number of these compact, hybrid colour receivers are around. Some common problems are discussed.
- 646 Letters
 - 648 TV Servicing: Beginners Start Here, Part 13 by S. Simon This time sync separator circuits, plus sync faults and how to recognise them. With some useful tips on particular chassis.
 - 652 Long-Distance Television by Roger Bunney Reports on DX reception and conditions, and news from abroad. Also a note on an interesting infra-red ENG link.
 - 656 Service Notebook by G. R. Wilding Notes on faults and how to tackle them.
 - **658** The Language of Logic, Part 1 Logic circuitry is being used increasingly in TV sets, so it's time to get to understand how this sort of circuitry operates. The various gates and how they are used are explained, and the operation of electronic memories, counting systems and some logic control systems described. The binary system and its use is also explained.
- 663 Your Problems Solved
- 665 Test Case 190

OUR NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED ON OCTOBER 16

TELEVISION OCTOBER 1978

MONO TUBES (tested) 19" Rimguard £3.0 23" Rimguard £4.0 20" Rimguard £5.0 24" Rimguard £6.0 +£3.00 p.p.	6 - button i at £6.50 U.H.F. P/Bi £4.50 U.H.	TUNERS	MONOL All D/Sta Lopts at +£1. p.p All S/Sta	OPTS andard £4.00 ndard +	MON i.e. Phi £3.50 Quotat comple S/Han	IO PANEL lips, Bush etc + £1 p.p. ions for	-S M f F f S S + a	IISC. S/Outpu E1 + VAT + f /Output Trar 1.25 + VAT cancoils £1.5 £1. P&P. Oth vailable. pleas phone for d	1 P&P ns. + £1. P&F 0 + VAT er spares se write
			VALVES (MO	NO & COLO	JR)				
PCL82 0.10 PCL83 0.25 PCL84 0.10 PCL85 0.10 PCL86 0.10 PFL200 0.10 PCF801 0.10 30C1 0.10 30C17 0.10 PL83 0.10	PCF805 O PCF806 O PCF808 O PCF808 O PCF808 O PCC189 O PCC86 O 30C15 O 30C18 O	0.10 PCC8 0.25 PC97 0.10 PC900 0.25 EF80 0.10 EF85 0.10 EF183 0.10 EF184 0.10 EH90	0.20 0 0.10 0.10 3 0.10 4 0.10 0.10 5 0.10	EY86/7 EY8/7 DY802 PY800/1 PL36 PL504 PL81 6/30L2 U26 ere is 25p p.p	0.10 0.10 0.10 0.25 0.25 0.10 0.10 0.10	30PL1 30PL3/ 30P12 30FL1/2 ECC82 ECC81 ECH81 ECL80 ECL82 der	0.10	PY500 GY501 PL508 PCH200 PCF200 CEY51	1.00 1.00 0.50 0.50 0.50 0.15
		D/STAND	ARD COLOUR	SPARE PAN	IELS				
IFBush/Murphy6.50GEC/Sobeli6.50Philips6.50Decca6.50Thorn 20006.50Pye7.50Baird6.50	6.50 6 7.50 - 9.50 - 12.50 12 7.50 7 7.50 5	9.50 — 3.50 —	.50 6.5	6.5 6.5 7.5 6.5 0 7.0 6.5 6.5	60 60 60 60 60 70 70 70	S/OUTPUT 1.50 - 2.00 (19" only) - - -	POWEF 6.50 8.00 8.00 	R L/TB 15.00 -	F/TB 7.50 6.50 6.00 6.50 4.00 6.00
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COLOUR TUBES 19" 18.00 19" A49.192 £20 20" 20.00 22" 25.00 25" 18.00 26" 32.00 Plus P & P £4	can suppy or	6.50 6.50 6.50 7.50 iners in stock request. Many ers also availab	Most lop from £7. British & makes. P or write. P & P pe	R LOPTS Its available 00. Both Foreign Ilease ring r lopt £1	from F/Ou Scand P & P	tput transform £1.50 tput from £1.2 oils from £5.00 £1 spares availabl	5 0 le on F	G8 PANE SPECIAL O CHROMA .F. POSTAGE & PA 1.25 PER PAN	E12.00 £10.00
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Pye 19" £55.00 GEC 19" £55.00 Bush 19" £65.00 Philips G6 – Many other makes & r Please ring or write fo	22'' £75 22'' £73 nodels available.	5.00 26 5.00 26 5.00 26 3.00 26 PERSON	"£75.00	20″ & 2 20″ & 2 19″ & 2 19″ & 2 12 <u>1</u> 2% ∨	4" S/S 4" D/S 3" D/S 3" D/S .A.T. on	£16.00 Pyo £14.00 Pyo P/button £ Rotary £8.0 all prices colou	e, GEC, B 12.00 F DO Pye, ar&mone	ush etc. Pye, GEC, Bush GEC, Bush etc	
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TELEVISION OCTOBER 1978

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		AC1B6 AC1B7	0.26 0.21	BC267 BC301	0.19	BR100 BSX20	0.20	PCLB4	0.75
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Bush 60 – 65 Kort – – 65	65 75 - 75	AF1B1 AF1B6	0.30 0.29	BDX22	0.73	OC74 OC75	0.35 0.35	TBA550Q TBA560CQ	1.60 1.80
Kort – – 65 Pye	- 75	AF239	0.43	BDX32 BDY1B	1.9B 0.75	OC76	0.35	TBA570Q	1.00
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	61 e 40p	BC10B	0.12	BF164	0.17	OCB5 OC123	0.13 0.20	COLOU	IR
G8 @ 36p Pye 723		BC109 BC113	0.12 0.12	BF167 BF173	0.23 0.21	OC169 OC170	0.20 0.22	Pye 691 693 Decca (large so	
GEC 2110-41R @	+op	BC114 BC115	0.14 0.12	BF177 BF17B	0.26 0.24	OC171	0.27	CS2030/2232 2632/2230/22	
PLEASE NOTE THER	EIS	BC116	0.12	BF179	0.2B	OA91 BRC4443	0.05 0.65	2631	5.67
12 1 % V.A.T.		BC117 BC119	0.13 0.24	BF1B0 BF1B1	0.30 0.34	R200BB R2010B	1.50 1.50	Philips GB 520	0/40/50 5.66
Please note all mono set		BC125	0.15	BF1B2	0.30	R2305	0.3B	Philips G9	5.79
100% comp. No broken r	masks, no	BC126 BC136	0.09 0.14	BF1B3 BF1B4	0.29 0.23	R2305/BD222 SCR957	0.37 0.B1	GEC C2110 GEC Hybrid C1	
broken panels etc.		BC137 BC13B	0.14 0.24	BF1B5 BF1B6	0.29 0.30	TIP31A	0.3B	Thorn 3000/31 Thorn B00	500 5.50 2.42
Colour sets sold with good	c.r.t.s and	BC139	0.21	BF194	0.09	TIP32A TIP3055	0.36 0.53	Thorn 8500	5.23
100% comp. Working Mono £3.00 extra		BC140 BC141	0.31 0.22	BF195 BF196	0.09 0.12	T1590	0.19	Thorn 9000 GEC TVM 25	6.10 2.5D
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Supplied in 1's or 100's	-	BC143 BC147	0.19 0.09	8F199	0.14			RRI (R8M) A8	
20pp		BC148 BC149	0.09 0.09	BF200 BF216	0.28 0.12	DIODES		8ang & Olufse 4/5000 Grund	
WE DO NOT SELL RU	BBISH	BC153	0.12	8F217	0.12	1N4001	0.04	5010/5011/50	012/
AT	-	8C154 BC157	0.12 0.10	BF218 BF219	0.12	1N4002 1N4003	0.04 0.06	6011/6012/72	
BRIARWOOD TV L	.10	BC158	0.11	8F220	0.12	1N4004 1N4005	0.07 0.07	Tandberg (radi	onette)
EXPORT		BC159 8C160	0.11 0.28	BF222 BF221	0.12 0.21	1 N4006	0.08	Autovox Grundig 3000/	
COLOUR & MONO		BC161 BC167	0.28 0.13	8F224 BF256	0.12 0.37	1N4007 1N4148	0.08 0.30	Saba 2705/37 Telefunken 70	
	DRUSE	BC168	0.10	BF258	0.27	1N4751A	0.11	717/2000	6.80
ABROAD		BC169C	0.12	8F259	0.27	1N5401	0.10	Korting	6.80
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1.10 1.26 9.00 1.26 1.20 <th< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></th<>																				
1200 120 <td>1114</td> <td></td> <td>7494</td> <td>900</td> <td>74196</td> <td>100p</td> <td>4093</td> <td>940</td> <td>MC7242</td> <td>120-1</td> <td>001000</td> <td></td> <td></td> <td></td> <td>Lavance</td> <td></td> <td></td> <td></td> <td></td> <td></td>	1114		7494	900	74196	100p	4093	940	MC7242	120-1	001000				Lavance					
1/201 1/20	7400	130											80234	70p	TIP29A	45p	2N2218	280	2N4259 16	0me 40411 300m
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1/203 2/20 7/20 <t< td=""><td></td><td></td><td>174104</td><td>75p</td><td>174HOO</td><td>85p</td><td>4162</td><td>1050</td><td>MK50398</td><td>7500*</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>			174104	75p	174HOO	85p	4162	1050	MK50398	7500*										
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1412 326 74120 1300 4001 150 4423 1260 1126 1126 1126 2143 126 21	7411	28p	74119	225o	4000	180													2N5296 5	5P° 8AX13 8n
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1/213 1/2133 1/213 1/213 <t< td=""><td></td><td></td><td></td><td>1300</td><td></td><td></td><td>4422</td><td>550p</td><td>I NE565A</td><td>125n</td><td>8C179</td><td>180</td><td>BF241</td><td>180*</td><td></td><td>90</td><td></td><td></td><td></td><td></td></t<>				1300			4422	550p	I NE565A	125n	8C179	180	BF241	180*		90				
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7420 712 7421 356 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7422 366 7423 366 7423 366 7423 366 7424 110 7423 366 7424 110 7426 366 7426 7426 7426 7426<							4450	290p	SEC2741		BC184		BE258							i jonos rop
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1422 280 74130 110° 6013 600° 6503 100° 6503 100° 6503 100° 6503 100° 6503 100°					4012	18p	4502	120p			802121	11								
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12/27 400 7413 500 2007 2007 4500 2007 1796 2007 1796 2007 120 11000 120 11000 120 11000 120 11000 120 11000 120 11000 120 11000 120 120 11000 120					4015	35p	4507	550							TIPSEC	280-				
7427 400 74137 600 6017 1000 1200			74136	80n	4016	50c										Sanb	2N3/02		3N201 110	
12:2:2: 4:0:0 1:0:0:0 4:0:0 9:0:0 1:0:0:0 4:0:0:0 9:0:0:0 1:0:0:0:0 1:0:0:0:0 1:0:0:0:0 1:0:0:0:0 1:0:0:0:0 1:0:0:0:0 1:0:0:0:0 1:0:0:0:0:0 1:0:0:0:0:0 1:0:0:0:0:0 1:0:0:0:0:0:0 1:0:0:0:0:0:0:0 1:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0	7427	400								175p*		13p*	8FR52	20p	TIP36A	260p	2N3703	12p*		
7432 380 7414 380 7414 380 7415 587 300 1100 140036 890 1100056 890 1100106 11000	7420						4510	95p	SN76110	150m*	8C237		BFR79			3300				
7430 180 74142 300p 019 50p Lineaer SiN 262.7 110p 81.72 10p 141.4 50p 141.4 50p 40.73 80p 144.4 20p 40.38 80p 114.40.75 8p 7433 340 7414.4 20p 40.21 11p Add 11 8pr 174.65 4pr 87.89 87.89 27.37 11p+ 174.44 70p 174.44 70p 174.44 70p 174.44 70p 174.66 145.9 87.88 30p 17p+2.6 82.7 179.75 77.88 87.88 30p 17p+2.6 82.7 179.75 77.86 87.88 30p 17p+2.6 82.7 179.75 77.88 87.88 30p 17p+2.6 82.7 179.75 77.88 87.88 30p 17p+2.6 82.7 179.75 77.88 82.7 179.75 77.7 82.8 179.75 77.7 82.7 170.75 170.75 170.75 170.75 170.75 170.75 170.75 170.75 170.75 170.75 170.75 170.75 <				85p	4018	110p		•												
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12433 446 1447 2100 1437 3869 74147 2100 1437 3869 74148 1800 4623 1429 1447 700 1467 300 1467 4033 446 1459 849 87238 300 1174148 700 1467 3030 1467 40332 446 4032 426 74144 1459 4043 1467 40382 446 40408 700 1467 40332 446 40408 700 1467 40408 700 4404 800 74144 1409 4026 1400 4028 820 1467 886 300 117255 746 748323 746	7432	38n				000				110p*		18p*	8FR81	300*	TIP418	800	2N3706	140*		
7438 339 7447 7400 4021 118p CA3011 88p TAA550 44p 8730 32p Tin22 700 713705 740	7433								SN76660	750*	BC238	180*	8FX29							
1/430 380 74148 1900 4002 1000 CA3014 1450 7446 1857 852386 187.0 857.34 507 40.00 746 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 40.00 700 80.338 189 87.88 300 178.92 27.882.3 40.00 700 80.5 40.01 650 40.01				210p	4021	115p	CA3011	850*		Aller									40361 4	5p 1N4148/9 4p
7430 38p 74150 130p 4023 222 22000 20000<		38p	74148	1600	4022					and a									40362 41	50 -
7441 900 7415 1000 7000 7000 7000 7000 7000 7000 7000 82/382 2000 82/382 2000 82/382 2000 82/382 2000 82/382 2000 82/382 2000 82/382 2000 7000 82/382 2000 82/382 2000 82/382 2000 82/382 2000 7000 22/382 2000 2000 6500 60/382 2000 7000 20/382 2000 7000 20/382 2000 7000 20/382	7438	380	74150							200p*		18p*	8FX84	30p	TIP428	820	2N3709	140*		- 4.011010
7441 A 900 7415 / 415 / 415 / 4026 800 / 4026<								70p*	TAA661A	1550*	8C238C	200*	BFX85	300	TIRADO	820		25.04		
7441 AN 300 741 b3 88p 4025 200 CA3028 817 81787 300 741 b5 970 603028 817887 300 741 b5 970					4024	80p	CA3020	170p*	TAD100		80328							FOLA		P 247_184 8-1
7441AN 120p 74154 140p 24154 120p 74156 140p 150p 1570p 157			74153	850	4025	200		1700*										oop-	40409 6!	
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1200 14153 370 14157 385 1400 14157 385 1400 14157 1500 1500 1500 1500 1500 1500 1555 1500 1555 4 for £1 + 00 1600<									TBA120S	700*	8C338	18o*	8FX88	300		340*		85	40410 01	^{op} 6v2 8p ^e
7444 120p 74156 96p 4028 98p CA3048 2200* TBA5500 350p* 6C517 700* 18755 22p 210390 12p 74159 210390 12p 7415 120390 12p 7415 120390 12p 7415 12p 7418 10p 7416 11p 4033 250p 740* 18a61811 240p 86547 18p 8679 86547 18p 8679 86547 18p 8679 8679 8578 8578 8578 8578 8578 8578 8578 8578 8578 8578 8579 214300 12p 7418 10p 4031 10p 4031 80p 748 18p 81010 13p 214007 12p 145p 555 400r 12p 145p 50 7657 14p 18p 214061 12p 145p 50 7657 14p 12p 14150 20p					4027	85p	CA3046	70p*	T845400											
7445 120p 74157 38p 4029 120p CA3075 170p 1120p 120p CA3075 170p 1120p 120p CA3080E 120p 120p </td <td></td> <td></td> <td>74156</td> <td>96p </td> <td>4028</td> <td>950</td> <td>CA3048</td> <td></td>			74156	96p	4028	950	CA3048													
7445 97p 74150 240p 100p 7420 100p 100p 7420 100p	7444	1200	74157	980				170							TIS91	25o*	2N3904	18p*	741s	5 for £1.00
741 59 2000 4030 500 CA3080E 7447 746 100 74160 120 2005 TTL 2009 10 tor 21 00 7448 600 74161 1100 4033 2500 CA3080E 2200r TTA8800 8504 8205 750 7500 150r 820405 120r 21000 7500 8204 8206 8205 750 750 8204 8206 820 8205 750 750 820 8206 120r 750 8206 120r 750 8206 120r 750 820 120r 12007 120r 12007 120r 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12007 12									T8A641811	240p*	8C547	18o*	8FY52	220			2N3905	200*	555s	
7440 7460 100p 74160 110p 4033 250p CA30986 220p 178,800 100p 100p <td></td> <td></td> <td></td> <td></td> <td></td> <td>50p</td> <td>CA3080E</td> <td>74p*</td> <td>T84651</td> <td>180.00</td> <td>805474</td> <td></td> <td>8EV00</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						50p	CA3080E	74p*	T84651	180.00	805474		8EV00							
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7448 85p 74162 100p 4035 320p CA3130 38p 105p* 8C548 18p* 8SX0 20p ZTXS00 15p* 2N4037 B5p* 6V2 Zeners 20 for £1-00 7450 18p 74184 100p 4040 120p CA3140 38p* TRA8105 14p* 8W20 2N4059 12p* EXCO 15p* BUIDS 180p* ZTXS02 18p* ZTXS04 30p* ZTXS04 30p* ZN4059 12p* EXCO 15p* BUIDS 18p* ZN4059 12p* EXCO 12p* ZN4059 12p* ICS55 Projects 95p SC550 14p* BUIDS 200p* ZN4061 13p* SC550 14p* BUIDS 200p* ZN4061 14p* SC557 14p* BUIDS ZN005 35p ZN4061 14p* ZN075 35p ZN4061 14p* ZN075 35p ZN4061 14p* ZN075 ZN76A 20p ZN4123 ZZp* ZZp* ZN1712 ZN775 ZN775A ZN775A ZN775A ZN775A ZN7747	7447	750	74161											45p	ZTX300	13p*1	2N4036	85p*	8AX 13	20 for £1.00
74102 100p 4035 130p CA3130 38p* TBA220 75p* 8C549 18p* 8SX20 20p 2TX502 18p* 2N4058 12p* BOOKS 7451 15p 74184 120p 4042 30p CA3140 38p* TBA220 28bp* BC556 14p* 8U108 280p* ZTX504 30p* ZN4058 12p* SOCKS 14p* 8U108 280p* ZN4058 12p* SOCKS 14p* 8U108 280p* ZN4061 14p* SOCKS 14p* 8U108 280p* ZN4061 14p* SOCKS 14p* 8U205 230p* ZN4061 14p* SOCKS 14p* SOCKS 14p* 8U205 ZOp* ZN4061 14p* SOCKS 14p* SOCKS 14p* 8U205 ZOp* ZN414 SOP SSCS78 14p* 8U206 240p* ZN4123 Z2p* ZN424 Zap	7448	85.					CASOSOAU		TBA810S	105p*	8C548	18p*	8SX19	200	ZTX 500	150*	2N4037	550*	6V2 Zeners	20 for £1.00
7430 190 74183 1000 4040 120p CA3140 98p* 178320 298p* 16055 14p* 8000 14p*							CA3130	980*	TBA820		80549	18.0*	BSX20							
7451 18p 74184 12op 40.2 30p CA3180 38p 74184 12op 1002 12p 10005 180p 21405 30p 12p 100055 30p 14p 80557 14p 8020 21405 21005 200p 21405 200p 214061 12p 100055 30p 14p 80257 14p 80205 200p 21405 21p 10005 12p 14p 8020 21005 14p 8020 21005 12p 10005 12p 1101 10005 10005 10005 21005 10005 12p 1101 10005 10005 10005 10005 11010 10005 10005 </td <td></td> <td></td> <td>74183</td> <td>100p</td> <td>4040</td> <td>1200</td> <td>CA3140</td> <td></td> <td>BOOKS</td>			74183	100p	4040	1200	CA3140													BOOKS
7453 18p 74165 150 100 200 200 200 2800	7451	18p	74184			00-									ZTX504	30p*	2N4059	12p*	IC 666 Proto	
7252 100 74 105 1000 LM301 AN 300 Standard Standard <t< td=""><td></td><td></td><td></td><td></td><td></td><td>anb</td><td></td><td></td><td>1080555</td><td>30p</td><td>8C556</td><td>150*</td><td>8U108</td><td>250p*</td><td></td><td></td><td>2N4060</td><td></td><td></td><td></td></t<>						anb			1080555	30p	8C556	150*	8U108	250p*			2N4060			
7430 18p 74166 160p 4044 100p LM318 200p 74414 200p 20042 230p 20042 230p 20042 230p 20042 18p 52 Projects IC 741 75p 7470 38p 74170 260p 4044 100p LM318 200p 20042 230p 200p 20042 220p 20042 2002 20042 20042 2004 20042							LM301AN	30p			80557			220-1						
7480 18p 74167 320p 1004 1007			74166	1600	4044	1000													52 Projects	
7470 380 7415 2800 4060 1900 LM324 700 2100 2100 2200 2101 2101 2200 2100 2000 21000 2100 2100	7480	18p				140-									2N706A	20p	2N4062	18p*		
7472 32p 7477 280p 4047 100p LM339 85p 326-50R 25p 8C559 12p- 8U406 145p- 2N918 45p 2N4124 22p- Linar L Guivalents 250p 7472 33p 74173 190p 4050 15p LM348 110p 8C59 16p- C1509 15p 2N113 20p 2N4125 22p- Linar L Guivalents 275p 7474 33p 74173 190p 4051 110p LM381A 145p- 8C590 16p- C1509 2N1131 20p 2N4125 22p- Linar L Guivalents 275p 50 Simple LED Circuits 75p 7476 33p 74177 120p 4055 140p- LM747 70p 8CY50 14p- 201255 100p- 2N1131 22p 2N4230 140p- 2N4243 140p-										130p		18p*	8U208	2400*						
7472 340 74172 6500 4049 500 100						100p	LM339	850	326-508		80558									
7473 38p 74173 190p 4050 55p 1109 25p. 25p. 16p- [Cl509] 15p 22p. 50 Simple LED Circuits 75p 7474 38p 74174 110p 4051 110p LM380 95p 15p. 8C5590 18p- MUE2955 100p 211131 20p 214125 22p. 50 Simple LED Circuits 75p 7476 33p 74176 130p 4054 120p LM733 100p 125p 100p 21131 20p 214125 22p S0 Simple LED Circuits 76p 7481 100p 74180 100p LM743 30p 100p			74172	650p	4049	500													Linear IC Fou	
7474 380 74175 100p 4050 950 KC5325KM 800 805598 18p* ME0491 18p 21131 20p 21x426 22p 90 Stringing LeD Circuits 7pp 7475 43p 74175 130p 4055 140p LM381A 145p* Ntx015332N 8C5592 18p* ML2955 100p 21x1132 20p 21x426 22p Stringing LeD Circuits 7pp 7476 33p 74175 130p 4055 140p LM3732 122p* 100p 110p 7till 20p 21x4236 180p*	7473	38p	74173	190		66-									2N930	20p	ZN4125	22p*		
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7476 349 74175 959 4054 120p LM732 125p* 11397011 25p 8C/70 22p MU2340 120p 21132 20p 214230 100p* Interview of the instator 7476 349 74176 130p 1005 LM732 125p* 11397011 25p 8C/70 22p MU2340 85p* 21132 20p 214230 100p* Equivalents 50p 7481 110p 74180 100p LM747 70p 70p 7476 33p LM747 70p 8C/70 22p MU2340 85p* 214323 140p* 2402 8c/70 22p MU2340 85p* 214323 140p* 2402 8c/70 22p MU2340 85p* 214323 140p* 2402 8c/71 22p MU2340 85p* 2140240 150p* Equivalents 110p 244240 150p* Equivalents 110p 244240 150p* Equivalents 110p 244240 150p* Equivalents 110p 244240 150p* Equivalents 110p						110p	LM381AN	1450*											First Book of	Transietor
7476 38p 74176 132p 1055 100p 1032 1032p 1032p 1132p 1032p 1132p 1132p<			74175	950					(1220101)											
7480 5417 7417 7200 4035 1400 1400 1400 1200 1200 1400	7476	38n							(1338101)	25p					2N1613	25p	2N4236	150p*		Equivalents 50p
7481 100p 7417 720p 4056 130p LM747 70p Tamelistors 80/5 22p MLE3055 70p 211923 110p 211923											8CY58	220	MJE340	850*		250			Second 800	k of Transistor
7480 100p 74180 110p 4060 130p LM748 35p AC107 249 80771 22p MB5233 30p ZM1893 35p ZM240 160p Equivelents 110p 7482 900p 74181 320p 4066 65p LM3900 66p 64C127 20p 8CY72 22p MP52335 30p ZM1893 35p ZM240 160p Equivelents 110p 7484 100p 74182 150p 4067 430p LM3911 125p AC127 20p 8CY72 22p MP5A05 30p MP5A12 45p MP5A12 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>LM747</td> <td>70p</td> <td>Transistors</td> <td></td> <td>BCY59</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>							LM747	70p	Transistors		BCY59									
7482 90p 74181 320p 4066 68p LM3300 65p AC127 20p MPS2369 20p 7483 110p 74184 250p 4067 430p LM3911 125p AC127 20p BCV72 20p MPS2369 20p MPS2369 20p 7484 110p 74184 250p 4066 4067 430p LM3911 125p AC122 20p BCV72 20p MPS2369 30p* 7485 120p 74185 190p 4068 25p FSA2510M 90p AC124 20p BCV72 20p MPSA06 30p* 7485 330p 74185 190p 4068 25p AD161 45p 8D131 50p MPSA56 32p* ELECTRICAL AND MECHANICAL ENGINEERING LTD. 7480 340p 74191 120p 4071 25p MC1458 50p MPSU56 75p* 0C70 40p MPSU56 75p* 75p* 0C71 45p Adddress 3C Barley Market Street, Tavistock, Devon PL19 05F Tavistock 5439 <			74180	110p	4060	1300				240					SIN193	2 ab	2N4240	1 SOD.		Equivalants 110p
7483 100p 74182 150p 4067 430p 110p 74182 150p 4067 430p 111 12bp AC127 20p MPSA05 30p* 30p* 7484 110p 74184 250p 4067 430p 12bp AC128 20p BCY78 22p MPSA05 30p* 30p* 7485 120p 74185 190p 4068 25p FSA2510M 90p* AD161 45p MPSA12 45p* MPSA12 45p* MPSA05 32p* EECTRICAL AND MECHANICAL ENGINEERING LTD. 7489 340p 74190 120p 4071 25p MC1458 80p 8C107A 12p 8D133 44p MPSU06 63p* Address 3C Barley Market Street, Tavistock, 7490 36p 74191 120p 4071 25p MC1458 420p 8C107A 12p 80133 34p MPSU06 75p* Address 3C Barley Market Street, Tavistock, 7491 90p 74131 90p MC1496 95p 8C107A 12p 80136 37p		90p	74181														-	_		
7484 100p 74124 250p 4007 430p LM3911 125p AC128 20p BCV78 20p MPSA06 30p- 7485 120p 74185 190p 4067 430p FSA2510M 90p+ AD149 70p BD121 95p MPSA06 30p- 7485 120p 74185 190p 4069 27p FPQ2467 85p+ AD149 70p BD121 50p MPSA06 32p- ELECTRICAL AND MECHANICAL ENGINEERING LTD. 7485 340p 74190 120p 4071 25p MC1458 50p BD132 44p MPSU56 78p- 74p- Tavistock, Tavistock, 7490 34p 74192 39p 4073 30p MC1486 95p BC107A 12p 8D135 33p 0C71 45p Tavistock 5439 Telex 45263 7491 90p 74193 90p 4078 170p BC108 12p 8D135 33p 0C71 45p Tavistock 5439 Telex 45263 7491 90p 7	7402											22p	MPSA05	30p*						
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7489 340p 74190 120p 4071 25p MC163 50p 80132 50p MPSU66 63p* New Address 3C Barley Market Street, Tavistock, 7490 36p 74191 120p 4071 25p MC1455 50p 80107 10p 80132 50p MPSU66 63p* New Address 3C Barley Market Street, Tavistock, 7491 30p 74193 120p 4073 30p MC1496 420p 80107 12p 80135 33p 0C70 40p Devon PL19 05F 7491 90p 74193 99p 4073 30p MC1496 95p 8C107A 12p 80136 37p 0C70 40p Tavistock 5439 Telex 45263 74913 90p 74193 99p 4078 170p MC1496 95p 8C108 10p 80136 37p 0C71 45p Tavistock 5439 Telex 45263 7493 58p 74194 160p 408 120p* 8C1088	7484 7485		74185										MPSA56	32p*	ELECTI	IICAL	ANDM	ECHA	NICALEN	GINEERING LTD
7490 3490 74190 120p 4071 28p MC1458 50p 8C107 10p 8D133 44p MPSU56 75p Norw Address SC barrey market street, Tavistock, 7490 340p 74191 120p 4072 30p MC1458 50p 8C107A 12p 8D133 34p MPSU56 75p Devon PL19 05F 7491 90p 74193 99p 4073 30p MC1496 95p 8C107A 12p 8D136 37p OC71 45p Devon PL19 05F 7491 90p 74193 99p 4073 30p MC1496 95p 8C107A 12p 8D136 37p OC71 45p Tavistock 5439 Telex 45263 7493 38p 74194 160p 4081 32p 8C108 10p 8D137 38p R2008 200p* P & P 25p VAT 8% Unless *124% 7493 38p 74194 100p 4081 32p* 8C108A 12p*	7484 7485	120p		990.			MICT 410P	160p*			8D132	500	MPSU06	630*	Now	delan	20 0-	and as a	Manland	and To I allow
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7491 90p 74192 99p 4073 30p MC1495 95p 8C1078 12p 8D135 33p OC70 40p Tavistock 5433 5433 5433 5433 </td <td>7484 7485 7486 7489</td> <td>120p 36p 340p</td> <td>74186 74190</td> <td>120p</td> <td></td> <td></td> <td></td> <td>50p</td> <td>8C107</td> <td>100</td> <td></td>	7484 7485 7486 7489	120p 36p 340p	74186 74190	120p				50p	8C107	100										
7491AN 30p 7413 39p 40/3 30p 810/8 12p 80136 37p 0C71 45p Tavistock 5439 Telex 45263 7491 36p 74194 160p 4081 20p 8C108 10p 80136 37p 0C71 45p Tavistock 5439 Telex 45263 7492 58p 74194 160p 4081 20p 8C108 10p 80137 38p R20088 200p* P & P & P & P & VAT 8% Unless 12P 80139 36p R2010B 200p* Sand 12p Inter 58p 58p 74194 10p 402 55p Mathematical states 12p 80139 38p 82010B 200p* Sand 12p Inter 58p 50p	7484 7485 7486 7489 7490	120p 36p 340p	74186 74190	120p	4071	25p	MC1458										De	NOD D	110 065	eet, latietoek,
7492 58p 74194 160p 4081 20p MC1103 95p 8C108 10p 8D137 38p R20088 200p* 7492 58p 74194 160p 4081 20p MC3340 120p* 8C108A 12p 8D139 36p R20108 200p* 7493 38p 74195 110p 4081 20p MC3340 120p* 8C108A 12p 8D139 36p R20108 200p* Sand 12p Large SAE for Price Line	7484 7485 7486 7489 7490	120p 36p 340p 36p	74186 74190 74191	120p 120p	4071 4072	25p 30p	MC1458 MC1495	420p	8C107A	12p	8D135	38p	0C70	40p			De	von P	L19 05F	
7492 880 74194 1600 4081 200 MC3340 1200* 8C108A 120 8D139 360 R2010B 2000* Sand 120 Large SAE for Direct interesting	7484 7485 7486 7489 7490 7490 7491	120p 36p 340p 36p 90p	74186 74190 74191 74192	120p 120p 99p	4071 4072 4073	25p 30p 30p	MC1458 MC1495 MC1496	420p 95p	8C107A 8C1078	12p 12p	8D135	38p	0C70	40p			De	von P	L19 05F	
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	7484 7485 7486 7489 7490 7491 7491 7491AN 7492	120p 36p 340p 36p 90p 90p 58p	74186 74190 74191 74192 74193 74194	120p 120p 99p 99p 160p	4071 4072 4073 4078 4081	25p 30p 30p 170p 20p	MC1458 MC1495 MC1496 MC1103 MC3340	420p 95p 95p 120p•	8C107A 8C1078 8C108 8C108A	12p 12p 10p 12p	8D135 8D136 8D137 8D139	38p 37p 38p 36p	OC70 OC71 R20088 R20108	40p 45p 200p* 200p*		Ta P 8	De avistock & P 25p	von P 5439 VAT	L19 05F Telex 4 8% Unless	¥5 263 *12 <u>∔</u> %
	7484 7485 7486 7489 7490 7491 7491 7491AN 7492	120p 36p 340p 36p 90p 90p 58p	74186 74190 74191 74192 74193 74194	120p 120p 99p 99p 160p	4071 4072 4073 4078 4081	25p 30p 30p 170p 20p	MC1458 MC1495 MC1496 MC1103 MC3340	420p 95p 95p 120p•	8C107A 8C1078 8C108 8C108A	12p 12p 10p 12p	8D135 8D136 8D137 8D139	38p 37p 38p 36p	OC70 OC71 R20088 R20108	40p 45p 200p* 200p*		Ta P 8	De avistock & P 25p	von P 5439 VAT	L19 05F Telex 4 8% Unless	¥5 263 *12 <u>∔</u> %



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| TRANSISTORS,
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 | Price (£) | Туре А | Price (£) | Type | Price (£)
 | Туре | Price (£) | Type
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AČ107 0.48 AC117 0.38 AC126 0.36 AC127 0.54	AU103 2.4 AU107 2.7 AU110 2.4	BC192 BC204 BC205 BC205	

 | 0.56
10.39
10.39
10.37 | BC377
BC394
BC440
BC441
 | 0.29
0.39
0.52
0.59 | BD234
BD235
BD236
BD237 | 0.88
0.63
0.63
0.63 | BF222
BF224 & J
BF240
BF241
 | 10.51
10.22
10.32
10.31 | BPX29
BR101
BR103
BR303 | 1.62
0.63
0.64
1.06 | MPSU05
MPSU06
MPSU55
MPSU56 | 0.88
0.76
1.26
1.32
 | ZTX500
ZTX502
ZTX504
2N404 | 10.18
10.22
10.26
1.30 | 2N3819
2N3820
2N3886
2N3904
 | 10.47
0.72
1.08
10.20 |
| AC12B 0.48
AC12BK 0.55
AC141 0.65
AC141K 0.70 | BC108* 0.1
BC109* 0.1
BC113 10.2 | BC208*
BC209*
BC211*

 | 10.39
10.37
10.39
10.36 | BC461
BC477
BC478
BC479
 | 0.76
0.30
0.25
0.33 | BD23B
BD253
BD410
BD433 | 0.88
1.58
1.65
0.65 | BF244*
BF245*
BF254
BF255
 | 10.51
10.43
10.48
10.58 | BRC4443
BRY39
BRY56
BSS27 | 1.76
0.60
10.44
0.92 | MPSU60
MPU131
OC28
OC28 | 0.62
10.59
1.90
1.49
 | 2N696
2N697
2N706A
2N708 | 0.48
0.48
0.33
0.29 | 2N3905
2N3906
2N4036
2N4123
 | 10.20
10.20
0.94
10.17 |
| AC142 0.60
AC142K 0.65
AC151 0.31
AC152 0.36 | BC115 10.2
BC118* 10.2 | BC212L*
BC213*
BC213L*

 | 10.17
10.17
10.16
10.16 | BC547*
BC548*
BC549*
BC550
 | 10.13
10.13
10.15
10.24 | BD435
BD436
BD437
BD438 | 0.70
0.71
0.74
0.75 | BF258L*
BF257
BF258
BF259
 | 10.49
10.44
0.52
10.54 | BT106
BT109
BT116
BT119 | 1.50
1.99
1.45
5.16 | 0C29
0C35
0C36
0C42 | 1.60
1.25
1.25
0.90
 | 2N914
2N916
2N918
2N930 | 0.32
0.48
0.54
0.29 | 2N4124
2N4126
2N4236
2N4289
 | 10.17
10.17
2.20
10.32 |
| AC153 0.42
AC153K 0.52
AC154 0.41
AC156 0.45 | BC119 10.3
BC125* 10.3 | BC214L*
BC225

 | 10.16
10.16
10.42
10.16 | BC556
BC557*
BC558*
BC559*
 | 10.23
10.16
10.16
0.17 | BD519
BD520
BD599
BD600 | 0.88
0.88
0.87
1.23 | BF262
BF263
BF270
BF271
 | 0.73
0.88
0.47
0.42 | BU102
BU105
BU105/02
BU108 | 2.65
11.80
11.95
12.98 | 0C44
0C45
0C70
0C71 | 0.88
0.63
0.65
0.73
 | 2N1164
2N1304
2N1305
2N1308 | 6.29
1.40
1.29
1.49 | 2N4292
2N4416
2N4444
2N4921
 | 10.32
0.85
1.90
0.80 |
| AC178 0.51
AC179 0.55
AC187 0.56
AC187 0.56
AC187K 0.65 | BC132 t0.2
BC134 t0.2
BC135 t0.2 | BC238*
BC239*
BC251*

 | 10.15
10.22
10.25
10.26 | BCY10
BCY30A
BCY32A
BCY34A
 | 0.30
1.06
1.19
1.02 | BD683BI
BDX1B
BDX32
BDY16A | R 0.86
1.55
2.95
0.63 | BF272A
BF273
BF274
BF336
 | 0.80
10.33
10.34
0.63 | BU128
BU204
BU205
BU206 | 12.91
12.50
12.78
13.09 | 0C72
0CB1
0CB1D
0C139 | 0.73
0.63
0.95
1.30
 | 2N1307
2N1308
2N1711
2N1893 | 1.32
1.53
0.47
0.52 | 2N5042
2N5060
2N5061
2N5064
 | 1.85
10.28
10.30
0.63 |
| AC188 0.52
AC188K 0.61
AC193K 0.70
AC194K 0.74 | BC137 10.3
BC138 10.3
BC140 0.3 | BC253*
BC281A*
BC282A*

 | 10.38
10.28
10.28
10.28 | BCY72
8D115
BD123
BD124
 | 0.27
1.35
1.50
1.85 | BDY18
BDY20
8DY38
BF115 | 1,55
2,29
1,38
0,48 | BF337
BF338
BF355
BF362
 | 0.65
0.88
10.72
10.49 | BU208
BU407
BUY77
C108D | 14.88
11.38
2.50
0.80 | 0C140
0C170
0C171
0C200 | 1.35
0.80
0.82
3.90
 | 2N2102
2N2217
2N2218
2N2218
2N2219 | 0.71
0.55
0.36
0.42 | 2N5088
2N5087
2N5208
2N5294
 | 10.49
10.50
10.59
0.88 |
| ACY17 1.20
ACY19 0.95
ACY28 0.96
ACY28 0.96
ACY39 2.02 | BC142 0.3
BC143 0.3
BC147* 10.1 | BC267*
BC288*
BC288

 | 0.20
0.28
0.40
0.49 | BD130Y
BD131
BD132
BD133
 | 1.56
0.58
0.88
0.70 | BF117
BF120
BF121
BF123 | 0.45
0.55
0.85
0.48 | BF383
BF367
BF451
BF457
 | 10.49
10.29
0.43
0.45 | C106F
C111E
D40N1
E1222 | 0.43
10.48
0.64
0.47 | 0C201
0C202
0C205
0C205 | 3.95
2.40
3.95
1.98
 | 2N22221/
2N22222/
2N2389/
2N2401 | 0.26 | 2N5298
2N5298
2N5322
2N5449
 | 0.88
0.71
1.16
10.18 |
| AD140 1.79
AD142 1.90
AD143 1.78
AD149 1.92 | BC149* 10.13
BC152 10.43
BC153 10.3 | BC291
BC294

 | 0.27
10.37
0.36
0.62 | 8D135
8D138
8D137
8D138
 | 10.37
10.38
0.40
0.42 | BF125
BF127
BF137F
BF152 | 0.88
0.51
0.78
10.19 | BF458
BF459
8F594
BF596
 | 0.49
0.52
10.16
10.17 | E5024
GET872
MC140
ME0402 | 10.19
0.48
10.36
10.18 | ON238A
R20088
R2010B
R2322 | 0.94
12.92
12.79
10.75
 | 2N2484
2N2570
2N2846
2N2784 | 0.35
0.74
0.82
1.15 | 2N5457
2N5458
2N5459
2N5494
 | 10.45
10.40
10.58
0.85 |
| AD181 0.56
AD181/162 1.22
AD162 0.71
AF114 0.35 | BC157* 10.1: | 8C302
BC303
BC304

 | 0.38
0.88
0.64
0.44 | BD139
BD140
BD144
8D145
 | 0.48
0.50
2.24
0.75 | BF158
BF159
BF160
BF181 | 10.25
10.27
10.20
0.64 | BF597
"8FR39
BFR40
BFR41
 | 10.27
10.30
10.29
10.30 | MF0404/02
ME6001
ME6002
MJ2955 | 2 10.18
10.18
10.18
1.30 | R2323
ST2110
ST8120
TIC44 | 10.85
0.49
0.48
10.25
 | 2N2889
2N2894
2N2904
2N2905 | 2.08
0.45
0.40
0.39 | 2N5496
2N6027
2N6107
2N8122
 | 1.05
0.55
0.71
0.60 |
| AF115 0.35
AF118 0.41
AF117 0.42
AF118 0.98 | BC181 10.54
BC187B 10.11
BC188B 10.14
BC189C 10.11 | 8C308*
8C309*
8C317*

 | 10.17
10.14
10.18
10.15 | BD150A*
BD155
BD157
BD158
 | 10.51
10.90
0.51
0.75 | BF163
BF184
BF188
BF187 | 10.65
10.95
0.50
0.38 | BFR50
BFR52
8FR61
8FR62
 | 10.29
10.33
10.29
10.26 | MJ3000
MJE340
MJE341
MJE370 | 1.58
0.88
0.72
0.74 | TIC46
TIC47
TIP29A
TIP30A | 10.35
10.45
0.47
0.50
 | 2N2906*
2N29280
2N29280
2N29280
2N29281 | 0.36
0.15
0 10.14 | 2N8178
2N8180
2N8211
2SB337B
 | 1.07
1.39
2.74 |
| AF121 0.88
AF124 0.38
AF125 0.38
AF128 0.36 | BC170* 10.19
BC171* 10.19
BC172* 10.14
BC173* 10.22 | BC319*
8C320
BC321A&I

 | 10.15
10.19
10.17
B 10.18 | BD159
BD160
BD183
8D165
 | 0.88
2.69
0.67
0.56 | BF173
BF177
BF178
BF179 | 0.35
0.36
0.48
0.58 | BFR79
BFR80
8FR81
BFR88
 | 10.30
10.29
10.30
10.42 | MJE371
MJE520
MJE521
MJE2955 | 0.79
0.85
0.95
1.20 | TIP31A
TIP31C
TIP32A
TIP32C | 0.51
0.67
0.56
0.72
 | 2N2955
2N3053
2N3054
2N3055 | 1.12
0.48
0.86
0.72 | 2SC458C
2SC843A
2SC930D
2SC1081
 | 0.78 |
| AF127 0.88
AF139 0.58
AF147 0.52
AF149 0.45 | BC177* 0.2 | BC327
BC32B

 | 10.28
1.15
10.16
10.18 | BD168
BD175
BD177
8D178
 | 0.88
0.90
0.58
0.92 | BF180
BF181
BF182
BF183 | 0.53
0.53
0.44
0.52 | BFT41
BFT43
BFW11
BFW30
 | 0.48
0.55
1.02
2.58 | MJE3000
MJE3055
MPF102
MPS3702 | 1.95
1.22
10.40
10.33 | TIP33A
TIP34A
TIP41A
TIP42A | 0.77
0.64
0.72
0.60
 | 2N3250
2N3254
2N3391/
2N3833 | 0.52
0.58 | 2SC1172
2SD234
3N128
40250
 | |
| AF178 1.35
AF179 1.36
AF180 1.35
AF181 1.33 | BC178* 0.23
8C179* 0.24
BC182* t0.11
BC182L* t0.11 | BC338
BC340
BC347*

 | | BD181
BD182
8D183
BD184
 | 1.94
2.10
1.34
2.30 | BF184
BF185
BF188
BF194* | 0.44
0.42
0.42
10.14 | 8FW59
8FW80
BFW90
BFX29
 | 10.19
10.20
10.65
0.38 | MPS3705
MPS6521
MPS8523
MPS8586 | 10.30
10.36
10.36
10.44 | TIP2955
TIP3055
TIS43
TIS73 | 0.77
0.58
10.44
11.36
 | 2N3703
2N3704
2N3705
2N3708 | 10.17
10.19
10.17
10.16 | 40251
40327
40381
40382
 | 1.14
0.67
0.48
0.50 |
| AF188 1.48
AF202 0.27
AF239 0.73
AF240 1.40 | | BC349B
BC350*

 | 10.17
10.17
10.24 | BD187
BD188
BD189
BD222
 | 1.20
1.25
0.71
0.91 | BF195°
BF196
BF197
BF198 | 10.13
10.14
10.15
10.29 | BFX84
BFY50
8FY51
BFY52
 | 0.42
0.38
0.37
0.36 | MPSA05
MPSA06
MPSA55
MPSA58 | 10.30
10.32
10.43
10.45 | TIS90
TIS91
ZTX108
ZTX109 | 10.23
10.28
10.14
10.16
 | 2N3707
2N3708
2N3715
2N3771 | 10.18
10.17
1.70
2.39 | 40410
40429
40530
40595
 | 0.94
0.88
0.79
1.39 |
| AF279S 0.91
AL100 1.30
AL103 1.58 | | BC352A*

 | | BD225
BD232
BD233
available on
 | 0.91
0.91
0.62
items ma | BF199
BF200
BF218
arked*. | 10.29
10.25
10.42 | BFY53
BFY90
BPX25
 | 0.36
1.98
1.62 | MPSA93
MPSL01
MPSU01
For mat | 10.56
10.33
0.61
tched pa | ZTX213
ZTX300
ZTX304
irs add 20p g | 10.23
10.16
10.26
 | 2N3772
2N3773
2N3794 | 2.58
3.90
10.40 | 40603
40638
40654
 | 1.13
1.25
0.89 |
| LINEAR IC's
Type Price (E) | Type Price (E
SN76008KE 1.56 | TBA240A

 | Price (£)
1 3.98 | AA113
 | rice (£)
0.17 | BY114 | Price (£)
0.60 | VOR's, etc
Type P
 | :. (†)
Price (£) | VALVES (†
Type P | rice (E) | RESISTO
Carbon Film |
 | 10 of on
Ea value | | s of a minimum
hcs of any velu
100pc
 | |
| BRC1330 10.93
CA8100M 2.44
CA3005 1.85 | SN76013N 1.50
SN76013ND1.40
SN76018KE 1.50 | TBA2B1
T8A395*

 | 12.07 | AA119
AA129
 | 0.21 | BY118
BY128 | 1.10
0.20 | E295ZZ
 | 0.00 | DÝB6/87 | 0.75 | ‡₩ 5.6Ω-33 |
 | 3p 28p
3p 28p | 96p
95a | £1.40
 | 28.40 |
| CA3012 1.45 | SN76023N 1.56 | TBA398
TBA400

 | 12.40
12.20 | AA143
AAY30
 | 0.18 | BY127
BY133 | 0.21
0.35 | /01
/02
E298CD
 | 0.28 | DY802
ECC81
ECC82 | 0.75
0.78
0.95 | 1W 10Ω-10
1W 10Ω-10
2W 10Ω-10 | DMΩ (E12)
 | 5p 45p
9p 80p | £1.95
£3.60 | £1.40
£3.40
£8.40
 | £5.40
£15.25
£25.90 |
| CA3014 2.23
CA3018 0.71
CA3020 1.89
CA3028A 0.80 | SN76023N 1.56
SN76023ND 1.40
SN76033N 2.22
SN78110N 1.20
SN78115N 11.82 | TBA400
TBA4800
TBA500*
TBA510*
TBA520P*

 | 12.20
11.64
12.21
12.21
13.40 | AA143
AAY30
AAZ13
AAZ15
AAZ17
AY102
 | 0.18
0.26
0.42
0.35
0.28
3.85 | BY127
BY133
BY140
BY184
BY178
BY179 | 0.21
0.35
1.40
0.75
2.80
0.83 | /02
E298CD
/A258
E298ED
/A258
/A260
 | 0.28
0.25
0.22
0.22 | ECC81
ECC82
ECC83
ECHB1
ECLB0
EFB0 | 0.78
0.95
0.78
0.83
0.82
0.60 | 1W 10Ω-10
2W 10Ω-10
Wirewound
2 W 0.22Ω-
4W 1.0Ω- | DMΩ (E12)
MΩ (E6)
d (5%)
270Ω
10kΩ
 | 5p 45p
9p 80p
18p 0-1
22p 100 | £1.95
£3.60
sets (1)
W (Vertical (
, 220, 470) | £3.40
£8.40
Ind Horizonta
2, 1, 2-2, 4-7,
 | 25.40
£15.25
£26.90 |
| CA3014 2.23
CA3018 0.71
CA3020 1.89
CA3028A 0.80
CA3028B 1.09
CA3045 3.75
CA3048 0.70
CA3065 1.74 | SN76023N 1.56
SN76023ND 1.4C
SN76033N 2.22
SN78110N 1.2C
SN78115N 11.82
SN78118N 1.7E
SN78131N 12.11
SN78228N 12.61
SN70227N 11.61 | TBA400
TBA480Q
TBA500°
TBA510°
TBA520P°
TBA520P°
TBA530P
TBA540°
TBA550°
TBA560C°

 | 12.20
11.64
12.21
13.40
12.24
12.88
13.13
13.18 | AA143
AAY30
AAZ13
AAZ15
AAZ17
AY102
BA100
BA102
8A104
BA110
 | 0.18
0.26
0.42
0.35
0.28
3.85
0.24
0.36
0.19
0.80 | BY127
BY133
BY140
BY184
BY178
BY179
BY182
BY184
BY189
BY189
BY190 | 0.21
0.35
1.40
0.75
2.80
0.83
1.14
0.44
5.30
4.90 | /02
E298CD
/A258
E298ED
/A258
/A260
/A282
/A285
/P288
E298ZZ
 | 0.28
0.25
0.22
0.22
0.22
0.22
0.22
0.22 | ECC81
ECC82
ECC83
ECH81
ECL80
EFB0
EF183
EF184
EF184
EH90
EL34 | 0.78
0.95
0.78
0.83
0.82
0.60
0.75
0.75
0.94
3.08 | 1W 10Ω-10
2W 10Ω-10
Wirewound
2JW 0.22Ω- | DMΩ (E12)
MQ (E6)
d (5%)
270Ω
10kΩ
-22kΩ
22kΩ
22kΩ
22kΩ
 | 5p 45p
9p 80p
18p 0-1
22p 100
24p 47,
28p
33p 0-2 | £1.95
£3.60
aets (1)
W (Vertical (
), 220, 4700
100, 220, 4 | 23.40
23.40
1.1, 2-2, 4-7,
70kΩ, 1, 2-6,
all 14
nd Horizontai)
 | 25.40
£15.25
£26.90 |
| CA3014 2.23 CA3018 0.71 CA30281 0.80 CA30288 0.80 CA30288 1.09 CA3045 3.75 CA3068 1.74 CA3068 1.90 CA3068 1.90 CA3130S 1.87 FCH181 12.40 FCJ101 13.32 | SN76023N 1.64
SN76023N 1.40
SN76023N 2.22
SN78110N 1.22
SN78115N 11.85
SN78115N 11.85
SN7813N 12.11
SN78228N 12.40
SN70227N 11.66
SN76228N 11.30
SN78520P 10.97
SN78530P 10.97
SN78530P 10.97 | TBA400
TBA480Q
TBA500*
TBA510*
TBA520P*
TBA530P
TBA550*
TBA550*
TBA560C*
TBA560C*
TBA580C*
TBA84118
TBA841A1

 | 12.20
11.64
12.21
12.21
13.40
12.24
12.68
13.13
13.18
11.29
2.68
2.55
2 2.35 | AA143
AAY30
AA213
AA215
AA215
AA217
AY102
BA100
BA102
BA104
BA104
BA110
BA115
BA118
BA118
BA121
 | 0.18
0.26
0.42
0.35
0.28
3.85
0.24
0.36
0.19
0.80
0.70
0.70
0.17
0.56
0.85 | BY127
BY133
BY140
BY184
BY178
BY179
BY182
BY182
BY184
BY189
BY190
BY206
BY208
BY208
BY208
BY208
BY208 | 0.21
0.35
1.40
0.75
2.80
0.83
1.14
5.30
4.90
0.26
0.25
0.30
0.70 | /02
E298CD
/A258
E298ED
/A258
/A258
/A258
/A260
/A282
/A285
/P288
E298ZZ
/05
/06
E299DD/P1
P354 a
 | 0.28
0.25
0.22
0.22
0.22
0.22
0.22
0.22
0.22 | ECC81
ECC82
ECC83
ECH81
ECL80
EF180
EF183
EF184
EH30
EL34
EY51
EY86/87
PCC84
PCC85 | 0.78
0.95
0.83
0.82
0.80
0.75
0.75
0.94
3.08
1.20
0.67
0.61
0.79 | 1W 10Ω-10 2W 10Ω-101 2W 0.22Ω-101 4W 1.0Ω-101 4W 1.0Ω-101 7W 0.88Ω-11W 1.0Ω-17W 1.0Ω-17A | DMΩ (E12)
MΩ (E6)
d (5%)
270Ω
10kΩ
22kΩ
22kΩ
22kΩ
22kΩ
 | 5p 48p
9p 80p
18p 0-1
22p 100
24p 47,
28p
33p 0-2
3p Valu
of 10)
(BEAB)
£3.88 | 21.95
23.60
sets (1)
W (Vertical a
0, 220, 470(
100, 220, 4
W (Vertical a
es as 0-1W
20mm qui
100mA | 23.40
28.40
ind Horizonta
3, 1, 2-2, 4-7,
70kΩ, 1, 2-5
all 14
nd Horizontal
ell 14
nd Horizo | 25.40
£15.25
£25.90
al)
10, 22,
55MΩ
4p each
4p each
55BΩ
65Bp
 |
| CA3014 2.33
CA3014 2.33
CA3018 0.71
CA3020 1.86
CA30228 0.80
CA30288 1.09
CA30288 1.00
CA3045 1.75
CA3048 0.70
CA3088 1.90
CA3088 1.90
CA31305 1.74
CA3088 1.90
FC1181 12.40
FC1101 13.32
LM330N-14 1.65
LM1303N 3.08
MC1310P ^e 11.94 | SN76023N 1.54
SN76033N 2.22
SN78110N 1.42
SN78110N 1.22
SN78110N 1.22
SN78118N 1.72
SN7812N 12.11
SN78228N 12.64
SN70227N 11.61
SN78530N 11.92
SN78530N 11.93
SN78530N 11.94
SN78544N 11.60
SN78544N 11.60
SN78540N 11.81
SN78540N 11.81
SN78820AN 11.61
SN78820AN 11.61
SN785 | TBA400
TBA500*
TBA500*
TBA520P*
TBA520P*
TBA550*
TBA550*
TBA550*
TBA550*
TBA50*
TBA580*
TBA580*
TBA580*
TBA8418
TBA8418
TBA8418
TBA8418
TBA8418
TBA8418
TBA8418
TBA8418
TBA8418
TBA8419
TBA700*
TBA720A0

 | 12.20
11.64
12.21
12.21
12.21
12.21
12.24
12.88
13.13
13.18
11.29
2.88
2.255
2.255
2.255
2.255
2.261
1.2.61
1.2.12
12.19
12.50 | AA143
AAY30
AAZ13
AAZ15
AAZ15
AA217
AY102
BA100
BA100
BA100
BA100
BA110
BA111
BA115
BA114
BA129
BA145
BA148
BA148
BA154 | 0.18
0.26
0.28
0.28
0.28
0.28
0.28
0.28
0.28
0.28
 | BY127
BY133
BY140
BY184
BY178
BY178
BY182
BY184
BY184
BY184
BY189
BY184
BY190
BY206
BY206
BY206
BY206
BY206
BY206
BY206
BY270/50
ITT44
ITT210
ITT827 | 0.21
0.35
1.40
0.75
2.80
0.83
1.14
5.30
4.90
0.26
0.25
0.30
0.70
0.053
0.63
0.63
0.80 | /02
E298CD
/A258
E298ED
/A258
/A282
/A282
/A282
/A285
/P288
E298DZ
/05
/06
E299DD/P1
P354 a
E299DH
/P230
R53
VA1015
 | 0.28
0.25
0.22
0.22
0.22
0.22
0.22
0.22
0.22 | ECC81
ECC82
ECC83
ECC83
ECL80
EF180
EF184
EH36
EH34
EY86/87
PCC84
PCC85
PCC89
PCC89
PCC89
PCC88 | 0.78
0.95
0.78
0.83
0.82
0.60
0.75
0.94
3.08
1.20
0.61
0.79
0.74
0.74
0.94
1.20
0.67 | 1W 100-10
2W 100-10
Wirswoum
21W 0.220-
4W 1.00-
17W 1.0 | DMQ (E12)
MQ (E6)
d (5%)
2700
22k0
22k0
22k0
rding pillars
M packs (
ne Oelay
250mA
800mA, - | 5p 48p
9p 80p
Pra
18p 0.1
22p 100
24p 47,
28p
33p 0.2
33p 0.2
33p Valu
of 10)
(BEAB)
£3.88
£2.55
£1.88
£1.44
£1.44 |
£1.95
£3.80
sets (1)
W (Vertical 1
, 220, 470(
100, 220, 4
W (Vertical a
es as 0-1W
20mm qui
100mA
200, 250. | 23.40
28.40
and Horizonta
0, 1, 2-2, 4-7,
70k0, 1, 2-5,
all 1
and Horizontal)
ell 1
idck-blow (1
, 315, 500,
, 1.25, 1.8,
breakers | 25.40
£15.25
£28.90
ii)
ii) . 10,22,
. 5MΩ
4p each
ii)
8EAB
68p
68p
68p,
630,
2,2.5,
NI 56p |
| CA3014 2.33
CA3014 2.33
CA3018 0.71
CA3020 1.89
CA3028 0.80
CA3048 3.79
CA3048 3.79
CA3048 1.90
CA3065 1.74
CA3065 1.74
CA3079 1.88
MC13107P 1.94
MC13127P 1.88
MC13307 10.87
CA306 1.82
CA3079 1.84
CA3079 1.84
C | SN76023N 1.64
SN76023N 1.44
SN76033N 2.22
SN78110N 1.22
SN78110N 1.22
SN78115N 11.32
SN78115N 11.32
SN78123N 12.11
SN78228N 12.6
SN78520N 11.32
SN78530P 10.37
SN78530N 11.38
SN78530N 11.38
SN78570N 11.85
SN7854N 11.85
SN7854N 11.85
SN78560N 11.45
SN78650N 11.45
SN78865N 10.45
SN78865N 10.45
SN78650N 11.45
SN78865N 10.45
SN78865N 10.45
SN78865N 11.45
SN78865N 10.45
SN78865N 11.45
SN78850N 11.45
SN7850N 1 | TBA400
TBA4800
TBA500*
TBA510*
TBA520P*
TBA530P
TBA540*
TBA550*
TBA550*
TBA5118
TBA84111
TBA8411
TBA8411
TBA8411
TBA8411
TBA8411
TBA851
TBA700*
TBA720A0
TBA720A0
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01-261 5762

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COVER

We don't need to tell you what's on the cover. Roy Palmer's daughter Vivienne. The nearby set is displaying the Philips PM5544 test pattern. A later type of field timebase i.c. was adopted for the final version of the set, giving greatly improved field linearity.

TELEVISION

Give the OBA a Chance!

The government's white paper on the future of broadcasting proposes that the UK's fourth TV channel should be run by a new broadcasting authority, the OBA (Open Broadcasting Authority), and that it should be financed partly by advertising and partly by a government grant. The proposals put forward in the white paper seem to have made little public impact however, doubtless due to the unfortunate timing of the paper's publication – at the run up to a likely autumn general election.

The government has taken its time in reaching a decision, as indeed did the Annan committee in putting forward its proposals following its long enquiry into the future of broadcasting, started in 1974. We have gone on record before in supporting the idea of the OBA, and continue to do so. We don't like politics to enter these pages, since they are largely irrelevant to the concerns of a technical magazine. The decisions now necessary on the future of broadcasting in the UK have become political ones however, a matter we feel to be one for public regret. It seems to us a pity that a non-party enquiry should be set up to consider the future of broadcasting but, when it comes up with modest though imaginative proposals, the decision on whether or not to accept them gets tossed back into the party political arena. It should have been possible to have achieved an all-party approach to the question of how we are to make use of the broadcasting frequencies available to us. But, dare we mention it, there are of course considerable commercial interests at stake.

The conservative party has come out against the idea of the OBA and in favour of making the fourth channel ITV-2. It says this would be cheaper, which is true. But the cost of setting up and running the OBA would be quite marginal. You could argue that ITV-2 would be in a better position to provide quality programmes since the ability of a wholly commercial network to obtain advertising revenue would provide the cash necessary to do so. But there's the rub. You can sell advertising only if you can guarantee a substantial audience, and this automatically means heavy reliance on wide appeal programming. The conclusion seems inescapable: if we want a new TV channel which will provide something different from the present run of programmes offered to the public, it'll have to be run on different lines (the BBC is not interested in running another TV channel).

The reaction of many members of the public to a fourth channel seems to be that we've already got enough TV thank you! This is precisely why the idea of the OBA is so important, and why it should be a better solution than ITV-2. It's a question of trying to provide a wider choice, a genuine alternative to what's being broadcast by the present three networks: this is surely what the public is entitled to expect from its fourth channel when it gets one.

Since broadcasting is a matter that doesn't rate all that highly amongst the concerns of those involved in the day-to-day political life of the country, decisions on it are unfortunately all too likely to be taken at the last minute and for the wrong reasons. The decision about the fourth channel is particularly important however. We're not going to get another opportunity for a long time to set up an organisation with a fresh approach to TV broadcasting. What's required in reaching this decision is delicate judgement and imagination, but these, unfortunately, are qualities that don't tend to flourish in the hurly-burly of day-to-day politics.

It could be of course that the OBA would not turn out to be a useful source of alternative programmes: the point however is that it should be given a worthwhile opportunity to see what it can achieve. The BBC and IBA have turned out to be successful institutions. Let's see whether the OBA can also do so.

Teletopics

VIEWDATA SERVICING AND DEVELOPMENTS

GEC Semiconductors is offering a tailor-made training course in Prestel (viewdata) terminal servicing - claimed to be the first such course. A group of Granada TV Rentals engineers has already attended the course, at GEC's East Lane, Wembley centre. A company spokesman comments that GEC will prepare courses for ten or more engineers, with the syllabus tailored to meet the group's exact requirements. Costs are likely to be around £100-£150 per person - the Granada course lasted for three days, with the majority of the time being spent in the workshop doing "hands on" training. GEC Semiconductors is deeply involved in work on the specialised i.c.s required for this application. Two new purpose-designed i.c.s to allow a full typewriter keyboard to be linked to a viewdata terminal by remote control are under development by GEC. These devices, one for the transmitter unit and one for the receiver, will be able to handle up to 256 control channels. GEC comment that ultrasonic links are insufficiently flexible with this number of channels, leading to the use of infra-red links instead. Prototype versions of these i.c.s are expected to be available to setmakers by the end of the year.

According to GEC, sales of the present generation of Prestel and teletext modules are going very well, though high-volume production has not yet started. About 2,000 complete kits are understood to have been ordered from GEC. These are sold as complete printed board assemblies, a set of four separate modules being required for a complete Prestel-teletext system. The sets of boards are being sold to setmakers at around £250-£300, but GEC expect the price to fall dramatically – to around the £25-£30 mark – when specialised i.c.s for the application become available. This is expected to be within eighteen months or so.

TV INVESTMENT

An important investment programme has been announced by Mullard. £24 millions is to be spent on further improving the manufacturing facilities at the company's Durham colour tube assembly plant and in establishing a production line for 20in., 90° colour tubes at the Simonstone plant. The programme is backed by a £4.5m grant under the government's industry support scheme, and will cover a three year period. Investment at Simonstone will total £13.1m and at Durham £7.8m. There will be further investment at Washington, where the neck components for the new 90° tube will be made, and £0.9m at Crossens where the related magnetic components will be manufactured.

The investment, in what Mullard call Project Vanguard, is considered to be vital in enabling an enhanced and expanding range of colour tubes and ancilliary components to be offered to meet setmakers' requirements. Mullard aim to increase their share of the UK tube market from around half in 1978 to over two-thirds by 1981 – both figures based on a total market of some 1.8 million sets. The project is also intended to strengthen Mullard's export performance – 40 per cent of tube output was exported in 1978.

Mullard's managing director Jack Ackerman commented that the government's grant is a clear recognition of the need to maintain, through viable UK-based tube production, a healthy and prosperous TV setmaking industry in the UK.

It's interesting to note that whereas 110° deflection has come to be the accepted standard for the larger sizes of selfconverging in-line gun tubes, for the smaller sizes - 20in. and below - 90° has remained the accepted standard.

Meanwhile Thorn have announced an increase in their planned investment for rationalising colour set production – from $\pounds 5m$ to $\pounds 8m$. The investment will go largely into automatic production and testing equipment. Production is to be concentrated at Thorn's Gosport and Enfield plants, and the aim is to achieve internationally competitive sets and costs.

Increased demand for the Philips TX monochrome portable chassis has led to the second increase in production capacity this year at their Lowestoft TV factory.

SPONTANEOUS CHANNEL CHANGING

A reader recently sent us a cutting from a Scottish paper with a story about a set changing channels due to a budgerigar's bell. We've come across similar occurrences before – due to jangling keys and so on. Such things can happen with simple remote control systems when harmonics cause the remote control system to operate. With more elaborate remote control systems error protection is built in, the system operating only when it counts bursts of signal which it converts to pulses.

Random channel changing can also be caused by the discharge of static build up. Rank have encountered this problem on some of their current chassis, and to overcome it are now fitting a 50mm square piece of self-adhesive PVC tape across the gap in the Claylastic trim at the bottom of the c.r.t. The tape is attached along the centre line of the trim and then taken down towards the bottom of the cabinet so as not to be seen from the front. Part number of the tape is 1252 0159.

VIDEO NEWS

National Panasonic point out that while their new VHSstandard Model NV8600 VCR is compatible with other machines made to this standard it nevertheless incorporates exclusive features such as direct motor drive and a diecast chassis for operating stability and robustness, and is "not just a relabelled version of somebody else's machine". The NV8600 shares the same basic specification as other VHS machines, and is in the same price range at £750 including VAT.

There seems to have been a considerable fall-off in domestic video recorder sales in the US recently – figures as high as 50 per cent have been mentioned – which could well account for the increased interest being shown by Japanese VCR manufacturers in the European market. We might yet prove wrong, but it's never seemed to us that the VCR is likely to become a mass-market item.

IPC have entered the video market with a package of ten prerecorded videocassettes providing what they call "alternative television". The cassettes are to the Philips N1700 standard, but production of cassettes to the VHS standard is planned to start in November. There are no plans so far to produce cassettes to the Sony Betamax standard. The packs are available only as a complete package containing the ten different tapes, and the price to dealers is £269.40 exclusive of VAT. Pack one covers sailing (58 minutes), equestrian games (52 min), the 1977 British Open Golf Championship (52 min), a history of golf (one hour), the world of birds (56 min), a history of Le Mans motor sport (52 min), angler's corner (one hour), Wimbledon 1977 (52 min), a history of Wimbledon (50 min), and skiing (58 min). A display box and point-of-sale material are included, and a national advertising 'campaign is planned. Further details can be obtained from IPC Video, Surrey House, Throwley Way, Sutton, Surrey SM1 4QQ, telephone 01-643 8040.

The first ever purpose-built TV games centre, called Silicon Chip, has been opened at 46 London Road, Kingston, Surrey (01-549 6657). The fittings include seven TV sets to enable devotees to try the large number of games held in stock, ranging from the simple four-game monochrome units to highly sophisticated microprocessor-based colour cartridge types such as the Optim Majestic video computer. The games can also be demonstrated on a projection unit with a 42×52 in. screen – the projection unit itself can be supplied for £845 plus VAT.

General Instrument Microelectronics have introduced a new set of MOS microcircuits for use in cartridge-based programmable TV games systems. Known as System 8601, the circuits include a clock generator, colour encoder, modulator and a selection of cartridge microcircuits – enabling fully programmable games systems to be built at low cost.

Each games system will consist of a console into which individual game set cartridges are slotted. Each console will contain the clock, encoder and modulator as well as the game controls, switches, power supplies, etc. Each cartridge contains the individual games microcircuits plus interface circuitry. All sets will feature realistic sound generation and on-screen scoring.

Some of the cartridge-mounted microcircuits are already available, including the 8610 "Supersport" (20 games), the 8765 "Motorcycle" (8 games) and the 8603 "Road Race" set (3 games). Three more circuits – the 8607 "Target" (12 games), the 8606 "Wipeout" (24 games) and 8605 "Warfare" (10 games) – will go into production within two months, with more to follow before the end of the year.

GIM introduced the AY-3-8500, which became the video games industry's standard i.c., in 1976.

INTELLIGENT GAMES CHIP

ITT have released details of a new i.c., type SAA1080, which provides ten games and is intended for use in conjunction with ITT ultrasonic or infrared i.c. remote control systems. The SAA1080 is incorporated inside the set, the player push-button control units being connected to the remote control transmitter. The games provided are: blockade, war at sea, solitaire, master mind, nimb, game of chance, othello, nine men's morris, five in a row and wolf and sheep: the first six are played by a single player against an electronic adversary, the last four requiring two players.

DATA RECEPTION

A code of practice is in preparation to give riggers guidance on the installation of aerials for data reception (teletext). As mentioned in these pages before, ghosts constitute a serious problem with data reception. It's also vital in weak signal areas to orientate the aerial for maximum signal pickup.

TELEVISION OCTOBER 1978

Tests carried out by the IBA revealed that in some locations turning the aerial by 10° reduced the teletext signal to virtually nil, while in others a turn of 30° either way made no difference. In 67 per cent of cases studied where difficulty with reception was investigated the problem was due to a weak signal: in 33 per cent of cases the problem was a weak signal plus reflections.

EMO AND EUROSONIC SPARES

Tele-Part (13 Worcester St., Wolverhampton WV2 4LU) tell us that that French manufacturer Matra Electronique has discontinued the production of EMO colour sets, a number of which were imported into the UK. The name EMO has been taken over by L.M.E. (Le Materiel Electronique), who are handling the after sales service of Matra produced sets and have appointed Tele-Part as their UK agents to handle all matters relating to the servicing of these sets.

SERVICE NOTES FROM RANK

Switch-off spot suppression has been added to later versions of Rank's current UK-produced monochrome portable chassis T16A. The modification is simple and can be added to earlier versions if required. R57 ($180k\Omega$) from the brightness control to the 100V rail is replaced by a BZX79/C47V zener diode, with its cathode to the 100V rail and its anode to the brightness control.

The 1.6A mains fuse (7FS2) fitted in the T20 chassis has been changed from a glass cartridge type to a ceramic tube (HRC) type.

In versions of the Z718 and T20 chassis using electromechanical tuning an 0.1μ F capacitor has been added between the tuning preset sliders and the screen lead earth in order to prevent bent verticals when the a.f.c. is switched on.

TELETEXT COURSE

In response to requests from those who have attended its previous courses on teletext systems, the South London College (Knights Hill, London SE27 0TX, telephone 01-670 4488) is now offering a course which devotes more time to teletext reception. The short course consists of nine special lectures on receiver decoders and will be held on consecutive Tuesday evenings starting on October 10th. The lectures will last for approximately two hours each, and the fee for the course, which is intended for television and telecommunications technicians and engineers, is £6.50.

TRANSMITTER NEWS

The following relay stations are now in operation: Corwen, Clwyd BBC-Wales channel 22, HTV-Wales channel 25, BBC-2 channel 28. Receiving aerial group A. Greenhill, Dyfed, BBC-Wales channel 21, HTV-Wales channel 24, BBC-2 channel 27. Receiving aerial group A.

Kingussie, Highland, BBC-1 (Scotland) channel 40, Grampian Television channel 43, BBC-2 channel 46. Receiving aerial group B.

Montpelier, Bristol, HTV-West channel 23, BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.

Praa Sands, Cornwall, BBC-1 channel 55, Westward Television channel 59, BBC-2 channel 62. Receiving aerial group C/D.

Truro, Cornwall, BBC-1 channel 58, Westward Television channel 61, BBC-2 channel 64. Receiving aerial group C/D. All the above transmissions are vertically polarised.

Never Knock a Neck

Les Lawry-Johns

I didn't like the look of them from the moment they walked in. She was short and fat and an ignoramous to boot. He was short and lean with a pinched look and another ignoramous to complete the pair.

The Saga of Grace and Sid

"If we bring our set in and tell you what's wrong with it, will you put a picture valve in?" she demanded. Before I could think up a telling reply, he staggered in with an ageing dual-standard Bush.

Breaking off the conversation I'd been having with the cat, I surveyed the wreck with a pessimistic eye. "Getting on a bit, isn't it? Think it's worth doing?"

"That's a good set that is," said the self-elected female spokesperson. "It only wants a picture valve."

Having been a coward all my life, particularly when faced with a loud mouthed woman, I connected the set to the mains and stuck an aerial in the socket.

The sound came on reasonably well, but after a long delay all that appeared on the screen was a very very dim raster which did not respond to the brightness. Obviously the tube. Just to confirm this I took the back off and checked the tube base voltages. All correct, grid swinging with the brightness control setting, but with no effect on the dim raster.

I told them that all the valves in the world wouldn't help and that the tube was at fault.

"How can it be the tube?" said the brain of Britain. "There was a lovely picture on it last night, wasn't there Sid?"

"I can't see it being the tube," Sid said dutifully. "Lovely picture last night, just like Grace said."

"Well there ain't no picture on it now," I bawled. "The tube's clapped. Finished. Buggered it is." So saying I tapped the neck of the tube with the handle of a screwdriver.

A nice flash of black and white picture appeared for a split second, then relapsed back to the dim raster as before.

"Do that again," said Sid. "I saw something come on there, there must be something loose."

"Loose, loose, of course it's loose. It's loose inside the tube you twit. Look." I gave the neck another clout. On came the picture in a brief flash, then off it went again.

"Well," said Grace. "That won't cost much to put right, a little thing like that. We'll go up to two pound but no more."

"Oh yes, two pounds all right," pronounced Sid.

That was enough for me. On went the back, out came the aerial, off went the mains. "Sorry, perhaps you ought to get a second opinion. It's beyond me."

"You mean you're not going to do it?" Grace quivered with indignation.

"No I'm not and that's that."

So off they went with lots of uncomplimentary remarks clouding the air as they left.

Later that day they stalked in again.

"We came back to tell you you don't know anything about television sets. There's nothing wrong with that tube. Tell him Sid." "You nearly made me throw that set away," moaned Sid. "But I took the back off and just cleaned the dust off from under that rubber cap on the side of the the tube and the picture is perfect. And I don't know anything about 'em."

"I do," said Grace. "I used to work in a TV factory and I'm telling you the tube ain't gone. You didn't ought to be 'ere you didn't."

Lots more was said before they went.

My fault of course. I shouldn't have knocked the neck.

I wonder what they said later when it reverted to the open-circuit condition again and there was no more dust to wipe off. I'll never know.

Troubles with a VC300

Kevin came in. He's done quite a few good turns for me in the past, so when he brought in a small ITT Featherlite VC300 which was worrying him I didn't hesitate to take the repair off his hands. The first symptom was field collapse, but the resultant white line was wriggling a bit. So we attacked the field circuit first, and quickly found one of the output transistors (T11, TIS91) open-circuit. In went another and the scan opened up, but with an undulating raster which proclaimed a nasty hum on the main 11V line. This was due to the mains bridge rectifier of course, and another went in without much ado.

This left a clear picture except for a few random flyback lines which appeared to move about the screen as though the sync was about to be lost and the picture about to roll, which it didn't and the field lock was very firm.

Flyback suppression, I mumbled to myself. Now although we've serviced these sets time and again, we were not familiar with the flyback suppression circuit and it was a bit irritating to observe that the lines would vanish for minutes at a time and then reappear, particularly if the panel was disturbed. This prompted us to diagnose (wrongly) a dry-joint or the like. Some time was spent chasing around from the field timebase to the blanking transistor T5.

At last we changed this (using a BF337 as a substitute), and were rewarded with a clear picture which lasted for about fifteen minutes before the picture became impossibly grainy with hissy sound. Back on familiar ground unfortunately. Check aerial socket, cable to tuner, remove tuner from panel. Take off covers. Put tuner back, check voltages. First stage transistor emitter voltage wrong and varying. Trace to where the emitter resistor is returned to earth via a screening peg. Nice crack around peg. Resolder. O.K.

Remove tuner, refit covers and put tuner back. No more trouble. Thanks Kev. With friends like you I don't need enemies.

Taffy's Turntable

We thought you might like to hear this one. We were asked to call to attend to a radiogram which had the complaint that although the radio section worked the turntable would not turn. We left it until there was another

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		BD137	380	SN76227N	160p
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LP1173	400p	80140		SN76666N	100p
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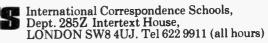
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World Radio History

call in the area and then popped in to see old Taffy.

"What's wrong Taff?" Taffy growled and gurgled as was his wont (he'd had a few during the lunch hour) so we decided to find out ourselves.

Usually this type of BSR changer grinds to a halt due to old, thick grease on the centre spindle. This stops the motor rotating, which it doesn't like and is thereafter reluctant to spin again even when completely free. It has to be spun a few times with perhaps a spot of oil on the top bearing until it gets its magnetism sorted out when it will then start up on its own. The turntable did indeed seem to be stuck fast on the centre spindle. Having freed it and lifted it off we were prepared to clean the centre spindle and the turntable bush, and lightly oil them. We were not prepared for what we found however. There was no motor fitted.

"Taff, Taff. Are you there Taff?"

"Whassermatchure, woswrong?"

"There's no motor in your radiogram Taff."

"No motor, no motor. Wodyoumean no motor? Theremusbe one. The radio's been going all morning. Matter of fact" – as his head cleared he climbed on his dignity – "matter of fact the thing's been working for six months on Radio Two. Never shift it."

"You don't need the motor to work the radio Taff. It only turns the records round."

"You'll have to ask the wife about that. She looks after all that sort of thing. She fixed it some time ago when the music was going slow. The music has been all right since but I haven't played any records you see."

"Is the wife around Taff?"

"No, she's in Finland. She sent me this greetings record but I can't play it because it won't go round. That's why I asked you to call."

Back to square one.

Feeling somewhat baffled, I went back to the radiogram and Taff wandered off to another room, grumbling to himself. Removing the rear cover of the gram, we found the motor on the floor of the cabinet, still with its leads connected. Switching on the juice made the motor buzz, but it wouldn't go round. Applying a drop of oil to the top bearing and raising the spindle up and down a few times seemed to free it off. Spinning it by hand helped it to start and away it went after that on its own. A careful search also located the three circlips which hold the motor fixings on top of the rubber bushes, so back the lot went and having cleaned off the centre spindle and bush the turntable spun freely.

"O.K. now Taff. Where's the record the wife sent you?"

In came Taff. Mumble, mumble. Eventually he found it. His wife's message was loud and clear. After the first greeting, she said. "You'll have to get the gram done before you can play this. Tell the man that the motor is underneath because I couldn't get the clips back and it won't go round anyway."

Taff gave me a baleful look. "If you'd played that before you started, you'd have known where the motor was." I quit.

Distorted Picture

The next call was nearby. I wish I hadn't bothered. It was yet another Pye 691 hybrid colour set.

The complaint was a distorted picture. Folded up from the bottom, then widespaced lines up to two thirds, then a bright kink, then severe compression up to the top.

The owner sat at the table and gave me his advice.

"It won't take long to do. The last chap fixed it in a couple of minutes with a screwdriver. I suppose it'll take

you longer if you're not used to the set."

"Why didn't you get him to come back and do it again?"

"He doesn't do them now. He gave me your phone number, so I thought I'd give you a chance if you're just starting up."

Off came the back cover. The field output transistors were the older BD124 types on the horizontal heatsink. Check these. Apparently in order. Check the AC128 driver transistor. Again o.k. Check resistors, o.k. Check electrolytics in turn, disconnecting each first. All had capacitance, none showed any significant leakage. Legs aching, panic setting in. No spare panel, no service manual. Check diodes, o.k. All supply voltages present and mid reading on BD124s not far out. Try presets. Produce weird effects but nothing of any value. Could be on convergence panel? Some messy work had been done here. Give up.

"Sorry, it'll have to go back to the workshop."

He sat at the table and drummed it with his fingers. "The last chap said it would need a panel before long. Have you got one?"

"Yes, but I'm not sure that's the answer."

"Can I have it back for tonight? – it's not much fun looking at the portable."

"It's not much fun sorting this out either!"

So load the thing into the waggon and take it back to the shop. Back at the ranch there were lots of other things to sort out but we finally got on to the Pye. Try another field panel. No joy. Open up the convergence panel and make good scorched connections, poor pots and dry joints. Check electrolytics. No joy.

Check continuity of circuit from field panel to convergence and to scanning assembly. All o.k. ... Scanning assembly ... Oh no! Try to check windings and thermistor. Not conclusive, only confusing.

Lady wants leads soldered on to transistor radio battery box which is falling to pieces anyway. Fit new box and connectors. Back to Pye.

Have we got a spare scanning assembly? Yes. Strip off tube base, blue lateral, convergence assembly and scan coils. Fit new coils, connect up but can't find one lead. Finally find it jammed up behind front of new assembly. Check connections, refit convergence, blue lateral assembly and base socket. Won't go on properly. One tube pin bent. Get it on.

Make sure all is in order. Switch on. Joy at last. Set up and converge. Return set to owner.

"Picture's not as bright as it was before you took it." Fit new PL802. No picture at all. Remove CDA panel and make good deteriorated soldering and small cracks around PL802. Nice bright picture.

"How much?! You blokes must be making a fortune at this job."

No Signals

I thought I'd make an early start the following afternoon, as I'd an uneasy feeling that things were not going to be plain sailing. Four colour sets and one mono, no two the same (for a change).

We made the nearest one the first call. This turned out to be Mr. Peacock's Dynatron. The Pye group chassis fitted was a 697. No picture, no sound except a loud hissing noise. That was Mr. Peacock's description. Bright as a new pin we first made sure that the aerial plug was in. It was.

Take the back off. Wave a neon over the line output section. Lights up, plenty of juice over that side. Check h.t. on CDA panel. None except at supply plug and socket on the right side of panel. Easy. Remove panel and note nasty black mark round track from socket. Clean up and jump a lead from the socket to the nearest relevant solder blob. Assemble and clip up. Switch on.

Sound o.k. Picture arrives after a time. Tune in after battle with remote control and receiver buttons. No colour. Check here, there and everywhere (Mr. Peacock watching). Find plug out of decoder panel, probably caused by upending CDA panel. Refit plug. Colour returns to screen and to my cheeks. Mr. Peacock was looking mystified.

"I thought the sound side was all transistor" he said. "It is."

"Well, when you were checking with your meter, why did you mutter to yourself about no h.t. I always thought transistors could work on low voltage."

Oh Gowd, I thought. Here we go again.

"The transistors were being supplied. That's why they were hissing at us. But the tuner wasn't tuning you see."

"Oh I see. The tuner needs h.t. Fancy that."

I was in a hurry so I didn't go on any further and left him thinking that tuner transistors must be pretty hefty devices.

Very Dark Picture

The next call wasn't far away. This was to a Ferguson set with a 3500 chassis. I was only praying that the tripler hadn't gone and buggered up the e.h.t. transformer, which appears to be our lot of late. Mrs. Dewdrop answered the door.

"Hallo Les," she greeted me.

"Hallo Dorothy, doing some decorating I see."

"Yes, I hang one strip of paper per day so I don't get bored with it." It takes all sorts to make a world, but that's about the daftest thing I've heard for a long time. It's not my business however and I wasn't going to ask what she did the rest of the day.

So we attacked the TV. In fact there was a very dark picture in the background, so the trippler was o.k. after all.

A dark picture on a 3500 means that the beam limiter should be the first item to receive attention. R907 (1.5Ω) should have about 1.5V across it (manual states 1.3V). If the voltage is higher, the brightness is backed off. The line timebase current flows through this resistor to earth so the resistor monitors the line output stage current and, if the circuit is not defective, it limits the beam current.

The voltage across R907 read over 3V, so there was either excess current flowing due to a fault in the line output stage or the resistor was not all that it should be. The dark picture seemed to be of the right size, and the c.r.t. first anode voltages on the convergence board were well up.

So we switched off and measured the 1.5Ω resistor which read 3Ω . We'd thoughtfully put a packet of 1.5Ω wirewounds in the box (spares box, not the TV) so it didn't take long to put a new one in. The voltage was now nearly 2V, which was still high. Checking around showed no faults, and the picture was good with plenty of brightness. So we didn't argue with it. By this time Dorothy had hung her daily strip, so all work was now complete.

Smoking Bush

Off we went to the next set, a Bush monochrome one that had smoked. It was an elderly dual-standard 23in. receiver (TV148 series).

Investigation showed that one of the h.t. feed resistors on the left side lower electrolytic block had been cooking. This was 3R59, $3 \cdot 3k\Omega$. It feeds one lead over to the timebase panel, another over to the receiver unit. There was a low resistance reading to earth, and unplugging the leads proved that the short was on the receiver unit. So we disconnected the system switch and swung down the chassis in order to peer behind it with the aid of our little torch. The tracks lead off here and there, but a close look on the component side revealed a blackened disc ceramic. Snip, snip and out it came. No short. In went another disc with the right voltage on it but the capacitance somewhat smudged. Swing up chassis. Make sure plugs are in and system switch is in 625-line position.

Switch on. Nice noisy raster, lovely rushing noise on sound. Plug in aerial. Push in buttons. Nothing to speak of at all. Check that aerial is in u.h.f. socket, ignore the three buttons which give whistle (who wants 405?). Finally tune in terrible picture. Oh dear. Surely the smudgy disc capacitor couldn't do this?

Call Mr. Latterly who assures me that the picture was good before the smoke. Then he noticed what I was trying to tune in. It was a BBC-2 test card.

"We never get BBC-2."

Wearily I plugged the aerial into the v.h.f. socket and selected the other buttons for 405. Bright BBC-1, not bad ITV.

"That's more like it. Did you think we had a BBC-2 aerial?"

Intermittent Colour

Feeling a little tattered we moved on to the next casualty, which we confidently thought to be a 3000 chassis HMV. On turning it round and seeing the row of knobs on the left side realisation burst. It was a 2000 chassis, and since the complaint was no colour I was frightened. This was mainly because we don't meet many 2000 chassis, and those we do meet generally need only power components – zeners, wire wounds etc.

The lady of the house refreshed my memory of the complaint. No colour for some time and then it tries to come in and sometimes does, but never right away.

"Is there anything I can get you?" she asked solicitously.

"Do you think I could have a mirror and a hairdryer?" She looked at me and my hair. "It does look a little rough, but do you think this is the right time to do something about it?" she ventured.

I combed my hair viciously. "I need them for the set, not for me. The dryer to warm things up a bit and the mirror to see when the colour comes in."

She went out and I remembered that I had a dryer in the spares box in the van. This was just as well because when she came back she was wheeling an enormous hooded affair on a stand.

She did however have a suitable mirror, so with this propped up in the right position and my dryer blowing away like made we were ready to attack the enemy.

The decoder board is at the bottom centre and we carefully covered the suspect areas with hot heat. Chrominance amplifiers, colour killer and reference oscillator, nothing escaped our ruthless scorched earth policy. It didn't do much good though, except for occasional half-hearted bursts now and again.

I tried to be clinical, though this never really comes off. Remove panel in its entirity and examine closely. So we unplugged the plugs and removed the board. We looked and looked, checked here and there and finally pronounced our judgement: "buggered if I know."

So back went the panel, in went the plugs and on went the set. Glorious colour. Considering the age of the tube, it was well nigh perfect. A tweek up on the gray scale and nothing was left to be desired. "Aren't you clever," said Mrs. Post.

"I suppose I am really" I admitted.

"What was wrong then?"

"Er, there was apparently an intermittency in the chrominance interconnecting connections you see."

"You mean a poor connection."

"Yes, I suppose you could say that."

"And the hairdryer found it?"

"Er, no. It might have done but it didn't. Perhaps it will next time." So off we went again. So much for the 2000. Kids' stuff really. Sets like that don't frighten me.

Ah Doric, I Knew Him Well

Which left one. Ah Doric, I knew him well.

As a matter of fact it was the first time one of these sets had come my way. I'd no servicing information on it, which doesn't make a lot of difference because I have great difficulty in reading anything anyway. I always seem to try to do things first and then have a go at reading the instructions afterwards. The owner however had a complete manual, which was presented to him when he retired from his firm a couple of years ago – together with the set of course.

I was amazed to find the imposing looking set in front of the window, with the coaxial cable connected to a small set-top aerial which was perched in the centre of the carpet.

"Do you always have the aerial there?" I asked.

"Most of the time," he said. "Except when we want BBC-2 when we put it on top of the set."

The reception area wasn't all that good, and it seemed a clear cut case of spoiling the ship for a hap'th of tar. Our's is not to reason why however.

Apparently the picture would completely lose it's "body" after an unspecified period, becoming a sort of plastic near negative with only some colour noise in the background.

Without consulting the manual, this suggested an i.c. or transistor failure somewhere between the detector and the splitting point of the luminance and chrominance signals. Wherever that was.

So we consulted the manual and got involved with an "SF" panel which we eventually found wasn't there (only on cable receivers it said). We had another go and found the relevant panel for "aerial" receivers, ending up on the top of the decoder panel around some likely looking BC148s.

Since the picture was acceptable at that moment, the voltages tallied with those given in the manual. When the "plastic" condition occurred, the voltages on one went haywire.

Consulting the circuit again we found that this was d.c. coupled to the preceding one which was reading right. So the d.c. coupling wasn't.

In fact the coupling agent was the luminance delay line so we hadn't got our diagnosis right in the first place. The one thing we didn't have with us was a luminance delay line, but to prove the point we jumped a lead across the suspect one and the picture stayed on and the voltage remained right. We expected a degraded colour picture, but it was as good as it had ever been with the aerial in the centre of the carpet (what's a ghost or two when you already had three!)

We told Mr. Sparerib that we would be back with a delay line later, but that he wouldn't notice the difference until he had a better aerial.

So back to the workshop, to the turntables that won't turn, the auto-ejects that won't eject, the cartridge player that went bang and the telly's which won't tell.

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next month in

TELEVISION

ELIMINATING GHOSTS

One of the most trying reception problems is ghosting, the reception of reflected signals that don't coincide with the direct one. Apart from giving an unacceptable picture, ghosts play havoc with teletext signals. There are various ways of alleviating the problem, but a certain amount of experiment is usually necessary. The best solution is the use of adjustable stacked arrays. Bill Wright explains how to go about this.

• VERSATILE REMOTE CONTROL SYSTEM

Plessey's latest remote control system is claimed to be the most versatile yet, using two purposedesigned i.c.s. Pulse-position modulation is used to provide high rejection of spurious signals and thus error-free operation. The signals can be transmitted via either an ultraviolet or an infra-red link. The system can be adopted for other purposes as well.

• FAULTS ON THE 9000 CHASSIS

In 1975 Thorn once again startled the TV industry with the introduction of the 9000 colour chassis with its Syclops combined chopper regulator/line output stage. John Coombes provides a summary of faults and servicing hints based on three years' experience of the chassis.

• VARICAP TUNER CHANNEL DISPLAY

Alan Damper describes a novel circuit using LEDs to show which channel has been selected by a varicap tuner. An incidental advantage is that maximum brightness corresponds to correct tuning. The system is useful mainly as an aid to DX-TV reception. The prototype caters for twelve channels, but the number can be reduced or increased as required.

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Colour Receiver Project

Part 1

GREAT changes in TV receiver techniques have occurred over the past few years. It doesn't seem all that long since a large, clanking mechanical tuner fed a substantial, handwired chassis with an array of things that lit up. If the tube was a colour one it would have a large deflection yoke, another large assembly for radial convergence, and a number of other bits and pieces. There were masses of adjustments, and the least said about the power consumption the better. We've been going through a period of rapid change however. Everything from the tuner to the tube has undergone substantial development. Tiny tuners can be digitally controlled, the latest colour tubes have as little impedimenta as the monochrome tubes of a few years ago, and what lies between can be taken care of by a compact array of solid-circuit electronics.

It seemed time for a fresh look at a colour receiver project for the constructor. Since an up-to-the-minute colour receiver contains less than a monochrome set a decade ago, neither construction nor setting up should present much trouble, while a receiver that utilises as many of the latest techniques as possible provides a very useful lesson in the present state of the art. So here we go.

Design Philosophy

Perhaps the biggest problem we had was in deciding just where to call a halt and say the design must stand as we can do it at a particular point in time. Had we waited another year for example we could have used some of the more sophisticated i.c.s we know are in the pipeline. Although the overall rate of development is fast however, individual devices often take a considerable time to get from the development sample to the off-the-shelf stage. Setmakers are confronted with the same problem of course. The answer is to divide the chassis up into a group of modules which can be updated as developments reach the stage of full-scale production.

The overall emphasis has been to make the receiver as simple as possible consistent with high-quality reproduction. Commercial setmakers have the same basic aim. With production costs constantly rising, simplicity in design is essential in order to maintain competitive prices while at the same time making the profit necessary to remain in business. The only way in which this can be done is to minimise the amount of individual circuit alignment and testing required in the factory and to reduce the component count as far as possible. The ultimate result is increased efficiency all round. One great advantage that a project for • the individual constructor has over the production of a commercial receiver is that decisions on capital investment don't have to be made. Thus the design of the set can be altered without having to take into consideration the possibility that a lot of costly assembly equipment may have to be scrapped or altered. This doesn't mean we've been chopping and changing the set up till the last minute. Well, not quite. But what it does mean is that we've got some slight edge over commercial designs in terms of being able to adopt new techniques and devices.

The accompanying photographs show how little hardware is required in our design. No currently available commercial set uses so few components. The problem of engineering a project doesn't stop with getting hold of a handful of samples and finding out that good reproduction can be obtained however. In the interests of reliability, detailed component specification is necessary. It's also essential to ensure that at least one supplier is available for every component.

Warning!

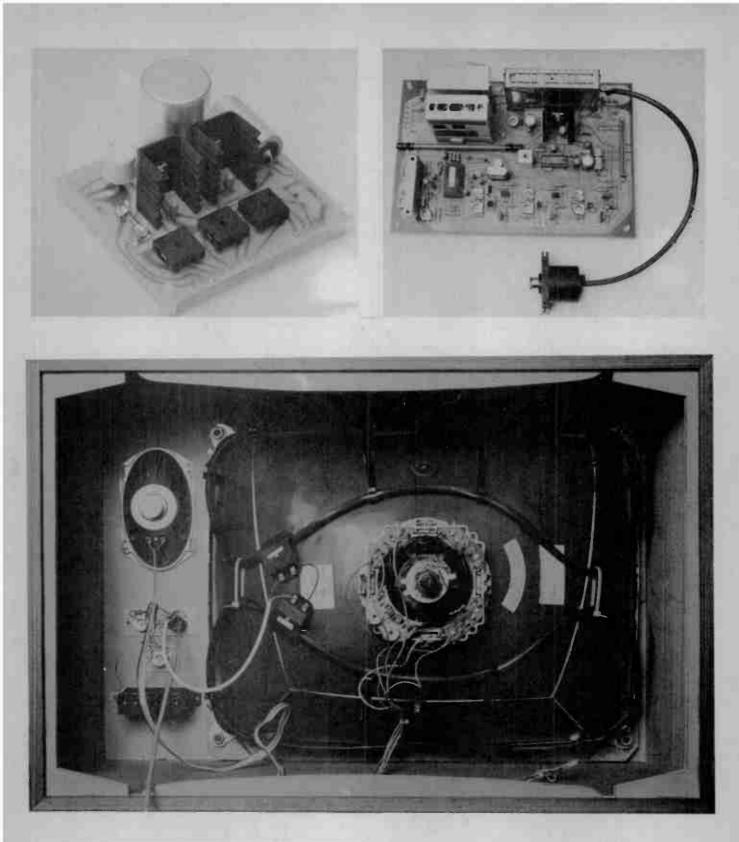
The use of printed circuit boards, which will be available to readers through Readers' PCB Services Ltd., and components as specified guarantees a project which the constructor with some experience and knowledge should be able to tackle with confidence. But though it may all look very simple, if you haven't had much experience and have little understanding of what the circuits are doing you'd probably do best to enlist the help of a friend who has. Very high voltages (an e.h.t. of around 25kV) and substantial currents are involved, with the result that mistakes can be expensive.

The Project in Outline

With the exception of a few components which for obvious reasons are attached to the cabinet all the components are arranged on four printed-circuit boards including the tube base panel. The first one, which we are describing in this first article, is the power supply board which feeds the receiver with all the supplies required. Subsequent articles will deal with the other boards in turn. and we suggest that constructors build each section up as it's published. In this way the total cost will be spread over several months. Having dealt with each board in turn, interconnection details, testing and setting up procedures and some hints on fault-finding will be given. There will then be a couple of important options: an ultrasonic remote control unit (the editor, who tends to keep away from constructional items because he has difficulty remembering which end of the soldering iron is which, has enjoyed playing with this), and a built-in teletext decoder unit.

Technical Features

We felt that mains isolation was a very desirable feature, not only from the point of view of safety, but because it allows the use of direct connections in and out of the receiver - to a high-fidelity audio system for example. So a mains isolating transformer was one of the starting points in the design.





Above: Rear view with all boards removed, showing the cabinet-mounted components (except for the mains transformer).

Top left: The power supply board (Molex connectors not fitted).

Top right: The signal board, which includes the decoder and RGB output stages and provides a mounting for the tuner and *i.f. modules*.

Left: Profile view of the timebase board.

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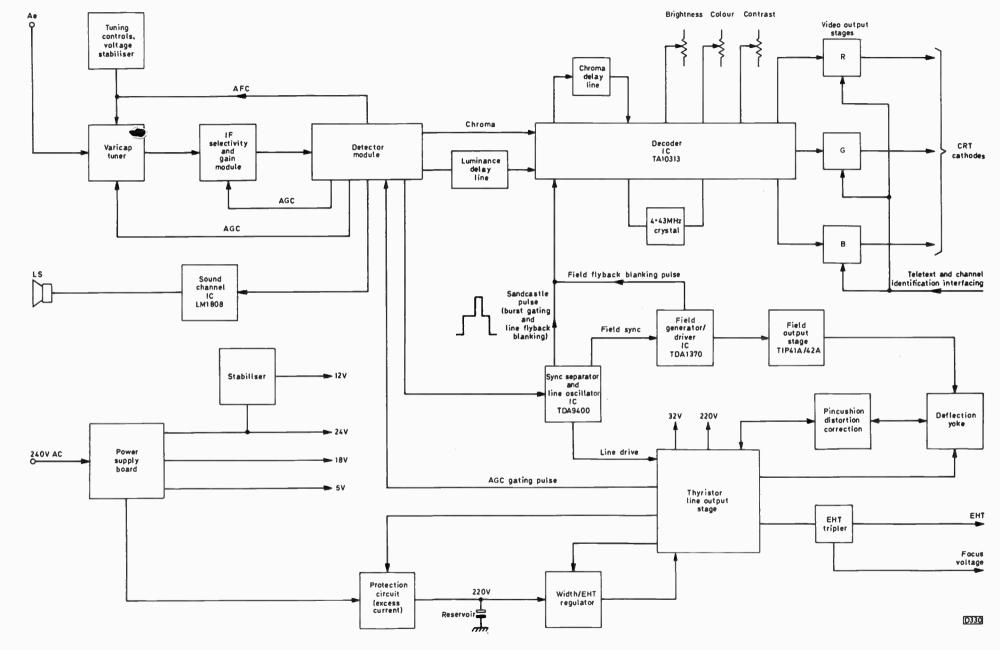
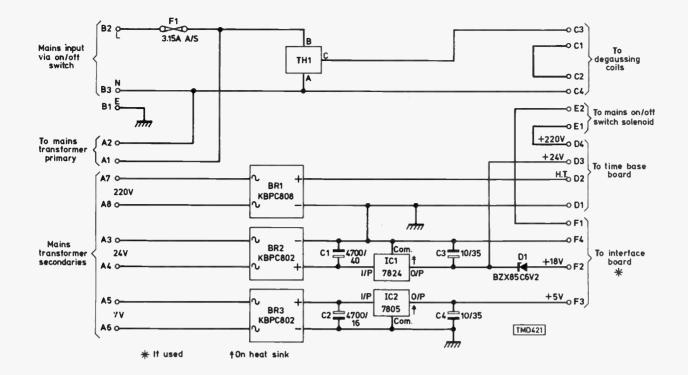
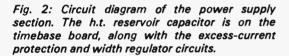


Fig. 1: Block diagram of the complete receiver.

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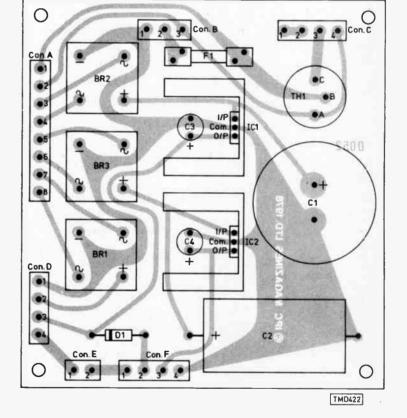
COST

At the time of going to press it has not been possible to cost the project, and it's likely to be a while before we can provide an estimate. This is simply because many of the components used in the prototypes have been manufacturers' samples, and it's not yet known at what prices suppliers will be able to offer them to individual customers. We will publish an estimated likely overall cost as soon as this is possible. Meanwhile, those interested should watch the advertisement pages over the next couple of months. Bear in mind that the aim of the exercise is not to undercut the cost of commercially produced sets, but to see how the latest technology can be exploited to provide a simple yet high-quality design suited to one-off construction.

Fig. 3: Power supply board component layout.



BR1	KBPC808 (or RS Components 262-084)
BR2, 3	KBPC802 (or RS Components 262-078)
TH1	2322-662-98009 (Mullard) or PT37P (ITT)
C1	4700µF 40V Siemens can B41070
C2	4700µF 16V Siemens tubular B41010
C3, 4	10µF 35V tantalum bead



D1 BZX85 C6V2 F1 3.15A anti-surge 20mm Misc. P.c.b. fuse clips; 0.2in. pitch p.c.b. connectors P.c.b. D052 from Readers' PCB Services Ltd. Mains transformer: Primary: 240V Secondaries: 220V, 1A 24V, 2A 7V, 2A The mains transformer will be available from regular advertisers in the magazine.

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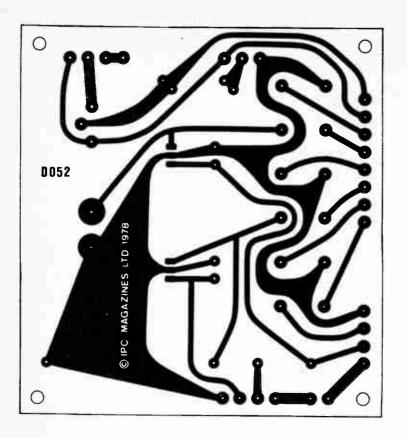


Fig. 4 (left): Power supply board print pattern. Scale 1:1.

Right: This month's board: the power supply unit.

Far right: View of the tube neck components, which are all preset and sealed.

Below: The c.r.t. base board. In view of the safety factors involved (high focus voltage, spark gaps etc.) this is a ready-made unit. Different connections will be used.

Apart from mains isolation, other major features of the design include:

- Use of the latest pin-diode varicap tuner.
- Prealigned i.f. modules.
- A single-chip colour decoder.
- Class AB RGB output stages.
- A single-chip sound channel.
- A thyristor line output stage.

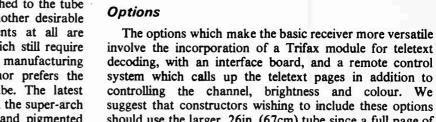
• Single-chip field oscillator/driver with a pair of discrete output transistors.

• Use of one of the latest sync separator/line oscillator i.c.s.

• A 110° RCA self-converging, precision-in-line (PIL) tube with integral, toroidally wound scanning yoke.

Choice of CRT

The use of the RCA PIL tube was fundamental to the whole concept of the set. The reasons for choosing it instead of one of the other in-line gun tubes currently available are worth mentioning therefore. First, it was felt that the RCA tube is particularly easy for the constructor to use, since the neck components are all permanently attached to the tube and thus don't require any setting up. Another desirable feature is that no convergence adjustments at all are required, unlike some in-line gun tubes which still require some adjustments, though very few, to take manufacturing tolerances into account. Finally, the author prefers the overall focus performance of the PIL tube. The latest generation of these tubes is being used, with the super-arch mask and with higher transmission glass and pigmented phosphors to provide increased brightness and a greater contrast ratio. Pricewise there's little difference between the tubes available. RCA have appointed Solus (Electronics) Ltd. of Kirkwood Road, Cambridge CB4 2PF as agents for

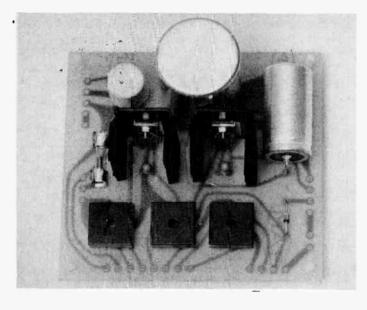


involve the incorporation of a Trifax module for teletext decoding, with an interface board, and a remote control system which calls up the teletext pages in addition to controlling the channel, brightness and colour. We suggest that constructors wishing to include these options should use the larger, 26in. (67cm) tube since a full page of teletext is rather tiring to read on the smaller size screen. The alternative is to use a 22in. (56cm) tube. This is a matter of preference of course and the decision is left entirely to the individual constructor. The only components

the supply of these tubes in the UK. The tubes can be

obtained by individual readers directly from Solus.

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which change (apart from the cabinet of course) are the degaussing coils and retaining clips.

Block Diagram

Fig. 1 shows the basic receiver in block diagram form. The receiver section is straightforward and conventional, though extremely compact due to the use of two preassembled i.f. modules and the single RCA TA10313 i.c. for colour decoding. This i.c. provides R, G and B outputs to drive the class AB output stages. Amongst the advantages of class AB circuits are the reduced dissipation, absence of a high-dissipation load resistor, low output impedance and tolerance to supply voltage variations. An LM1808 i.c. takes care of the intercarrier sound amplification and demodulation, and provides a 2W audio output.

Thyristor Line Output Stage

The main feature that might cause some surprise is the use of a thyristor line output stage, since this is inherently more complex than a transistor line output stage. The latter would involve a fairly complex h.t. regulator circuit however, while a very simple width/e.h.t. regulator system can be used with a thyristor line output stage. Overall therefore, taking both the power supply and line output stage into consideration, the use of a thyristor line output stage is the simpler solution. It's also ideal for driving the PIL tube with its low-impedance, toroidally-wound deflection coils.

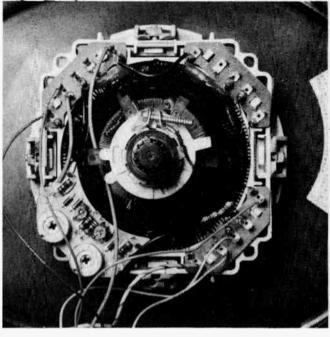
The Power Supply

The power supply circuit is shown in Fig. 2. It's very simple since the regulator and excess current protection circuits form part of the timebase module, while the 220V supply required for the RGB output stages and the 32V supply required for the field timebase are derived from the line output transformer.

The mains transformer has three independent secondary windings each feeding a bridge rectifier. Knowing the problems that bridge rectifiers cause in commercial receivers, we decided to use some fairly beefy ones. These are rated at 6A continuously and can withstand very high peak currents.

The h.t. reservoir capacitor is on the timebase board,

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with the associated protection and regulation circuits, and these will be described when we come to deal with this board.

The main l.t. supply is stabilised by a 24V regulator. The use of a zener diode in series with the 24V rail provides the 18V supply required by the remote control receiver circuitry.

The third secondary provides, after rectification and regulation, the 5V rail required by the Tifax module and some of the interfacing circuitry.

The basic remote control system enables the set to be switched off but not on. To obtain the latter function, a special switch incorporating a solenoid is required. The power supply board contains some link connections to enable this to be added.

If teletext and remote control are not required, D1, BR3, C2, IC2 and C4 will not be needed and can be left off the board. They can obviously be added at a later date if you decide to add the options.

Degaussing Circuit

A double positive-temperature-coefficient (PTC) thermistor controls the degaussing action. This device is produced by both Mullard and ITT and results in the simplest possible degaussing circuit, dispensing as it does with the usual resistor.

Non-isolated Chassis

Some constructors may wish to dispense with the mains transformer, operating the set without mains isolation. This is perfectly feasible, though we don't recommend it. If this course of action is adopted, it's essential that the mains earth connection is not used and that the c.r.t. clamp band is connected to chassis via an RC network. We'll describe this when we come to deal with the tube. With a non-isolated set a 24V, 2A mains transformer will be required, while if teletext and remote control are added a 5V supply will also be necessary. These supplies can be obtained either from separate transformers or a combined transformer. In either case it's essential that the transformer(s) are adequately rated.

CONTINUED NEXT MONTH

Faults Encountered...

Dewi James

I think the main reason I enjoy TV servicing so much is the variety of sets that come in for repair. That's perhaps one of the advantages of working for an independent dealer.

Hitachi CSP680

Take the Hitachi CSP680 colour set that came in the other day. The initial fault displayed was no sound or raster, though the line timebase whistle was present and the e.h.t. sigh could be heard. Then after about thirty seconds a blueish horizontal line appeared on the screen, indicating that the field timebase was inoperative. The regulated 120V h.t. line measured high at 145V. The real problem however was no 12V l.t. supply. This is obtained from a rectifier (CR25) which is fed from a tap on the line output transformer. Absence of this supply is often due to a shortcircuit in the tuner unit, but there was no short-circuit this time. The rectifier itself proved to be all right, and there was a line-frequency waveform at its anode - we realised later that its amplitude was very low. The fault was eventually traced to an open-circuit connector in the lead from CR25 to the line output transformer - an open-circuit in the d.c. sense, as there was sufficient capacitive coupling within the connector for the line-frequency waveform to appear at CR25's anode.

The moral I suppose is that I should read my instruments from time to time instead of using them merely as indicators. The fact that there was a waveform at the correct frequency at the diode's anode was no reason to assume that there should be a d.c. output.

Sony KV1810UB

Another recent encounter was with an 18in. Sony colour set - a KV1810UB. It came in completely dead, with the 2.5A mains fuse F601 blown. It was simple enough to ascertain that the chopper and line output devices were both short-circuit. These are gate-controlled switches, type SG613, a sort of cross between a transistor and a thyristor. Replacing them and fitting a new fuse restored the set to normal operation, but back it came two days later with the same fault. Another two days passed and back it came again (remember the story "half way down I met the bricks half way up?"). As the trouble seemed to be intermittent we decided to see what advice Sony could give. Replace C624 (47 μ F 25V) which decouples the 19V rail on the power regulator board and the flyback tuning capacitor C542 (1,800pF, 1.5kV) on the timebase (VH) board they said. This advice proved correct.

Sony suggest the following quick checks on this set where the problem is no sound or raster:

(1) Check F601, the chopper SGS Q603 and the line output SGS Q510.

(2) Measure the resistance between the 130V stabilised rail and chassis both ways. The reading should be 500Ω one way (positive to pin 19 of the power regulator board,

negative to chassis) and $6k\Omega$ the other way (negative to pin 19, positive to chassis). If low suspect the field output transistors Q503/4 or the sound output transistor Q901.

(3) Measure the resistance between the 19V rail and chassis both ways. The reading should be 350Ω with positive to pin 17 of the power regulator board and negative to chassis, and 500Ω the other way round. If low, suspect the line driver transistor Q509 or the chopper SGS driver transistor Q604.

Since the power supply operates as a closed-loop system, depending for its operation on pulses obtained from the line oscillator, it may be necessary when fault finding to connect an external 19V supply to the l.t. rail. Connect between pins 15/16 (chassis) and pin 17 of the power supply board, with a silicon diode in series with the positive side to provide protection against voltage surges.

Wouldn't it be nice if all switch-mode power supply faults involved smoke and burnt bits? For an account of the operation of the KV1810UB's switch-mode power supply see the July 1977 issue of *Television*.

Kuba Florence

A Kuba Florence 26in. colour set appeared on the bench the other day with the fault very little brightness. It didn't take long to discover that the trouble was lack of c.r.t. first anode voltage. Now the c.r.t. first anode supply is rather unusual, though those familiar with the Philips G6 chassis will recognise the idea (see Fig. 1). The first anode preset controls are connected between a 410V supply derived from the boost rail and a "floating" supply which is obtained by rectifying $\pm 350V$ line flyback pulses. The pulses are fed via C584 and C585 to diode D580 for rectification, and the trouble was that C585 (0.0047 μ F, 1.25kV working) was short-circuit.

Another of these sets displayed a picture whose bottom half was completely missing. The voltages in the field output stage were completely wrong. A glance at the circuit diagram revealed that the field output stage is connected between +25V and -27V supplies: the latter was missing. So the fault was in the power supply, where the shunt regulator transistor TR602 (TIP31) was found to be defective, a replacement restoring normal scan. Shades of the Pye hybrid colour chassis.

A fault we get from time to time on these sets is brightness troubles due to the beam limiter diode D104. The latter is connected between the BD115 luminance output transistor and the cathodes of the c.r.t. It operates in the same way as in several monochrome sets such as the Pye

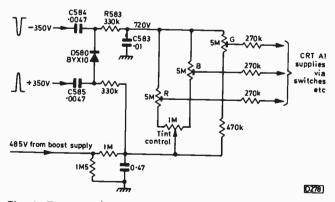


Fig. 1: The c.r.t. first anode supply circuit used in the Kuba Florence. When D580 conducts, the right-hand plate of C584 is charged positively. R583 and C583 provide smoothing. C584 and C585 are rated at 1.25kV.

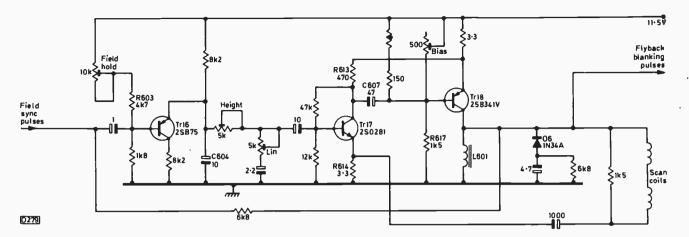


Fig. 2: Field timebase circuit used in early Hitachi monochrome portables. D6 and the associated components limit the field flyback pulse amplitude. Oscillation is sustained by feedback from the output transistor Tr18 to the base of the oscillator transistor Tr16.

169 (see page 540, August issue, for a description of the principle).

ITT Hybrid Colour Chassis

Our main UK line is the ITT range. I recently had a set fitted with the CVC9 chassis giving fairly loud bangs and buzzes from the loudspeaker. To realise that the fault was due to a break in the printed circuit board didn't take long, to find it did! The grid of the audio amplifier triode is returned to chassis via D57 which is on the line output board. It's part of the sound muting during warm-up circuit. The open-circuit was between D57's cathode and chassis.

On a set fitted with the CVC8 chassis the fault was described as "poor frame". On examination this turned out to be something of an understatement. The lower two thirds of the picture were relatively normal: the top third was expanded, with the scanning lines criss-crossing like an expandable wooden fence. It occurred to me that the trouble might be due to an interaction between the line and field circuits, the most likely culprit being the raster correction transductor. This proved to be the case, a replacement restoring normal scan.

ITT CVC20 Chassis

We had one of the newer CVC20 chassis in the other day with the fault no raster. The fusible resistor R100 which damps the line linearity coil had sprung open, though the coil itself was not open-circuit. Instead, there was a hairline fracture in the print leading to the coil. Similar symptoms occur if the EW modulation transformer is leaky (one winding is connected in series with the line scan coils).

If you have the vaguest suspicion that someone has been tampering with one of these sets, check the 125V line. If the voltage is too high, the e.h.t. can flash over dramatically.

Also on this chassis, watch out for field foldover at the bottom of the screen due to C27 (1,000 μ F), the bootstrap capacitor in the field output stage.

The later versions of this chassis (CVC20/2, CVC30 etc.) are proving to be much more reliable. We had a dead CVC20/2 in the other day however, with no l.e.d.s alight and the 2A fuse F3 open-circuit and completely blackened. It didn't take long to discover that the BU126 chopper transistor was short-circuit. This sometimes happens spontaneously, but on earlier versions it can be due to R80 (150k Ω 1W close tolerance) which biases the base of the chopper driver transistor, especially if it's light brown in colour. Later sets have a resistor that's more red in

appearance. These checks proved o.k. however, but on fitting a new BU126 and switching on the only l.e.d. to light up was LED6, proving that the -320V supply was present. The fault was due to the 125V supply rectfier D18, a replacement restoring normal operation.

Problems with Portables

With the summer months we get a lot more portables coming in. Take the Hitachi P32 we came across the other day (in fact it came off a mussel boat) with sound o.k. but no raster. Waveform 10 at the base of the line driver transistor was as shown in the manual, but there was nothing at the collector. A replacement transistor (TR 702, 2SA673) restored normal operation. We've had a little trouble on this model with the line driver transformer T702 going open-circuit, and also on occasion C742 $(0.01\mu F)$ going short-circuit – this short-circuits the base of the line output transistor to chassis.

A similar chassis is used in the Hitachi TW12L, TWU67 and TU75 series. We've had the following faults on these sets. First the electrolytic C502 $(1\mu F)$ which feeds the base of the sync separator transistor going open-circuit to cause no sync or short-circuit to give no vision or sound. Another cause of no sync has been the sync pulse amplifier/phase splitter transistor TR15's collector load resistor R511 (470 Ω) going open-circuit. In the field timebase we've had the coupling electrolytic C607 (47 μ F) between the field driver and output transistors going short-circuit to remove the bottom half of the picture, and R617 (1.5k Ω) from the base of the field output transistor to chassis going opencircuit to remove the top half of the picture. Little vertical scan, with just a folded picture across the centre of the screen, can be due to either the field charging capacitor C604 (10 μ F) or R603 (4.7k Ω) from the slider of the field hold control to the base of the field oscillator transistor TR 16 going open-circuit. We've traced no field scan at all to the driver transistor's collector and emitter resistors R613 (470 Ω) and R614 (3.3 Ω) respectively going open-circuit – apart from more obvious things like the oscillator transistor etc. The rather unusual field timebase circuit is shown in Fig. 2. In fairness I must point out that these faults have been collected over a period of several years.

We had a Toshiba portable Model B1201 in recently with the symptoms field roll plus very bad field linearity – severe cramping at the top and elongation at the bottom of the raster. The trouble turned out to be due to the field charging capacitor C308 (22μ F, 16V) being open-circuit.

- continued on page 657

Video Notebook

D. K. Matthewson, B.Sc., Ph.D.

Obtaining Preview on the N1502

One of the more popular modifications to the Philips' N1500/1501 series of VCRs was one which enabled a picture to be displayed in the fast forward/rewind positions (see May 1977 *Television*, page 382) so that the operator could get an idea of the whereabouts on the tape of different scenes. The modular construction of the N1502 is rather different from the open p.c.b. layout of its predecessor however, and to obtain the same preview effect a different approach is required. Examining the service manual is not very rewarding, as all the functional units are shown as "black boxes", with none of the internal circuitry shown. The only circuits shown in detail are the standard boards such as the power supply etc.

After some head scratching it was discovered that the stop-motion button could be pressed into service to give the desired effect. This entails linking pins 1 and 2 on SK8. After this has been done, depressing the stop-motion button will result in the VCR displaying the off tape signal: the incoming audio signal is also suppressed.

Improved Auto Stop: N1700

Here's an official modification to the N1700 to improve the operation of the automatic stop. Remove R123 from panel 11 (circuit C in the manual), reduce the value of R135 from 220k Ω to 100k Ω , and add a BAW62 diode in series with a 220k Ω resistor between the junction of R124/C116 and the +11 (40V) supply. The latter assembly should be mounted in an insulating sleeve on the print side of the panel, with the resistor connected between the output from bridge rectifier D103 and the anode of the diode, and the diode's cathode connected to the junction of R124/C116.

Grundig Super Video System

I was interested to see the new Grundig four-hour VCR at the 1978 Audio-Visual exhibition. The new format used is called Super Video (SV), the special cassettes having metal guide rollers and cut-out lugs to tell the VCR that the tape is of the SV type. Novel features of the SV4004 VCR are a ten-day digital clock and a control which alters the crispness of the displayed picture.

G8 Chassis VCR Modification

A Philips colour set fitted with the G8 chassis had been in use as a VCR monitor for a considerable while without any problems occurring, but it was noticed that when the VCR was switched to the still frame position all the colours were washed out with green. In the play position everything was normal, but those green faces on still frame.... Though not important for everyday use, we decided to delve into the G8. After some thought we decided that the problem was due to the signal phase relationships being distorted in the still mode. The following modification solved the problem, giving us nice pink frozen faces. R7190 in the feed from the ident stage to the TBA520Q i.c. was increased in value to $5.6k\Omega$ (from $2.7k\Omega$), and a $5.6k\Omega$ resistor was added between the junction of R7190 and the capacitor (C7206) in series with it and chassis. The ident coil L7205 was then adjusted for optimum effect.

Philips VCRs: Models and Derivatives

I've received several requests for details on the similarities and differences between the various VCRs that have been produced using the Philips' standards. It seems an appropriate time to clarify the position.

The basic specification of the original Philips system (CCIR-PAL) was as follows:

Tape speed: 14.29cm/sec.

Tape width: 12.5mm.

Video bandwidth: 3MHz colour, 3.2MHz monochrome, -26dB.

Video signal-to-noise ratio: 40dB.

Audio bandwidth: 80Hz-12.5kHz ±4dB.

Audio signal-to-noise ratio: 40dB.

Colour system: Heterodyned.

N1500: This was the designation of the first Philips machine designed to the above specification. It first appeared in the UK in 1973. Suffixes indicate which national TV system the machine is designed for, and this arrangement has been continued with all following VCRs. The suffixes are as follows:

- /00 47-88, 174-230 and 470-870MHz, PAL B and G, Europe (not OIRT).
- /15 47-88, 174-230, 470-870MHz, PAL I, UK.
- /29 470-870MHz, SECAM L, France.
- /43 174-254, 470-862MHz, PAL I, S. Africa.
- /45 v.h.f. and u.h.f., PAL B and G.
- /65 As/15 but 220V instead of 240V.

In addition to the u.h.f. input and output sockets the machine had two DIN sockets, one for audio input/output and the other for supplying separate chrominance, luminance and a 12V d.c. output to connect to certain television sets.

The N1500 was the original off-air, aerial input machine, incorporating a cooker type mechanical time switch. There were several variants, including the following two, most being designed for video inputs/outputs as well as u.h.f. inputs/outputs.

N1500M: An official variant designed to operate with video as well as u.h.f. signals. Depressing channel selector number six changed from off-air to video input. There were separate, buffered sound and vision outputs.

Various dealers and individuals carried out their own modifications to provide similar features, especially as the N1500M was often in short supply. Many of these modifications can cope with only monochrome video input, though a colour video output would be provided from a colour tape. The reason for this is related to the manner in which Philips process the chrominance and luminance signals separately, necessitating a complex arrangement of chokes and inductors.

N1500CM: A version of the N1500M, produced in small numbers, intended as a master machine for use in copying suites.

European equivalents: Various other European firms produced machines to the original Philips standard, including Telefunken and Skantic. The Skantic 5631 was imported in small quantities when other machines were in

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short supply. The Telefunken and Skantic VCRs had identical chassis to the N1500.

The Grundig BK 2000 and BK 2500 were imported for a time and were rather more sophisticated than the basic N1500. The de-luxe BK 2500 had video input/output facilities. Both sound tracks were used in the two machines, which had mechanical digital clocks of the falling letter-type.

Radio Rentals 8200 and 8201: These machines are based on the N1500 and were produced in quite large numbers. They were intended mainly for schools' use in conjunction with a suitable RR (Thorn) colour receiver such as the 22in. Model 1714. They differ from the N1500 in having a camera input socket but no off-air tuner unit or timer. There are DIN and multipole connectors for the video signals and separate audio input/output sockets. The multipole video connector was intended to couple the VCR to a suitable TV set, carrying the audio signal as well. The differences between the two machines are small but significant. The original 8200 was designed to give and receive video signals with separate chrominance and luminance components. The 8201 operates with a conventional composite 1V peak-topeak signal. An adaptor was produced to enable the 8200 to be used with a composite signal. Inside, the 8201 is almost pure N1500, though Thorn use paxolin instead of fibreglass PCBs.

To make these VCRs more versatile, Thorn produced an off-air tuner-timer unit which fits on top of the VCR and is connected via a multiway plug. The timer can be battery operated to provide a back-up against mains failure.

N1501: The second Philips VCR was essentially a reboxed and slightly modified version of the N1500. Modifications include the provision of a stop-motion facility, tracking meter indication on playback, and some other minor alterations. Most spares are common to the N1500.

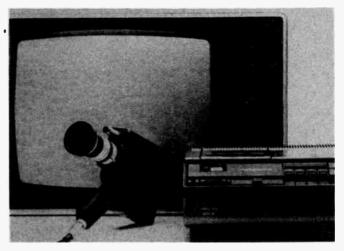
N1501M: The video input/output version of the N1501, similar in many ways to the N1500M.

LDL6269/01: Very similar to the N1501M, with in addition a video crispener circuit. Supplied by Pye Business Communications. Uses a Philips designed colour capable circuit, though of different design to the Austrian produced Philips machines.

N1460: A playback only machine produced by Philips for about six months. Ideal for use in libraries, lecture rooms etc. Many of the boards and mechanical parts are common with the N1501. The standard version had output at u.h.f., though again several dealers modified the machines to give separate sound and video outputs. An interesting feature is the P65 panel which suppresses the white flyback dots sometimes apparent during playback of recordings on some sets (see *Television* May 1977).

N1520: One of two electronic editing VCRs produced by Philips, mechanically very similar to the original N1500. Much of the electronics differ since they have to cope with the pulse counting and servo adjustment for editing. No off-air tuner or timer is provided, but there are video input/output and u.h.f. output facilities. The sound can be fed in or extracted as either a 600Ω balanced line or a high-impedance signal.

There were several official modifications, some quite major. The audio record and playback track selector PCB was replaced for example, to enable one track to be monitored whilst dubbing new sound on to the other: the



The Philips V100/15 monochrome camera.

two PCBs are quite dissimilar! The N1520 is the only VCR in the Philips range to make use of both sound tracks. In view of the complexities of this machine, the cost of the manual and its supplement is well worthwhile.

N1502: Built to the original specification but very different from the N1500 derived machines, both in style and design. Incorporates an off-air tuner, timer, etc. Most of the electronics are contained in modules which plug into a mother board. This main PCB is linked to the other bits of the VCR by means of plugs and sockets. This makes maintenance on a module swapping basis very easy, but even the Philips manual gives no clues about the innards of the modules, which are supposed to be returned to Philips for servicing. This means that true fault-finding is not at all easy. The main PCB remains of discrete component design, as are the three-day digital timer and a few other small PCBs. The standard version has u.h.f. input/output and audio input/output sockets.

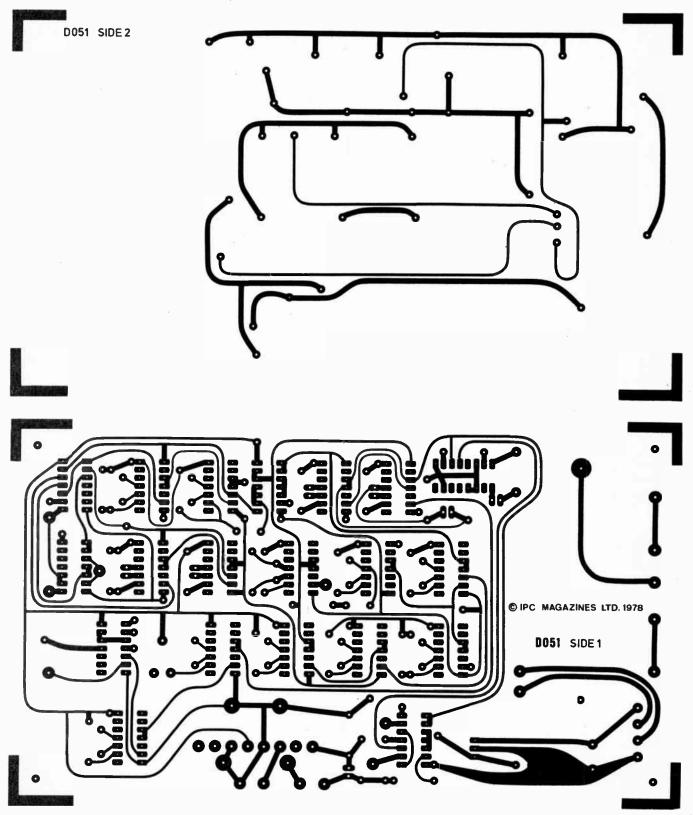
N1512: A video input/output version of the N1502. The difference consists of one plug-in PCB which copes with all the input/output functions. The additional PCB should be available for around £25 for those who want to modify an N1502, but at the time of writing there are no spare boards in the UK. Selection of video input is by selector number eight.

N1700: The latest Philips offering, using the LP (long play) format which gives up to two and a half hours' playing time. Similar externally to the N1502, but quite different internally. Instead of TTL i.c.s, the logic circuits employ CMOS technology. This helps keep the current consumption down. The VCR is an improvement on the N1502 mechanically, the new motors giving a very rapid rewind and wind time. There's no commercial video input/output version, Philips' policy being to keep the N1700 as a domestic only use machine. A perusal of the manual however indicates that video output and monochrome input could be arranged on similar lines to the N1500. For further details, see *Television* April 1978.

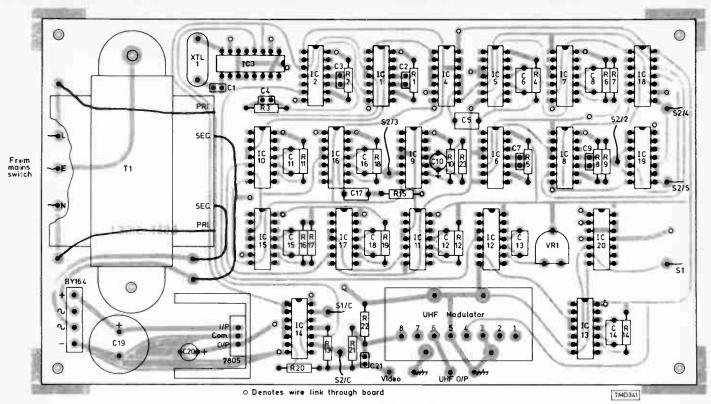
LDL1100: A very sophisticated battery-operated portable VCR available from-Philips and Grundig. Designed to the original Philips format but intended for high-quality ENG work. Includes full electronic editing, with an auto-edit facility to ensure clean transitions between camera shots. Other features include an electronic tape timer, solenoidoperated tape transport, remote control, etc. Originally intended for operation with the Hitachi/Philips colour camera, but can also be used with the Grundig ENG camera.

Grundig: Grundig have had a stake in the VCR market for some time, with a large range of machines. Some are similar to the Philips designs but some are unique. The BK3000 and VCR3000 are broadly similar to the N1502 and N1512: the BK4000 and VCR4000 are similar to the N1700 and a video input/output adapted N1700 respectively. The recently announced SVR4004 provides four hours' playing time. The dual-standard VCR5000AV can record and play back both N1500 and N1700 type tapes: playback selection is automatic. See also the earlier comments on the BK2000 and BK2500.

DIAGNOSTIC PATTERN GENERATOR PCB DETAILS



Top and underside print patterns. The actual board size is $8 \times 4\frac{1}{2}$ in.



Diagnostic pattern generator PCB component layout.

Project

Ultrasonic Remote Control

IC Sound Circuits for the Constructor

Issue

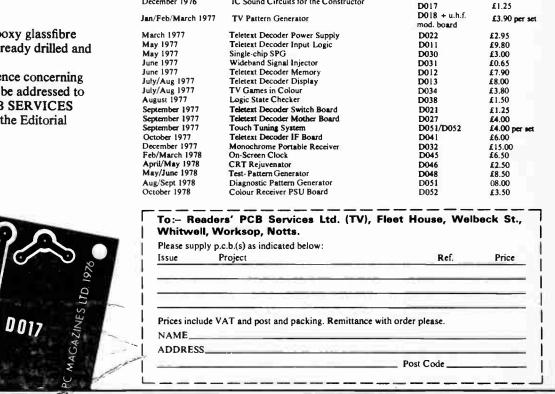
November 1976

December 1976



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D007/D008

Price

£1.25

£2.95 per set

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Notes on the Sanyo CTP370

THE phone rang one morning. "Do you mend Japanese TVs?" enquired a voice. "What make?" I asked. "A Sanyo" the voice replied. Relief spread through my mind that it was not a similar sounding Japanese make with four letters. Little did I know what was in store however...

Initial Complaint

The set concerned turned out to be a CTP370, which is somewhat unusual in being of hybrid design, with valves in the timebases, audio and video sections and transistors elsewhere. The valves are all familiar types except for the e.h.t. rectifier which is an oriental 3BS2A. The complaint was no sound or picture, and there was an upper expenditure limit as the owner had just bought another set. On removing the back I discovered that the e.h.t. rectifier had been removed by the previous "repairer". This looked ominous to say the least, so I thought it prudent to take the set back to the workshop.

On switching the set on the valve heaters lit up and h.t. was present but there was no l.t. The c.r.t. didn't light up – its heater supply is derived from a secondary winding on the mains autotransformer. This transformer (see Fig. 1) also supplies 120V to the degaussing circuit, with the l.t. supplies being derived from a 71V tap. The h.t. and valve heater supplies are derived from the mains directly – doubtless in countries with 120V mains supplies the transformer is used to step up the voltage for these supplies.

Defective Mains Transformer

To cut the story short, I found that the chassis end of the transformer had been disconnected. Connecting it blew the cutout (no fuses at all in this set!). The last person who had found the transformer defective had left the l.t. rail connected, so that nearly the full mains voltage was applied to the l.t. supply. After removing the chassis to gain access to the power supply components, which are mostly handwired on tagstrips on the rear metalwork, I found that the l.t. smoothing resistors had gone open-circuit while the capacitors looked a bit sick. Hooking in a substitute transformer and new resistors and capacitors brought some sound — less picture of course since there was no e.h.t. rectifier.

In view of the expenditure limit I decided to consult the owner – and ended up buying the set for a small sum. Had I known what was to come I'd have asked to be paid to take the set away!

AGC and EHT Variations

Not being very fond of valve e.h.t. rectifiers I decided to instal a Thorn e.h.t. stick rectifier of the type used in the 8000 chassis. The screen then lit up, but I found that the set would overload on even the weakest of signals regardless of the setting of the a.g.c. control on the rear panel, where a multitude of presets live. Prodding this panel would produce

Hugh Cocks and David Martin

proper a.g.c. action – and wild e.h.t. variations. Access to the print side of the panel is poor to say the least, and becoming exasperated with the set when the e.h.t. stick finally succumbed to panel prodding I passed it to David Martin who felt brave and wanted a cheap colour set. In between prodding the rear panel I'd replaced the "burst amplifier-2" transistor Q405 (2SC65Y) in the non-PAL decoder, because of unlocked colour picture V components (there are separate V and U reference oscillators). A BF178 gives a good account of itself in this position. Miraculously this was the only casualty when the l.t. line had experienced the onslaught.

Boost Circuit Short

Before handing over to David Martin to continue the story, some notes on another CTP370 that came my way while preparing the original draft of this article. On switching on, the PY500A boost diode glowed fiercely accompanied by violent arcing on the deflection board which carries the PCL805 field timebase valve, the ECC82 hine oscillator/a.f.c. valve and the PCL86 audio valve. The feed from the boost rail to the triode section of the PCL805 comes via the height control VR710 (see Fig. 2) which is mounted on the rear panel: it's then taken via a long length of wire to a large $1M\Omega$ resistor (R322) just below the PCL805. This resistor is very close to the earthing print, and a conductive path had formed between the supply end of the resistor and the earthing print. This short-circuit had lowered the value of R706 (100k Ω) in series with and adjacent to the height control to a few ohms, while R910 near the PY500A had also fallen in value, thus presenting a low-impedance path from the boost rail to chassis.

As the print on the deflection panel at the point of arcing was beyond repair I made a wire junction between C320 and R322 above the board. If R706 is left in position with reduced value incidentally the result is full scan with very weak field sync and field frequency variations with brightness. The height control VR710 appeared to have survived due to having been set at minimum resistance: had it been set midway, doubtless it too would have needed changing.

This set gave me an opportunity to inspect the official e.h.t. rectifier. Suffice it to say that the noise coming out of the X-ray can is reminiscent of dual-standard sets - i.e. arcing and corona discharge. Thank heavens there's no PD500 lurking in the can. Now over to David who takes up the story of the original set.

More EHT Problems

After taking the set over from Hugh I installed two 20kV rectifier sticks in series and set about mending the earthing crack on the rear panel. By this time the line output transformer voiced its disapproval and gave the job up. A new transformer was fitted – and a nasty 33kV was obtained. I switched off quickly and completed repair of the crack – towards the bottom of the board, on the left-hand side looking from the rear. On switching on again there was

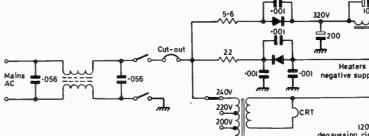


Fig. 1: The basic power supply circuit. The negative supplies consist of a -10V rail and other feeds to the colour-killer and brightness controls. The latter acts on the luminance output pentode's control grid.

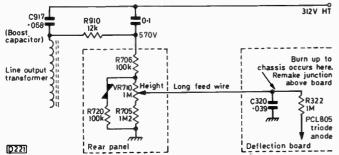


Fig. 2: Simplified circuit showing where the burn-up which shorts the boost rail occurs.

good a.g.c. action and "nice" e.h.t. O.K. so far then.

Width Circuit Fault

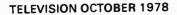
D702 in the width/e.h.t. stabilisation circuit (see Fig. 3) was then found to be short-circuit and was replaced with a BY127. I shudder to think of the X-rays that would have been present with the original e.h.t. rectifier fitted. Moral: when servicing one of these sets, check the e.h.t. and buy a Geiger counter... The e.h.t. rectifier sticks were not very satisfactory, so we fitted another Thorn 8000 rectifier stick which has worked well for several months.

Faulty Presets

I found that the presets on the rear panel were prone to poor wiper contact – many of the gremlins in this set live on this panel. I haven't yet encountered the a.g.c. problem mentioned by Peter Murchison in the August 1977 issue (overloading due to R157 or R158 in the a.g.c. circuit being defective), but C914 (47pF) which feeds the gating pulses from the line output transformer to the anode of the PCL84 (triode section) a.g.c. gate gave problems, resulting in intermittent overloading.

Valve Consumption

After dealing with these various faults and setting up the receiver a good picture was obtained. I've had a lot of valve problems however - doubtless due to the high working temperature inside the small cabinet. Amongst the problems have been brightness drift due to the two PCL84 video amplifiers, horrible colours due to the ECC82 colour-difference output valves, and the usual PCL805 problems. The PCL86 audio valve hasn't given any trouble however. The



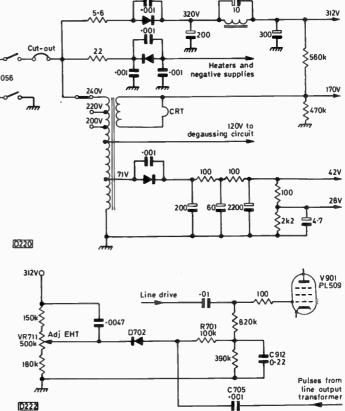


Fig. 3: The width/e.h.t. stabilising circuit. A diode (D702) is used instead of the more common v.d.r. D702 is normally cut off by the positive bias applied to its cathode from the preset VR711. A positive-going line flyback pulse switches it on at the end of each line however. When D702 switches off, a negative charge proportional to the flyback pulse amplitude is left on C705. This is filtered by R701/C912 and is used to bias the control grid of the PL509 line output valve. The same basic system is used for feedback clamp circuits in a.c. coupled RGB channels. VR711 adjusts the point at which D702 conducts during the flyback pulse and thus the e.h.t. obtained from the line output stage.

latest problem is almost continuous demise of the PCL84 (triode section) sync separator. Roughly once a week sync is more or less lost and a replacement valve provides a cure. All the voltages are correct, so for the moment we're putting it down to a dud batch of valves.

Conclusions

The transistor side of the set has for the most part proved reliable. This is just as well, since access to some of the transistors is quite difficult. The chassis is quite easy to remove from the cabinet, and this is often necesssary when a component needs to be replaced. Be careful not to foul the convergence board on the tube neck when withdrawing the chassis.

When working, the set gives a good picture. I've had it in full domestic use for several months, and the set is also a good one for DX use due to the rotary u.h.f. tuner and the colour-killer threshold control on the rear panel. The latter enables weak colour signals to be resolved. The unusual decoder gives quite good colour - if setting up is necessary, the full manual should be obtained. Many people believe that the model is quite old, but this one is stamped September 1974.

One hopes that no other reader will encounter all these faults on one set. The mind boggles at the repair bills had Hugh's original customer decided to keep the set going!

Letters

COMMON FAULTS

Following the article on the Thorn 1590/1/3 series of portables (August issue) I thought you might like to include a note on the following common fault in the line output stage. The reported fault is lack of line scan, which I've normally traced to dry-joints on the line output transformer and flyback tuning capacitor C109. On some sets however a burn mark will be seen around the circumference of the winding when the transformer is examined, and in this case it's necessary to replace the transformer, the line output transistor VT26 and resolder C109, also checking that there are no other dry-joints in the area. I've also found on several occasions that the a.g.c. gating diode W1 has failed when this fault has occurred.

Another fault that's showing up with increasing frequency is intermittent loss of field scan on the earlier Pye hybrid colour chassis (691, 693). If the usual items are checked to no avail look for a dry-joint on smoothing panel B – normally at R313 or a wire which carries the 20V (B) supply to the edge connector.

I hope these tips will be of help to other readers. – M. Brett, T. Eng. (CEI) AFSERT, Sidcup, Kent.

VCR CONVERSIONS

I would like to thank your contributors who wrote about their successful experiments in converting 1500 series VCRs to the long-play standard, and to confirm their findings using an additional tape servo, 1700 series head and reducing the diameter of the capstan and pulley.

To complete the conversion I found that it was possible to modify the clock-timer to extend the switching period. This can be done as follows. Dismantle the front section of the clock mechanism by removing the hands and releasing the four split spring washer clips, also removing the front timing disc. The modification involves carefully elongating the three radial slots in the plastic time setting gear -I used a small Swiss file to do this - extending the cutout on the periphery of the period setting gear wheel, and extending the

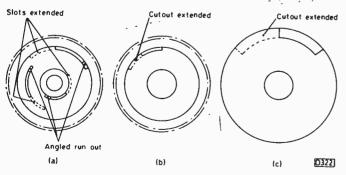


Fig. 1: Modifications to the Philips N1500 series VCR clocktimer to extend the switching period to convert to the N1700 standard. (a) Time setting gear. (b) Period setting gear. (c) Front timing disc plate. timing cutout on the front timing disc (see Fig. 1). The amount of elongation was determined using dividers to measure the chordal length of the remainder of each slot after inserting the mating trip plate, with trips against the runout position. - S. J. Humphrys, C.Eng., M.I.Mech.E., Welwyn, Herts.

PHILIPS COLOUR RECEIVERS

I'd like to correct an error which occurred in the final instalment (Part 3) of my article on the Philips G8 chassis. This was in the instructions given on page 543 of the August issue for setting up the decoder. In the second paragraph, it's L7007 that should be adjusted for minimum hanover bars on R - Y, not L7003. The third paragraph "L7007, the burst phase detector transformer, is best left undisturbed" should be deleted. I hope this hasn't caused anyone any difficulty.

In the same issue Andy Denham mentions a tricky problem on this chassis, intermittent no sound or raster. I've had this one a few times and the cause has always been a dry-joint, either on one of the 1Ω wirewound resistors in the base circuits of the pair of line output transistors or on one of the four tags carrying the connections from the two secondary windings on the driver transformer to the top panel. It's impossible to provoke the fault once the set is operating normally, presumably because it's due to the line oscillator running from a slightly reduced supply before the line output stage starts up, not enough drive being produced to "bridge that gap".

The weak raster on the Philips G6 chassis (Your Problems Solved, page 551) is presumably a case of excessive brightness. A common cause of this is the zener diode (X2154) in the cathode circuit of the PFL200 luminance output pentode going short-circuit. Replace it with a BZX61/C4V7. – Mike Phelan, Holmfirth Yorkshire.

TRIPLER CONVERSION

While digging through an ever growing pile of faulty old TV sets I came across a Bush TV161 which didn't look too bad. After replacing the dropper resistor and h.t. rectifier the set came to life, so it was left on for an hour or so to see what would happen. On checking, sound o.k., no raster, due to the overwinding on the line output transformer having gone. Before scrapping the set I decided to experiment with an e.h.t. tripler, as outlined in a previous issue of *Television* (see March 1976) in connection with the Decca CTV25 colour receiver.

I removed the overwinding completely, connecting the top cap of the PL504 to the input of a tripler for the 24in. Thorn 1500 chassis. I then fitted a 220pF; 12kV capacitor from the cathode of the PY88 to chassis to adjust the tuning. Being a coward, I next persuaded the wife to switch the set on while I hid... Not hearing any strange noises, I came out of hiding and found a good picture with perfect sound. The width was a bit excessive, so the value of the capacitor added was reduced to 180pF. This corrected the width on this particular set.

I'm now trying to fit the tripler in the space vacated by the redundant DY802 e.h.t. rectifier and its base. When completed, this will have been a very good and cheap repair. Perhaps the idea may be of use to other readers as an alternative to buying a new line output transformer for an elderly set. – **P. Naylor**, Aston, Birmingham 6.

CONVERGENCE MODIFICATION

Mention was made in the August Your Problems Solved of repeated failure of the R/G parabola control R1934 on the convergence board of the Philips G8 chassis. There's an official modification I thought you'd like to know to overcome this problem on earlier convergence boards – by fitting up-rated controls and adding a resistor. The details are as follows: change R1934 to part no. 103-17042 (10 Ω) and R1933 to part no. 103-17091 (20 Ω), and add a 15 Ω resistor (part no. 113-87201) from the junction of R1933/4 to the junction of R1919 and the R/G tilt control L1917, i.e. in parallel with R1934 and R1919. This modification seems to be fairly reliable using the Philips approved parts. – P. **Cole**, St. Austell, Cornwall.

HEATER CHAIN ORDER

I read with interest B.C. Alabaster's letter in the August issue on the order of the heater chain. This problem of 50Hz hum was new to me and I've been unable to find any reference to it in the usual textbooks. Anyway, I decided to try out an experiment to see what would happen. I got an old Bush set (Model TV135U) which was displaying a good, clean picture and reversed the order of the heater chain so that the tube heater was first in line and the line output valve last. Once the picture came on, a lovely 50Hz hum bar was found travelling up the picture! Having satisfied myself on that point, I then short-circuited the boost diode's heater and cathode (the boost diode is second in the chain in these sets, after the line output valve). As a result the boost diode glowed brilliantly while all the other valves, except for the line output valve which was now down at the earthy end of the chain, appeared to be near normal. The fuse didn't blow, even after a couple of minutes. What did happen was that the boost diode blew up, it's heater going open-circuit. I can't say that this would be the case on other chassis of course. - Robin D. Smith, Knebworth, Herts.

SERVICING ACROSS THE CHANNEL

I've been reading with interest the correspondence on TV cowboys in *Televisi n*. The situation here seems to be worse still from the custa rer's point of view. According to the Federal Union of Consumers' magazine *Que Choisir*? you're sure to run the risk of being swindled if you 'phone the first servicing company whose number comes to your attention when your set goes wrong. The magazine explains that servicing companies are interested in doing as much servicing as possible rather than maintaining sets in working order, so jobs are done as quickly as possible with the greatest possible number of parts being involved. The magazine conducted a small test, calling in seven firms to repair a set with an open-circuit fuse. Components in perfect condition were changed, sometimes being replaced by secondhand ones... when the fuse was not simply shorted with wire! Though the cost of the correct fuse was not more than one franc the prices invoiced ranged from 47F to 304.77F, with the total cost of the repair varying between 190F and 414.20F (from about £20 to nearly £50). Que Choisir? concludes that it's better to call the setmaker or retailer. – Thierry Weber, Paris, France.

RECOMMENDATION FOR RECONDITIONING

Keith Cummins may have a couple of Thorn 2000 chassis still giving good results but, as someone who spends most of his time reconditioning colour sets for sale, I'm happier with hybrids. In common with J. Pierce (June letters) I've found that the best chassis for this purpose is the GEC one. I sell both the dual-standard (modified for single-standard operation) and single-standard versions and obtain reasonable periods of operation from both. I've had the dual-standard version working for over a year after reconditioning and then with only minor faults. I'm quite sure I'd rather face a line output stage fault in a hybrid set than one in a solid-state chassis. Valves are obtainable much more cheaply, with nearly all sets using the same type, and one always has that second chance not available with a solid-state line output stage. - J. Broadhead, Leeds, Yorkshire.

CRT REACTIVATOR

Other readers may be interested in the c.r.t. reactivator design shown in Fig. 2. Before I built this I had been using the one published in the February 1973 issue of Television. That one fed the c.r.t. heater from the mains via a 100W bulb, and had just a 15W bulb in the grid-cathode emission circuit. I felt that it was probably limited to monochrome tubes, and had insufficient kick to clear some monochrome tubes. The design shown in Fig. 2 clears both colour and monochrome tubes. It uses a transformer with 6V/2A and 240V/40mA outputs. To get an extra kick for clearing the grid-cathode path, a $15\mu F$ capacitor is added across the output. I first tried this after having no luck with a 23in. monochrome tube: it came up like new after adding the capacitor! The connectors are similar to those used for pickup cartridges: they were made from a small piece of tin can by squeezing around a needle the size of a c.r.t. pin, finally covering with tape.

In use, connect the heater leads to each side of the c.r.t. key, then the red lead to the grid and the black lead to the cathode, with SW2 closed. For slow tubes it may be best to start with SW2 open for about ten seconds to allow the 15μ F output capacitor to charge. For colour tubes the heater leads are again connected to each side of the key, then each gun is cleared by connecting the red and black leads to pins 2/3, 6/7 and 11/12. Switching the mains on and off several times clears much better. – G. T. Jones, *Pwllheli, Gwynedd.*

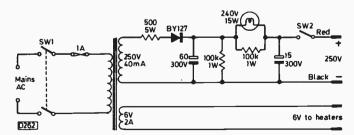


Fig. 2: Colour and monochrome c.r.t. reactivator suggested by G. T. Jones.

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TV Servicing: Beginners Start Here ...

Part 13

S. Simon

As we've seen, the line timebase deflects the c.r.t.'s beam from side to side of the screen while the field timebase deflects the beam downwards so that successive lines fall below each other. As a result, a complete picture is built up on the screen, and due to the speed at which these processes occur and the persistence of human vision the eye sees this complete picture rather than the scanning spot. A vital aspect of television is synchronisation, i.e. ensuring that the television receiver's horizontal and vertical scanning are kept in synchronism with the original signal source, be this a camera or whatever (VCR, TV games unit or pattern generator maybe). Without synchronisation, the display would be a jumble; with weak synchronisation, the result is ragged verticals with unreliable field hold, i.e. a tendency for the picture to roll upwards or downwards.

Synchronisation is effected by adding sync pulses to the video signal at the signal source, i.e. studio, outside broadcast unit, etc. The line sync pulse occurs at the end of each line, to start the c.r.t. beam flying back to the left-hand side of the screen before the beginning of the next line. Likewise field sync is effected at the end of each field, to get the beam to return from the bottom to the top of the screen. This is a longer period than the line flyback time, the field scanning being relatively slow (at 50Hz while, with 625 lines, the line frequency is 15,625Hz). During the time allotted for the field flyback, a group of pulses is transmitted: these are integrated to give a single, large pulse which is used to lock the field oscillator.

Since the beam has to return to the left-hand side of the screen at the end of each line, and from the bottom to the top of the screen at the end of each field, these processes taking a certain finite time, there's plenty of time available for the necessary synchronising pulses (it's the leading edge of the pulses that initiates the actual flyback). We can set arbitrary points for the black and white levels of our video waveform – provided we keep to them. As Fig. 1(a) shows, with a standard 1V video signal 0.7V is taken as the extreme from black to white. This leaves us with 0.3V which is "blacker than black" and can be used for the sync pulses. We want the screen to be blanked out anyway while the line and field flyback are occurring, so this is a convenient arrangement.

The waveform in Fig. 1(a) is a typical line waveform. The signal rests at black level for a short period before and after the actual sync pulse – the front and back porch respectively. Otherwise the signal might have to drop from peak white to zero and back again instantaneously, which is impossible. The relatively long back porch gives us a convenient point at which to add a colour sync signal, but we must leave that aside until we come to colour later.

Field synchronisation is a more complex business since with 625 lines each complete picture consists of two interleaved fields of $312\frac{1}{2}$ lines each. Interleaving, or interleaving as it's called, is used to reduce picture flicker and save bandwidth, but we don't need to go into the theory of that. From the practical aspect those half lines mean that successive fields begin and end at different points along a line. This results in a rather complex field sync signal, while if precise field sync is not maintained the complementary fields will not interleave exactly and the spacing between lines will alter, giving loss of vertical definition.

The video signal is generally used to drive the cathode of the c.r.t. It must be negative-going for peak white therefore, i.e. inverted as shown in Fig. 1(b). This is equivalent to driving the grid positively. Now suppose that we apply the signal shown in Fig. 1(b) to a stage which is so biased that it does not conduct until the input signal rises above 70% of its maximum amplitude. It will pass the sync signals only of course. This is the simple principle of the sync separator. Ah, you might say, but how do we distinguish between the line and field sync pulses? This is again a simple matter. Since the line pulse frequency is much higher than the field pulse frequency, simple time-conscious filter networks can be used to separate the pulses and send them on their separate ways to synchronise the line and field timebases.

Flywheel Line Sync

We're rather fortunate in the UK in that TV reception conditions are generally good. This is reflected in the comparative simplicity of the sync separator circuits used. Many imported sets use quite elaborate sync separator circuits in order to guard against the effects of noise and so on. But even in the UK the line sync pulses are not used directly to synchronise the line timebase. Instead, they are fed to a circuit which compares their timing with that of the flyback pulses produced by the line output stage. Any disparity results in a control voltage which is used to adjust the line oscillator frequency. This system is called flywheel line sync, and was mentioned in some detail in an earlier instalment.

Sync Separator Circuits

First however the sync pulses have to be separated from the rest of the video signal. It's essential that the sync separator does not pass any picture information otherwise the picture information will also be present at the output of the sync separator and will confuse the timebases. The biasing of the sync separator is quite an important point therefore in maintaining good sync performance.

Let's start with valve sync separator circuits. We've already made the point that a valve can be biased towards cut-off by applying a positive voltage to its cathode – positive with respect to the control grid voltage that is – or alternatively by doing things the other way round, i.e. applying a negative voltage to its control grid, with the

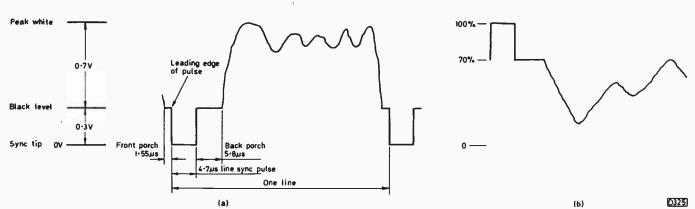


Fig. 1: (a) Position of the line sync pulse in the video waveform. (b) Positive-going sync pulses are applied to the sync separator and to the c.r.t. cathode (with cathode c.r.t. drive).

cathode taken directly to chassis say. In considering valve audio circuits last month we saw how the control grid can be negatively biased by applying the signal via a capacitor and using a high-value resistor between the control grid and chassis. The high-value resistor ensures that the plate of the capacitor connected to the valve's control grid retains an average negative charge, thus providing the required bias. This is the approach used with valve sync separator stages. A typical example is shown in Fig. 2, where it will be seen that the charge developed by the coupling capacitor C70 is -26V.

Consider again the waveform shown in Fig. 1(b). The valve is biased off until the input rises above 70%, signifying that there is a sync pulse present. Note however that once the waveform rises above 70% it moves rapidly to 100% and stays there until the end of the pulse. This means that the valve is being switched into heavy conduction for brief periods. When a valve conducts heavily current will flow in the control grid circuit, i.e. the control grid and cathode will act as a rectifier diode, and in consequence the grid coupling capacitor will receive a negative charge. This is exactly what we want: we use a high-value resistor in the grid circuit so that this charge remains, holding the valve cut off between sync pulses.

Since the negative charge acquired by the capacitor is proportional to signal strength, we also have a simple measure of the signal strength. The voltage can be used therefore to provide the a.g.c. action.

We can use the same biasing technique to operate a transistor as a sync separator. A.G.C. doesn't come in here however. With the 625-line system the sync pulse tip represents maximum signal modulation (it represents zero modulation with the 405-line system). Thus on 625 lines a simple peak detector can be used to measure the sync pulse amplitude for a.g.c. purposes. The use of the 625-line system and transistors as sync separators started at much the same time, making it unnecessary to complicate

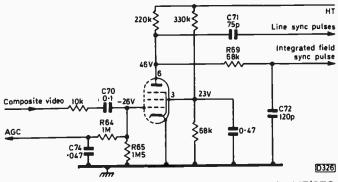


Fig. 2: A typical valve sync separator circuit – from the ITT/STC series of monochrome dual-standard chassis.

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transistor sync separator circuits by linking them to the a.g.c. system.

As we've said, time-conscious filters are used to separate the field and line sync pulses. The series of field sync pulses usually charge a capacitor through a resistor (integration). The components involved in Fig. 2 are R69 and C72. The important things here are that the correct component values are chosen and that the components keep to their original value. There are occasions when they don't and the signals get mixed up. This is usually due to a capacitor failing to do its job.

Recognising Sync Faults

It's easy to confuse timebase faults with sync trouble, and whilst it's a simple matter to trace the sync signal from the video amplifier through to the output of the sync separator etc. with an oscilloscope we have to assume that the reader does not have this advantage. Some practical tips can be of more value therefore than nice pictures of waveforms, however useful these are to those who have more elaborate equipment. Those possessing such items, plus the knowledge to use them (correctly), will hardly be reading these articles anyway.

Poor Sync

There are one or two points to remember before we start. Most line timebases work in conjunction with a flywheel sync circuit which tends to keep the line steady even when the sync signals are weak. Therefore weak sync will most often be seen by the inability to lock the field timebase firmly. By this we mean that the picture tends to roll up or down, with no positive lock. The ideal is to use the field (frame) hold control so that the picture starts to roll downward, then adjust it so that the picture rolls up and almost "clicks" into lock, with a degree of further rotation of the control having no effect. With this happy state of affairs established, the control should be returned to the setting where it just caused the picture to roll up and lock, this being the point where the timebase is being triggered at the most sensitive part of the oscillator's cycle (slightly slow).

An interlace diode is often included in the sync feed to the field oscillator, and this can give rise to weak field hold, the sync separator itself being perfectly in order. It's helpful therefore to note the effect of the line hold control before jumping to conclusions. The writer is and always has been an expert at jumping to conclusions. Many hours have been wasted in the pursuit of this sport, when careful observation and checking could have wrapped the job up in no time.

The average type of line oscillator circuit is quite tolerant of

the line hold control setting. Adjusting this control should result in the picture moving sideways before hold is completely lost. Weak sync will result in a more critical setting, thus giving an indication that the reason for the poor field lock is in the sync stage or perhaps before this (in the video stage or a.g.c. circuit in some cases). It will have been noted that the sync pulses are at one extreme of the signal waveform (in the "blacker than black" part). Thus if the video amplifier is not biased to operate at the mean centre of its characteristic curve, the sync pulses could be considerably impaired or crushed. The same effect occurs if the input to the video stage is excessive, and can also occur in the i.f. strip if the a.g.c. bias is incorrect. Thus it's prudent to reduce the setting of the contrast control to see if this improves the sync performance.

A quick check on the video output stage voltages and those of the sync separator can be very revealing if one knows the approximate readings to expect. For example, to return to our Thorn 1500 chassis for a moment, poor sync is nearly always the result of R44 increasing in value $(47k\Omega to$ pin 7 of the 30FL2, see Fig. 3): a voltage check here will show whether or not this is so. If the reading is much below 60V, suspicion should fall on the resistor. The sync will hold when the voltage starts to fall below 60V as the resistor goes higher in value, implying that $47k\Omega$ is not a critical value. Once the resistor's value starts to rise however it will certainly not stop (or obligingly fall), and the resistor should be changed for one of higher wattage as a matter of routine.

If all is well at this point one should check over the video stage generally. The electrolytic capacitor C38 should not be above suspicion, as when this dries up and no longer functions a further $8.2k\Omega$ resistor enters the signal circuit in the shape of R126 and the designed operating conditions are drastically changed. Likewise C37 can leak, thus altering the video transistor's base voltage (strictly speaking base current) and pushing the sync pulse response "into the red" as it were.

Thus there are many factors to take into consideration, and each chassis (or series of models) has its own habits or traits which when enough have been serviced enable the repairer to pounce quickly upon the most likely component. What's sauce for one model is not necessarily sauce for another. Only experience provides the quick remedy, or a close study of the experiences of others if this valuable knowledge is available.

The alternative is a good working knowledge of the factors involved and a methodical approach whatever the basic design. We offer below some practical examples of our own experience over the last few years.

Faults in Valve Circuits

Whilst the valve in a valve sync separator circuit may well be at fault, resistors are the primary cause of poor sync performance. We've already mentioned the 1500 chassis. A similar case occurs with the GEC Series One chassis. Here a PFL200 valve performs the functions of video amplifier and sync separator. Although the valve may well be responsible for weak sync, in the majority of cases R141 (again $47k\Omega$) in the screen grid circuit will be found high.

In an earlier series of models (many still in use), namely the ITT/KB VC1 to VC52 chassis, a PCF80 valve was used with the pentode section as the sync separator (see Fig. 2). Whilst this valve can give trouble, again the resistors are more likely to be responsible, the likely ones having values of $330k\Omega$ and $220k\Omega$ (the screen grid and anode resistors). Both tend to go high in value. They can easily be

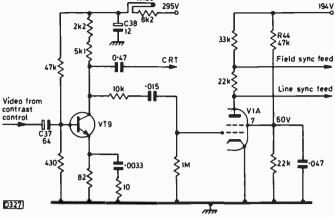


Fig. 3: The video output and sync separator circuits used in the Thorn 1500 chassis.

found by tracing the leads back from valve pins 3 and 6 to the tag panel. $330k\Omega$ (orange, orange, yellow), $220k\Omega$ (red, red, yellow).

In some chassis the sync circuit itself is rarely at fault. In the Bush TV161 series of receivers for example the cause of poor sync is more likely to be found in the a.g.c. circuit, where the setting of the contrast control is quite critical. This is also the case with some Philips receivers. As far as the Bush series is concerned however a likely culprit is indeed in the sync stage and is C48 (8μ F) – especially if this is a white component! We have referred to this item in a previous article (capacitors and their habits) so there is no point in labouring the point here. Suffice it to say that the capacitor is below the PFL200 valve.

Transistor Sync Separators

Transistor sync separator circuits can be complicated, but not necessarily so. In the popular Pye dual-standard and single-standard colour sets (Dynatron, Ekco, Invicta etc.) for example there's a fairly simple and easy to check stage (VT7, see Fig. 4). The transistor is a BC147 which can be checked in moments with an ohmmeter switched to the low ohms range (remember the drill, check an npn transistor with the black probe to the base, low reading of about 30Ω with the red probe to the collector or emitter, high reading with any other connection). In fact the transistor will usually be found to be in order, the main suspect being the $4.7M\Omega$ resistor R33 which "turns on" the base current. The diode D3 is easy to check with the black probe to the emitter of VT7 and the red probe to chassis to produce some sort of deflection on the low ohms range, but not with the probes the other way round.

In most other receivers with transistor sync circuits if the trouble is known to be in the sync separator stage(s) the transistors are the main suspect(s), but the associated resistors and capacitors may need to be separately checked. In some Philips colour sets of Swedish origin for example a multi-transistor circuit which it is not easy to follow is used. The collector of one of the transistors is fed from the h.t. line via two resistors in series, and our experience here is that these resistors are the items likely to give trouble. So,

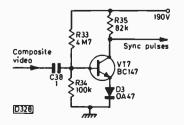


Fig. 4: The simple transistor sync separator circuit used in the Pye hybrid colour chassis. ۲

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coupling this up with what has been related before we can expound Simon's Second Law: if there are small sized resistors connected between the h.t. line and a fairly low voltage point, check them.

Misleading Symptoms

Quite often the symptoms presented on the screen suggest that there's a fault in the sync or even the video stage when the fault is not in these circuits at all. There are usually clues however which the more experienced (or clued up) will observe – but this series is not intended for them anyway.

A common condition is where the picture cannot be locked horizontally, i.e. it will bend or drift one way or the other but will not lock. The line hold control may or may not affect the condition, depending on the circuit. If the field (vertical) lock is solid the fault is unlikely to be in the sync separator circuit.

If a PCF802 valve is used in the line oscillator circuit, this must be the first suspect. If replacing the valve fails to improve matters the trouble is probably in the flywheel sync circuit, which we've already described (see Part 5 and the letter in the April issue). One tends to think in terms of the original sync pulses being lost on route to the flywheel sync circuit (this could be the case) but all too often, and it's most important to remember this, the feedback pulse from the line output stage has gone astray instead. The feedback path normally consists of a capacitor and a resistor in series between a winding on the line output transformer and "one side" of the discriminator diodes. In the 1500 chassis the resistor is R51 (220k Ω) and the capacitor C45 (0.001 μ F) – see Fig. 1, page 190, February. While these components don't give much trouble in the 1500 chassis, in some other chassis the resistor is very often at fault. This seems to be because the pulse is derived from a high-energy point in the line output stage. The capacitor usually puts up with this sort of stress but the resistor (usually carbon) deteriorates. If it increases in value to become well nigh open-circuit the result is that the picture falls about horizontally or is just a mass of lines. All too often however the resistor is not so obliging in its manner of deteriorating.

In the Pye group hybrid colour chassis for example the resistor has an original value of $47k\Omega$ but in the process of deteriorating it falls to a very low value (discolouring in the process). The high energy is then transferred to the discriminator diodes, which are totally unable to cope and thus also end up on the funeral pyre. So the lesson here is to suspect the PCF802 but first check on the condition of R203. If it's discoloured, change it and check the diodes D40 and D41 if the line hold is lost. If R203 is not discoloured check R210 which is in series with the line hold control and also tends to change value.

The little Indesit portable Model T12 also tends to have line sync troubles. Here the reference pulse feedback resistors are R913 and R915 (Model T12LGB, see Fig. 5). These and the $2 \cdot 2M\Omega$ resistors R412-R413 on either side of the discriminator balance preset R414 are suspect if TR404 etc. read right.

Use of Integrated Circuits

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Many receivers don't use discrete components in the video processing and sync stages. Chips are used instead and these are the main suspect if the sync is poor or is lost.

A commonly used video/sync i.c. is the TBA550, and this often has to be replaced before sync can be restored. Since this chip performs several functions however it can

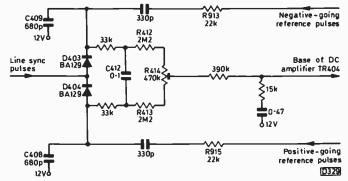


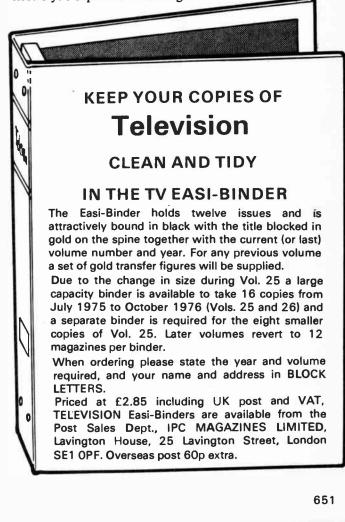
Fig. 5: The flywheel line sync discriminator circuit used in the Indesit T12LGB monochrome portable. A similar circuit is used in the ITT CVC5-CVC9 series of colour chassis. This is an example of a circuit in which both positive- and negativegoing flyback pulses are fed back to the discriminator from the line output stage. This particular circuit has a wider than normal locking range due to the action of C412 which is connected between the voltage summing points that determine the output fed to TR404. The designer uses the 12V rail as a signal "earth" in this area.

give rise to many and varied symptoms. Loss of sync is only one of them. Others include a picture with a "washed out" appearance (poor video response), tending to lead the uninitiated to think that the tube has lost emission.

On some occasions (certainly not all) some local heating and rapid cooling can help to identify the faulty item. To this end a small hairdrier with a narrow nozzle is often an immense help, along with one of the several freezing aerosols available.

Before condemning an integrated circuit verify the voltages at the various pins.

Where these are absent or low, check any associated electrolytic capacitor for leakage.



Long-Distance Television

Roger Bunney

JULY was an active month, with both Sporadic E and F2/TE reception abounding. High-pressure systems gave improved tropospheric conditions during part of the month, though there was nothing very spectacular. An extremely large sunspot group at the centre of the Sun produced a giant flare and radio blackout on the 14th, but there have been no reports of Aurora or other associated phenomena unfortunately. Most strange!

Month's Log

My own log shows that the month was an active one, but the only important event was reception of Rhodesia ch. E2 on July the 8th at 1800. There was a good Sp.E opening that day, and it was interesting to see DR (Denmark) ch. E3 over a short skip distance carrying the PM5544 test pattern (at 1842). There were Sp.E openings here at Romsey on the following days:

- 1/7/78 ORF (Austria); TVP (Poland); RTVE (Spain); also unidentified signals.
- 2/7/78 Mostly unidentified programmes from Eastern Europe.
- 3/7/78 TSS (USSR); SR (Sweden).
- 5/7/78 DFF (East Germany); RTVE.
- 8/7/78 RAI (Italy); TVP; DR; JRT (Yugoslavia); RTVE. Also Rhodesia via TE.
- 9/7/78 Unidentified programmes.
- 10/7/78 TSS; JRT; RAI; CST (Czechoslovakia); Switzerland.
- 11/7/78 TSS (up to ch. R4); TVP; DR; DFF; WG (West Germany); JRT; RAI.
- 12/7/78 RTVE; very weak unidentified ch. E2 signals from the south at 1852.
- 14/7/78 Improved trops several Band III French 625line signals (PM5544 test pattern) carrying the Paris studio identification "BUTTES CH".
- 15/7/78 RTVE; RAI; SR; TSS; MTV (Hungary).
- 16/7/78 SR; NRK (Norway).
- 17/7/78 TSS; NRK.
- 18/7/78 RTVE; unidentified programmes from Eastern Europe.
- 20/7/78 Unidentified programmes from E. Europe; CST ch. R1 noted with EZO test pattern and the identification "PRG-1" (Prague 1 or Programme 1?).
- 25/7/78 TSS; TVP; NRK; SR.
- 26/7/78 RTVE; RTP (Portugal).

Readers' Reports

On June 28th Clive Athowe (Norwich) received Gwelo ch. E2 between 1650-1715, with a lady announcer and a clear identification slide (this was also seen by Hugh Cocks in S. Devon) with signals at "fair strength". July 1st brought John Lees (Cirencester) a mystery signal on ch. E2 - from1930 onwards – a very blurred southerly signal showing African people in a news programme with an obvious military content: at 2012 the sound channel broke through – in French! Any ideas? The only possible southerly countries that use French and system B transmissions are Chad and the Central African Republic. If any readers can help please do so. This isn't the first time that French ch. E2 sound has been received.

Mike Allmark (Leeds) reports a good Aurora on the 4th, giving all the BBC-1 Band 1 Scottish stations plus NRK ch. E4 at good strengths, also Sandale ch. B6 and NRK Stoord ch. E5. Kevin Jackson (Leeds) received RAI ch. ID (E5) via Sp.E on the same day.

The 7th produced Amman, Jordan ch. E3 via multiplehop Sp.E in Devon at 1900, with single-hop JRT. A few minutes earlier CLT (Lebanon) ch. E4 was received. It's interesting to note Hugh's comment about a characteristic rumble on the Amman signal – broad thick bars on vision. Gwelo ch. E2 appeared again "very ghostly" the same day, with an accompaniment of Arabic harmonics throughout Band I.

Clive Athowe reports Gwelo ch. E2 again on the 8th, between 1754-1830 via F2/TE, with the usual spiral crest identification slide – a very strong signal this time!

Following an improvement in southerly trops on the 9th the scene changed, with the Canary Islands ch. E3 on the 10th, a clear "RTVE IZANA CANAL 3" being seen by several observers at 1300 and again at 1720. With the propagation path open to the south Gwelo, Rhodesia strangely didn't appear but NTV (Nigeria) Sokoto ch. E3 did! – at fair strength, using the globe slide as shown before in these pages. Only David Martin (Shaftesbury) noted this slide, but Hugh logged programmes a little later. Back to Clive Athowe who logged Gwelo on the 9th, RAI ch. D on the 10th and signs of F2 reception at 1800-1900 on the 11th with in addition local Italian f.m. stations at 103MHz as late as 2230.

After a four day pause Clive wrote again on 15th to



TSS (USSR) news caption received by Steve Birkhill (Sheffield) at 4GHz from the Statsionar-2 satellite.

report a ch. E2 signal with coloured gentleman (white hair and glasses) – a very strong signal at 1845, suspected to be Nigeria. Gwelo was received again at Norwich on the 17th (1827-1831) and 18th (1839-1855), this time with a second co-channel signal! Both Hugh and Clive received Rhodesia on the 21st between 1630-1830, with English language sound and commercials. RTVE ch. E2 fought with the signal and eventually swamped it at 1830.

At a tangent, we have received a number of reports of test patterns, colour bars etc. being seen during the evenings at times when programmes are normally on the air. These ch. E3, 4 signals are most likely to have originated from the now numerous transmitters being operated in Italy under the "free station" umbrella.

This long list indicates improving conditions.

News Items

Holland: A report from Brian Fitch suggests that the ch. E4 (and u.h.f.) transmitters at present sited at Lopik will be moved to central Holland, due mainly to four new 500kW short-wave transmitters being constructed.

Eire: RTE is manufacturing special u.h.f. filters to enable viewers to continue to view the relatively weak UK u.h.f. signals alongside the new high-powered RTE-2 transmitters as and when they come into service. We are hoping to include further information on these low-loss filters shortly.

WARC 1979: At the World Administrative Radio Conference in 1979, which will deal with the revision and allocation of radio frequencies, the EBU will ask for an increase in the spectrum avilable for broadcasting. The 26MHz band, at present an international short-wave broadcasting band, is to be suggested as a potential satellite broadcasting band. Of greater importance however is the demand for retention of Band I 47-68MHz and Band III 174-223MHz (with a 7MHz extention). An extention of Band II (currently f.m. radio) to 108MHz is suggested. The conference will be held at Geneva.

Satellites: The Japanese BSE satellite is now in operation. The 12GHz television tests involve two colour channels.

Publications

Two new books published by the IBA are strongly recommended. A Broadcasting Engineer's Vade Mecum is an invaluable compendium of reference information ranging from basic measurements through decibels, light, propagation, channel allocations, TV systems in various countries to aerial and noise measurements and much more. Even more exciting is Satellites for Broadcasting. This is a must for all enthusiasts and includes many articles on both transmitting and receiving systems and associated information. The article on "Low-Cost Satellite Receiving Techniques" by Pat Hawker is particularly worthy of close study. Copies of these publications can be obtained at £1.50 each from the Chief Accountant, IBA, Crawley Court, Winchester, Hants SO21 2QA (make crossed cheques/POs payable to the Independent Broadcasting Authority).

From Our Correspondents . . .

Whilst watching Southern ITV on June 19th Francis Jimenez (St. Mary's College, Twickenham) noticed an announcement that the u.h.f. service was suffering from tropospheric interference. On tuning to the v.h.f. Band I spectrum Francis was able to watch the Norwegian weather forecast followed by the Icelandic test card "RUV



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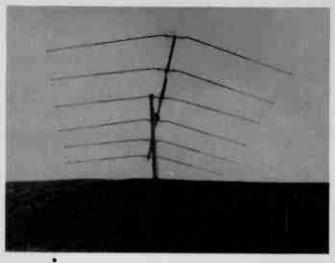
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Chris Wilson's ch. E3-4 log-periodic array. Note the angled elements to reduce the beamwidth and increase the gain.



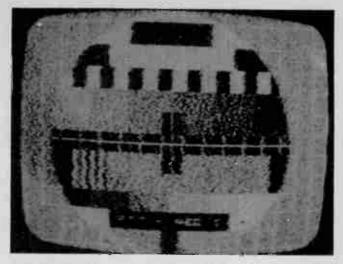
Much reduced signal pick-up from Lopik (ch. E4) with Chris Wilson's log-periodic 30° off-beam.

ISLAND" on ch. E4. He later noted Budapest and Yugoslavia (test card with identification "JRT BGRG1").

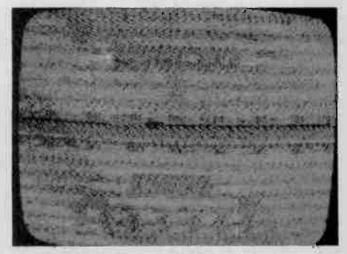
Frank Lumen and his friend Don have been conducting Sporadic E reception experiments. On June 19th Don received CST ch. R2 whilst Frank was receiving JRT ch. E4. On comparing notes it was found that neither could receive the other's signal despite being only five miles apart! John Cowan at Ayr, some 30 miles distant, received Italian and Yugoslav signals on the 1st and 2nd respectively, but neither of these two signals were seen at Frank's or Don's (Glasgow) locations despite the same channel being tuned in. This selective reception has been noted before: any suggestions from readers as to why?

Kevin Jackson (Leeds) has been in touch with the RSGB Propagation Study Committee following his reception of certain Scandinavian signals via Aurora. The committee is anxious to obtain information on signal reflection for a close study of auroral ionisation drift. To this end if any enthusiast receives an Auroral signal from a *definite* transmitter the RSGB would appreciate a note on the reception. Information needed is of the station/country, time, duration of signal and if possible the aerial beam heading. Send observations to the I.A.R.U. Auroral Coordinator, RSGB Propagation Committee, Mr. C. Newton, 61 Merriman Road, Blackheath, London SE3 8SB. If there is any query enclose an SAE but important questions only please.

Robert Copeman's friend in Dunedin, NZ, quite



Lopik (Holland) ch. E4 picked up via Chris Wilson's logperiodic aerial with the aerial on beam.



Lopik ch. E4 with the aerial 45° off-beam: with increasing off-beam rotation the signal disappears into the noise.

unintentionally received CBN-8 TV Orange NSW, Australia on her TV ch. 6 position (this corresponds to the Australian ch. 8), indicating more Band III Sp.E. You may recall that Robert Copeman received Samoa ch. A2 (KVZK-TV 2) on Christmas Day 1976!

Log-periodic Aerial Design

Chris Wilson has constructed a Band I log-periodic array with certain modifications that depart from convention. The elements are bent forwards to increase the forward gain (by restricting the forward beamwidth and side lobe radiation). His design (see Fig. 1) is for chs. E3-4 inclusive, but a seventh element can be included to improve ch. E2/R1 performance. The photos show the performance on a ch. E4 Lopik signal.

Infra-red Link

A development of increasing importance in broadcasting is ENG, electronic news gathering, which was the subject of an article in the August 1976 issue of *Television*. Numerous US TV companies now use this technique which has only recently come to be accepted by UK broadcasters. Basically, ENG is the use of a small TV camera instead of a film camera for news coverage, the camera's output being recorded on to videotape or transmitted back to base via a microwave link (in the 13GHz band). The advantage of course is speed, since film has to be developed.

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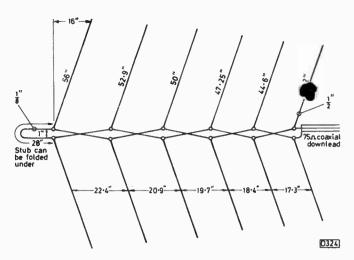


Fig. 1: Six-element log-periodic aerial array designed by Chris Wilson for reception of channels E3-4. A seventh element could be added to extend the coverage to channel E2/R1: this would have 59in. sections with a spacing of 24in. and the stub increased to 30in. Note that the design does not follow strict log-periodic calculations.

An interesting development of this technique was required at KSL-TV, Salt Lake City. A conventional microwave link licence couldn't be obtained for a 780ft. part of the proposed link, whilst renting a coaxial cable link was prohibitively expensive. The solution adopted was to use an infra-red light beam for which no licence was required. The system gives a flat bandwith of over 10MHz, while the transient response is improved because no bandwidth limiting filters are required. A couple of problems have been experienced however. The inclination of the receiver at 35° facing west means that for a short period during a week or so in the summer the sun passes across the receiver's field of view, giving an increase in the noise level. A winter problem, again degrading the signal, results from snow build up in front of the receiver's lens.

The infra-red source transmits the modulated light via an optical filter to give a narrow beam. The beam in practice spreads to a diameter of approximately 10ft. at a distance of 2,000ft. At the receiver, a lens assembly focuses the light through a bandpass filter on to a silicon avalanche photodetector – the bandpass filter resembles a piece of flat black glass and is basically an optical resonator designed to pass only the infra-red information, suppressing interference from other light sources such as the sun, street lighting, etc. The silicon avalanche detector both amplifies and recovers the video signal along with the sound subcarriers (there are two 15kHz f.m. sound channels on 10MHz subcarriers on the same infra-red beam). Further processing and clamping are then used to remove propagation fluctuations.

Circular Polarisation

Another development, circular polarisation, was the subject of an article in the October 1976 issue of *Television*. This is gaining popularity in N. America for both TV and f.m. radio broadcasting, the advantages being felt in metropolitan areas where high buildings cause severe ghosting. A circularly polarised transmission has either leftor right-hand polarisation, but the important point is that the polarisation sense of a reflected signal is reversed. This means that a correctly polarised receiving aerial will give minimum output from reflected signals. A recent article in the *RCA Broadcast News* suggests that circularly polarised TV "is here to stay", some off-screen shots demonstrating the dramatic improvement in reception achieved in difficult areas by using circular polarisation.

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Service Notebook

G. R. Wilding

Checking Transistor Stages

While substitution is a common way of checking suspect transistors, nevertheless the need to obtain and fit a replacement takes time so that it's best to check first to make sure that the suspect is faulty.

As a general rule, if the voltages are correct, particularly at the base and emitter, a transistor can be considered to be operational. With a normal silicon amplifier transistor – as distinct from a sync separator, pulse amplifier, oscillator or a.g.c. stage – the base voltage should be about 0.6-0.7Vabove the emitter voltage, the latter voltage depending on the value of the emitter resistor and the current flowing through it. To confirm that a transistor's emitter voltage is the result of its current flowing through the emitter resistor, short-circuit the base-emitter connections. The result should be to reduce the emitter voltage to zero – unless there's a stabilising resistor between the emitter and one of the supply lines. In this case a small emitter voltage should still be present, but noticeably less than the normal, correct value.

On occasions you may find that the base voltage is nearly normal but that the emitter voltage is only slight, with the collector voltage at the supply rail potential. In this case the collector-base junction is probably open-circuit. The small emitter voltage is due to the base-emitter current flowing through the emitter resistor. If the base-collector junction is short-circuit, the collector, base and emitter voltages will all be much the same.

With the base-emitter junction open-circuit there'll be zero emitter voltage and the collector will be at the rail potential. The latter will also be the case with a short-circuit base-emitter junction, but this time the base and emitter voltages will be the same.

If you have an i.f. strip or chrominance channel giving zero or negligible output and all the voltages are correct, then you've a coupling, tuning or load problem. If the interstage coupling is capacitive, there could be an opencircuit or dry-jointed capacitor. With the coils or transformers capacitively tuned, there could be an open-

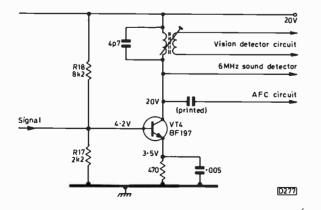


Fig. 1: Final i.f. stage, Pye hybrid colour chassis.

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circuit or changed value capacitor thus mistuning the stage, or a short-circuit capacitor thus removing the load altogether.

Incorrect voltages in gain-controlled i.f. stages are often due to a fault in the a.g.c. circuit. Excessive forward bias will result in the controlled stage(s) being driven into saturation where it/they will be unable to respond to the signal voltage. Under this condition all three voltages will be about the same, as occurs when there's a collector-base short-circuit or heavy leak, though if you measure carefully you will usually find that the base voltage is a fraction of a volt above the emitter and collector voltages, due to both junctions being forward biased.

Occasions sometimes arise when one or more transistors are simply under or over biased, resulting in either case in markedly reduced gain. For example, a Pye colour receiver fitted with the 697 chassis recently came our way, the complaint being weak contrast and lack of saturation even with the controls fully advanced. Absence of grain on the picture indicated that the fault was after the tuner, while the low colour strength suggested that there was reduced signal amplitude at the chrominance signal take-off point, i.e. at the emitter of the first video phase splitter transistor VT5. Naturally the first thing to check was the preceding detector diode, but this was found to be in order. VT5's voltages were all normal, but on working back to the final i.f. amplifier transistor VT4 (see Fig. 1) we found the base and emitter voltages both markedly above the correct figures. The collector voltage was correct, but since the load consists of the low d.c. resistance of the final i.f. transformer's primary winding no change was to be expected. The base bias for this transistor is provided by a potential divider, R18 ($8.2k\Omega$) to the 20V supply line and R17 $(2 \cdot 2k\Omega)$ to chassis, so it seemed that either the former resistor had fallen in value or the latter increased in value or gone open-circuit. Since only very small currents flow in such resistors, value change is very rare. What had actually happened was that the lower resistor R17 had become dry-jointed. As a result, the transistor's base voltage had increased, raising its forward bias but reducing its gain. On resoldering R17, normal voltages and correct contrast and saturation were restored.

No Results: Thorn 3000 Chassis

The complaint with a Thorn colour set fitted with the 3000 chassis was no sound or picture, though we found that sound was present for a fraction of a second after switching on. Tests on the power supply panel revealed that there was no chopper rail, though the 2.5A fuse was intact. On checking the three-section dropper resistor R605/6/7 the first section, which acts as a surge limiter, was found to be open-circuit. In most receivers an open-circuit section of a multiple dropper resistor can be shunted by a replacement, but in these sets there's no safe way in which this can be done. So although sections of this dropper don't break down very often, a complete replacement component is a must for the spares stock.

Severe Line Tearing

The trouble with a hybrid, single-standard GEC colour set was two-inch wide bands of severe line tearing which moved slowly up the screen, tripping the field timebase when they reached the top. Poor heater-cathode insulation in the PCF802 line oscillator valve was the first suspect, but a replacement valve brought no improvement. Inadequate h.t. smoothing was ruled out since there was no hum from the speaker while the only raster disturbance was the bands of tearing. Attention was turned to the smoothing of the l.t. supply therefore, and it was found that on contacting a 64μ F test capacitor across the $2,000\mu$ F smoothing capacitor C58 the line tearing was greatly reduced. Clearly the capacitance of this electrolytic had greatly decreased, and although the accompanying reservoir section of the can appeared to be good the complete unit was replaced. Apart from anything else, it's usually awkward to wire replacement capacitors and mount them securely on compact colour chassis.

Top Cramping

The raster on a Thorn portable fitted with the 1590 chassis was cramped, mainly in the top half of the screen. This suggested that one of the field output transistors was faulty, but voltage checks back through the complementary symmetry driver stage to the preceding "linearity amplifier" transistor VT16 showed that the incorrect voltages started in this stage – all three stages are direct coupled. The two diodes associated with VT16 both proved to be in order, so as all nearby resistors looked and tested normal the transistor was changed. This restored correct voltages and a normal raster, though the defective transistor was found to give acceptable forward and reverse readings across its two junctions. In all d.c. coupled transistor circuits, concentrate on the first stage where incorrect voltages are found.

Field Collapse

The trouble with a hybrid single-standard GEC colour receiver was field collapse, and on inspection we found that the 560k Ω resistor (R526) feeding the height control had burnt out. The resistor forms part of an RC filter with C519 $(0.01\mu F)$, and suspicion naturally fell on this capacitor. An ohms test showed that the capacitor was o.k. however, but as the panel was badly charred where R526 had been we gave it a thorough clean up - charred paxolin can become conductive. On fitting a new resistor to the cleaned up panel a raster of only about half the normal height was obtained, while the resistor soon began to overheat. Although it looked perfect, the only conclusion we could come to was that the associated height stabilising v.d.r. (VDR 500) was faulty, falling to a very low resistance. Removing the v.d.r. produced grossly excessive height - as one would expect since R526 and the v.d.r. form a potential divider. The point was proved however, and a replacement v.d.r. produced a normal raster.

Intermittent Field Failure

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Now and then we all come across a printed board on which a fault either appears or clears when the board is tapped or pressure is applied to it in a particular area. Where there's no visual indication as to where the fault lies, the temptation is to resolder all connections in the suspect area. All too often however this produces no improvement, while there's always the risk of inadvertently connecting adjacent tracks with a blob of solder. Far better, wherever possible, to keep a meter connected to relevant points in the circuit in order to see where voltage changes occur when the board is tapped or pressure is applied.

This was brought home to us the other day when we had a case of intermittent field collapse on a set fitted with the Thorn 1500 chassis. Naturally the first move was to try a new PCL805, but the fault remained. We then found that the fault could be instigated by rocking the valve to one side, suggesting either a defective valveholder or a dryjointed pin connection on the board. Inspection of the valveholder sockets showed that they were all in order however, while the pin soldering was equally faultless.

Next move therefore was to check voltages around the valveholder connections, noting the effect produced by valve displacement. There was a distinct fall in the voltage at pin 1 (triode anode) when the fault was present, indicating that the valve was then failing to oscillate – the absence of negative bias generated at the grid during oscillation would result in increased anode current. So the fault could lie in either part of the circuit, the two sections of the PCL805 being connected as a cross-coupled multivibrator. Failure of the pentode would also result in failure to oscillate therefore. Moving the test prod to pin 2 (triode grid) confirmed the absence of negative bias when the valve was pushed to one side, and on moving to pin 6 (pentode anode) it was found that there was zero voltage under the fault condition.

Had a short-circuit been responsible, the resulting very heavy current, limited only by the d.c. resistance of the output transformer's primary winding and the smoothing circuit, would have blown the fuse. Absence of h.t. had to be due to a break in the feed therefore. Checking on the panel revealed that while there was always h.t. at one of the output transformer's primary winding connection tags, the voltage at the other one fell to zero when the valve was pushed over. Closer inspection revealed the inadequacy of the soldering at this tag. The surprising thing about this fault is that although the transformer is mounted at one corner of the board, the field collapse could be instigated only by pressure on the valve which is mounted well away.

Faults Encountered

– continued from page 639

Perhaps the most difficult portable set fault we've had of late however concerned a Bush Model TV300. The set would work perfectly for hours on end, after which the peak whites would begin to smear, the symptom becoming progressively worse until the set gave an excellent imitation of a faulty tube. One clue that presented itself however was that the collector voltage of the video output transistor TR10 was very low when the fault condition was present. The supply for the video output transistor comes from a rectifier which is fed from the line output transformer. There are two electrolytics involved in this supply, the reservoir capacitor C519 and the smoothing capacitor C520, both 1μ F. Replacing them cured the fault. I've since discovered that this trouble is not so rare, so before condemning the tube in these sets check these two capacitors first.

Indesit T24EGB

Finally, large screen monochrome sets. We've a number of Indesit Model T24EGB receivers out on rental. By and large they've turned out to be reliable, the only major weakness being the line output transformer. One set gave us a very poor picture however, of muddy appearance with pronounced vision hum. The sound was unaffected. Electrolytic trouble again, this time C914 (500μ F). It's the reservoir capacitor in the 24V supply, which is derived from the earthy end of the heater chain.

The Language of Logic

Part 1

E. A. Parr, B.Sc., C.Eng., M.I.E.E.

IN THE past few years many TV engineers have been casting nervous glances over their shoulders at the quiet intrusion of digital techniques into television systems. These digital circuits call for a certain change of attitude, but worse is the large number of specialised terms that digital engineers use. An engineer I know (brought up like me on ECC83s) summed it up by saying "I understand the words, I just don't understand them when they are put together to make a sentence."

This article is intended as a newcomer's primer to logical circuits, and is arranged in two basic sections. The first is a description of basic electronic logic ideas, the second being a dictionary of common terms.

It's interesting to note that communications engineering is returning to digital circuits after a gap of several decades: early forms of communications (from the heliograph through the telegraph to morse code) were all digital.

What does "digital" mean?

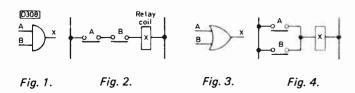
In most electronic circuits, information (such as speech) is represented by voltages. In a standard 1V peak-to-peak CCTV signal for example, a voltage span of 0.7V covers the entire range from black to white. In theory at least any shade of grey can be represented and there is infinite resolution.

In a digital system, only two voltages are present. These are called "0" and "1". One of the most common digital systems used is the so called TTL (transistor-transistor logic) family. This uses voltages of 0.2V for the 0 state and 3.5V for the 1 state. Digital circuits are therefore very similar to switches and relays which both have two states: on/off; energised/de-energised.

At first sight, a circuit using only two voltages would seem a bit useless (like the hovercraft steamroller). After all, who wants a TV that could display only black or white? This is valid, but there are areas where digital systems come into their own: control, number crunching and information transmission.

Control engineering is the design of systems that originally used relays. There are many industrial control devices that have two states – relays, contactors, valves (hydraulic and steam), switches etc. These can in turn be controlled by digital circuits built round statements like "If signal A is present, and signal B, but not signal C then energise output X".

Number crunching is the use of digital systems to represent numbers. At the simplest level we can display the



channel number on a TV set. At the complex end we have calculators and computers.

Finally we have information transmission. The information to be transmitted (which can be anything from a TV signal from Mars to the water level in the local reservoir) is converted into a sequence of digital on/off signals representing numbers. These digital signals are sent down the transmission path and at the receiving end they are converted back to voltages to produce the TV picture or drive the level gauge in the distant control room. Note that this implies two limitations. First the signal can change only in fixed steps, i.e. it's not continuously variable. Secondly the signal is sampled only at intervals. In the design of a system, the minimum step size (accuracy) and sample rate (frequency response) first need to be defined.

Most digital systems combine the three digital techniques. In Teletext for example, we have control, number crunching and information transmission all at once.

Logic Gates

Control systems are the easiest to understand, following, as they do, the basic concepts of relay design. Control systems are built round circuits called "gates". These have one or more inputs and one output. The relationship between the input and output is defined for all possible circumstances. Surprisingly, there are only a few types of gates. These will now be described.

First the and gate, whose symbol is shown in Fig. 1. The inputs can be in only the 0 or 1 state. The output is at 1 when all the inputs are at 1. We can thus draw a chart of all the possible conditions – this is called a truth table:

Input A	Input B	Output X
0	0	Ō
1	0	0
0	1	0
1	1	1

In many ways the and gate is similar to the relay chain shown in Fig. 2.

Occasionally you may see "logical equations". These express the logical operation being performed in mathematical form. The symbol for the and operation is a dot (\cdot) and our gate can be expressed as: $X = A \cdot B$. And gates are available with up to eight inputs.

In the case of an or gate the output is at 1 when any input is at 1. The symbol is shown in Fig. 3 and the truth table is:

A	В	X
0	0	0
0	1	1
1	0	1
1	1	1

The or operation is represented by a plus sign (+) and the logic equation is: X = A + B. As before, this has an

analogy in relay designs. Fig. 4 shows the relay analogy. Or gates are available with up to eight inputs.

Inverters have one input and one output. The output is the opposite binary state to the input. The symbol for an inverter is shown in Fig. 5, the small circle on the output denoting inversion. Inversion is sometimes called negation. The truth table is simple:

In a logical equation, inversion is denoted by a line above the letter concerned, thus \overline{A} . This is said "bar A". The logic equation is: $X = \overline{A}$. Inversion is similar to a relay normallyclosed contact. By definition, there can be only one input to an inverter.

The nand gate is an and gate followed by an inverter. Its symbol is shown on Fig. 6, the circle on the output showing inversion. The truth table is:

A	В	X
0	0	1
0 0	1	1
1	0	1
1	1	0

This might appear a rather useless gate, but in fact it's the most common type of gate. The reason for this lies in its flexibility. It can be used as an and gate, an or gate or as an inverter by being clever with the logic design. We'll return to this when we come to positive and negative logic.

The logic equation is: $X = (\overline{A \cdot B})$. Nand gates are available with up to eight inputs.

The nor gate is an or gate followed by an inverter. Its symbol is shown in Fig. 7. As before, the circle shows inversion. The truth table is:

A	В	X
A 0	0	1
0	1	0
1	0	0
1	1	0

The logic equation is: $X = (\overline{A + B})$. Nor gates are available with up to eight inputs but are rarely used in logic designs.

The exclusive-or gate has only two inputs. The output is at 1 when the two inputs are in different states, at 0 when the two inputs are the same. The symbol is shown in Fig. 8. The truth table is:

A	В	X
0	0	0
0	1	1
1	0	1
1	1	0

The logic equation symbol for exclusive or is \oplus , hence the equation is: $X = A \oplus B$.

The exclusive-or gate is made by the logic combination shown in Fig. 9. This has the logic equation:

$$X = (\overline{A \cdot B}) + (\overline{A \cdot B}).$$

$$Fig. 5.$$

$$Fig. 6.$$

$$Fig. 7.$$

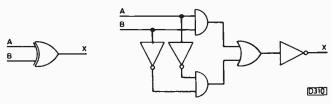


Fig. 8: Exclusive-or gate symbol.

Fig. 9: Internal arrangement of an exclusive-or gate.

It will be left to the reader to convince himself that this is the same logic and equation as the exclusive-or.

If this seems complicated, take heart. Exclusive-or gates are normally encountered only in fairly complex number crunching systems.

By definition, an exclusive-or gate is available only with two inputs.

That completes the basic family of logical gates.

Positive and Negative Logic

Manufacturers define the voltage for logic levels. For TTL a 1 is 3.5V and a 0 is 0.2V. If the 1 is more positive than 0 the logic is described as positive logic. If the 1 is more negative it is described as negative logic. TTL is therefore positive logic. A logic system I once worked with which had a 1 of -3V and a 0 of +3V was negative logic.

In theory, negative logic should have a small circle at the corresponding inputs and outputs. The logic symbols for a negative logic or gate and nand gate are shown on Fig. 10.

The small circle at the output of a conventional positive nand gate means, in effect, that the state at the output when the input conditions are satisfied is the more negative.

As the vast majority of logic systems use positive logic (TTL, RTL, DTL, ECL, CMOS) you probably think this is academic. Consider however the circuit shown in Fig. 11. This has the truth table:

A	В	С	D	X
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0 1 0
0	1	0	0	
0	1	0	1	0
0	1	1	0	0 0 1
0	1	1	1	J
1	0	0	0	0
1	0	0	1	0 0
1	0	1 1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0 1	1
1	1	1	1	1
0	0	0	0	0

which means it has performed

$$\mathbf{X} = (\mathbf{A} \cdot \mathbf{B}) + (\mathbf{C} \cdot \mathbf{D}).$$

In some odd way, gate three has performed like an or gate. To see why, let us take the operation a step at a time. The output of a nand gate in terms of voltage is:

A	B	X
0.2	0.2	3.5
0.2	3.5	3.5
3.5	0.2	3.5
3.5	3.5	0.2

TELEVISION OCTOBER 1978

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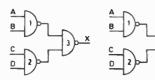


Fig. 10: Negative or (a) and nand (b) Gates.

Fig. 12.

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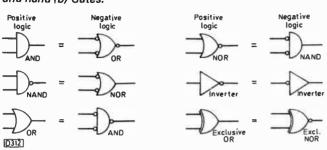


Fig. 11.

Fig. 13: Demonstrating the interchangeability of positive and negative logic.

If we define 1 as 0.2V and 0 as 3.5V we get:

4	B	X
1	1	0 0 0
1	0	0
0	1	0
0	0	1

which is a nor gate in negative logic. In Fig. 11 gates one and two give a 0 out for $A \cdot B$ and $C \cdot D$. Gate three then acts as a negative logic nor gate on the signals from gates one and two.

In theory, Fig. 11 should be drawn as Fig. 12.

It's only honest to say that very few people bother, least of all the author, and it's usual to find logic drawings done entirely with positive logic symbols even though negative logic might be performed at places inside it.

This flexibility is the reason for the common usage of nand gates rather than and gates.

As might be expected, there is a similar interchangeability between other gates. The positive logic gates above when used as negative logic change as below:

Positive logic	Negative logic
and	or
or	and
nand	nor
nor	nand
inverter	inverter
exclusive-or	exclusive-nor
	(an exclusive-or
	followed by an inverter)

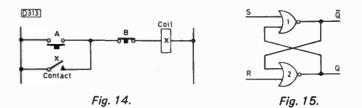
Non trusting readers should draw up the truth table for each gate, replace it with voltages, then replace the voltages with 1 = 0.2V and 0 = 3.5V.

The interchangeability of positive and negative logic gates is summarised in Fig. 13.

Memories

In logic it's often necessary to remember that something has happened. This is equivalent to the latching relay network shown in Fig. 14. Relay X is energised when button A is momentarily pressed, and stays energised until button B is pressed.

The simplest way of making an electronic memory is to use two nor gates as shown in Fig. 15.



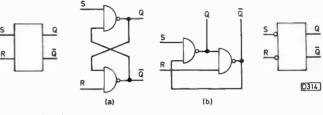


Fig. 16 (left): SR flip-flop symbol.

Fig. 17 (centre): Nand gate flip-flop (a). This is sometimes drawn as shown in (b).

Fig. 18 (right): Active low SR flip-flop symbol.

We have two inputs labelled S and R and two outputs labelled Q and \overline{Q} (pronounced bar Q remember). Let us assume that S is at 1 and R at 0. Because S = 1, $\overline{Q} = 0$. At the input of gate two we have R = 0 and $\overline{Q} = 0$. The output of gate two is thus Q = 1. This has no effect on gate one.

Let us now take S to 0. We have S = R = 0. On gate one we have S = 0 and Q = 1 so the output of gate two stays \overline{Q} = 0. On gate two we have R = Q = 0, so the output of gate two stays Q = 1. With Q = 1, gate two is unaffected. The circuit remains with its outputs: Q = 1, $\overline{Q} = 0$.

Let us now take R to 1. The output of gate two, Q, goes to a 0. At the input of gate one we have Q = 0, S = 0. The output of gate one, \overline{Q} , goes to 1. At gate two's input we now have $\overline{Q} = 1$ and R = 1. The output of gate two stays Q = 0.

If we now take R = S = 0, as before, nothing will change and we are left with: Q = 0, $\overline{Q} = 1$.

The circuit thus has two stable states. The first is Q = 1, $\overline{Q} = 0$, when the S input was last at 1. The second state is Q = 0 and $\overline{Q} = 1$, when the R input was last at 1.

The first state is known as the "set" state and the second

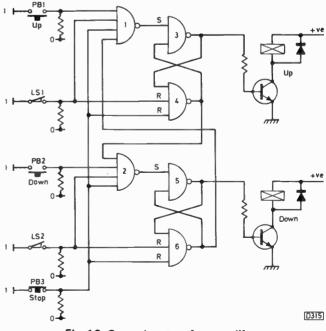


Fig. 19: Control system for a car lift.

as the "reset" state. Not surprisingly the S input stands for set and the R input for reset. (The reasons for the use of Q are lost in the mists of time.)

This circuit is known as an RS memory. It's also called an RS flip-flop or an RS statisciser (or stat for short). Often the RS label is omitted and it's simply called a flip-flop or stat. It has it's own circuit symbol, shown in Fig. 16.

It's possible to construct an RS memory from nand gates as shown in Fig. 17. This is set and reset by 0 at the inputs (rather than 1 in the nor constructed memory shown in Fig. 15.) We thus have:

a 0 on the S input sets Q to 1 and \overline{Q} to 0;

a 0 on the R input resets Q to 0 and Q to 1.

The nand constructed RS memory has the symbol shown in Fig. 18.

As with the gates, the circles show that the set and reset are active for a low signal.

An RS flip-flop is not the only type of memory. Other common types are the D type, toggle and JK flip-flops. These will be dealt with in the dictionary part of the article.

These then are the basic elements of digital control. Other more complex devices (such as monostables) will be dealt with in the dictionary.

Typical Control Scheme

A typical (but somewhat trivial) example of a control scheme is shown in Fig. 19. The device being controlled is a garage car hoist. There are three push buttons: PB1 up; PB2 down; and PB3 stop. Once the up button is pressed the lift goes up until limit switch LS1 opens or the stop button is pressed.

The operation is obvious, but there are a few points to note. Gates three and four form an RS flip-flop, activated by 0 at the S input. The flip-flop can be reset by a 0 at either of the two R inputs of gate four. Setting the flip-flop energises the up relay.

Gate one inhibits the setting of the up flip-flop if LS1 is open, the stop button is pressed or we are already going down (the latter being the purpose of the link from gate six, the \overline{Q} output of the down memory).

Gates two, five and six behave in a similar manner to energise the down relay.

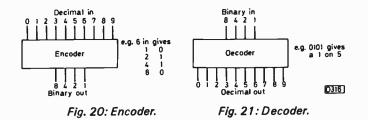
Both flip-flops are reset if the stop button is pressed.

Most television control schemes tend to be more complex than a car hoist, but the same basic gate functions apply. In addition, most TV logic systems operate at far higher speeds than the average relay system!

Number Crunching (or One Ten Buckle My Shoe)

Number crunching is the use of digital techniques to handle numbers. Before we can deal with the actual circuits we must, I'm sorry to say, indulge in a little mathematics.

We are used to counting in units, tens, hundreds etc., so the number 4057 means "four thousands plus no hundreds plus five tens plus seven units". This is counting to the base of ten.



It's possible to make a number system to any base. The only reason we use ten is simply because we have ten fingers. If the inhabitants of a planet round Alpha Centurai had six fingers they would probably count:

Base 6 0 1 2 3 4 5 10 11 12 13 14 15 or Base 10 0 1 2 3 4 5 6 7 8 9 10 11.

In Alpha Centuria, 14 means "one six plus 4 units"; 351 would mean "3 times 36 plus 5 sixes plus one unit."

Suppose we now want a number system based on two (don't ask awkward questions like why, all will suddenly come like day). This peculiar number system could only have two symbols 0 and 1. The columns (units, tens, hundreds and thousands in decimal) would be 1,2,4,8,16 etc. and we would count

0	
1	
10	
11	
100	
101	etc.

0

1

2

3

4

5

This number system is called binary. Remembering that each column stands for 1, 2, 4, 8 etc., we can look at the binary number 1011011.

We start taking units at the right (as usual) and say that this is:

one unit	1
plus one 2	2
plus no 4	0
plus one 8	8
plus one 16	16
plus no 32	0
plus one 64	64
Total	91 in decimal

All this may seem academic and laborious. After all, it's easy to write 91: 1011011 is laborious and a bit meaningless – imagine what 4057 would be like in binary (111111011001 actually).

But because we have only two symbols with this system, 0 and 1, it's very easy for electronic digital circuits to handle numbers in binary form. The large numbers of gates necessary to handle large numbers is no problem, since gates and flip-flops are cheap. The circuits won't get confused, like we would, with the binary numbers. The only restriction is that inputs to the system should be decimal, and outputs decimal, so that they are intelligible to us.

Decimal inputs are converted into binary form by a chip called an encoder. This takes in a 1 on one of the input lines and produces the correct binary pattern on the output (see Fig. 20).

Note that the binary output will be in the range 0000 to 1001. Incidentally, it's usual to draw diagrams with the smallest column to the right and the largest (in this case the column representing 8) to the left.

A binary digit is known in the jargon as a bit.

Readers might like to try to work out what goes on inside an encoder – it's just a load of or gates.

The opposite chip is called a decoder. This takes in a four bit binary number (as the jargon says) in the range 0000 to 1001 and puts a 1 on the corresponding output line (see Fig. 21).

Readers might again like to work out its innards. You will need a collection of and gates and inverters. As a start, the circuit for the 6 decode is shown in Fig. 22.

We can easily design an adder using gates. This is not

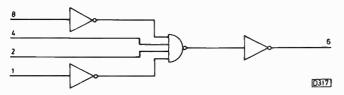


Fig. 22: Internal logic for decoding "6".

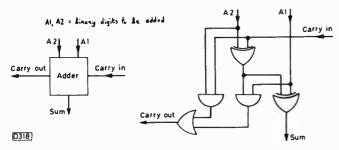


Fig. 23 (left): One-bit binary adder. Fig. 24 (right): Internal logic of a one-bit binary adder.

really the place to go into the intricacies of binary arithmetic circuits, but to add two binary digits (i.e. two bits) we need three inputs: the two bits to be added, and the carry bit from the lower column. We produce the answer bit plus a carry bit to the next highest column (see Fig. 23). The truth table for this is:

X	Y	Carry in	Sum	Carry out
0	0	Ó	0	Ó
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

The logic required to do this is relatively simple (see Fig. 24), but chips are available to do this. These are usually four bit adders, with carry into the bottom bit and carry out from the top so that 8, 12 bit adders can be made.

With an encoder, a decoder and an adder we can make a very simple adding machine. We have two decade switches SW1 and SW2, the outputs of which are encoded into binary form by IC1 and IC2. The two four-bit numbers are

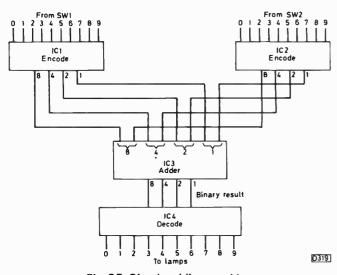


Fig. 25: Simple adding machine.

added by IC3 and the result (again in four bits) is decoded by IC4 to light one of the ten output lamps. Note that the result must be in the range 0-9. The adder will work with 7 + 2 but not 7 + 5 (see Fig. 25).

One final component of number crunching systems is a counter. This is constructed around the toggle flip-flop (described in the dictionary) but for our purpose here it's a box with one input and four outputs (see Fig. 26).

This counts pulses at its input, giving the answer in binary form at the output.

There are many variations on counters. They usually have a reset pin so that they can be reset to zero (0000). Counters are also available that can be preset to a given number before counting commences. Finally counters are available for counting up or down.

It's hard to believe, but even the largest computers in the world are just a collection of the control and arithmetic elements described so far.

Data Transmission

Finally we have the use of digital techniques to transmit analogue signals (e.g. conventional video or audio waveforms) by digital methods. All data transmission systems have a common block diagram (see Fig. 27). The input

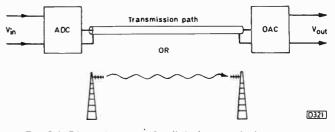


Fig. 27: Block diagram of a digital transmission system.

voltage is converted into a digital signal by a device called an ADC (see dictionary for further details). The digital signal is sent along the transmission path and at the receiver a DAC converts the digital signal back to an analogue one.

A somewhat pointless exercise you might think. The system does have some great advantages however. For example, a digital system cannot produce distortion due to differential phase and non linearities. Because the signal is simply on or off, it has excellent noise rejection. And with error correcting codes the transmission can be made almost error free.

Digital transmission has been used by the GPO for telephone links for some time, and TV pictures are linked to some IBA and BBC transmitters by digital links.

An interesting mixture of data transmission and number crunching techniques is the digital standards converter, where a 525-line TV signal is digitised, processed then reassembled as a 625-line signal.

TO FOLLOW: DICTIONARY OF LOGIC TERMS



Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 665 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

PYE HYBRID COLOUR CHASSIS

The contrast on this set is very weak, the picture being neither as crisp nor as bright as it was. The screen is fully illuminated, with little grain in the picture, which improves somewhat with time. The sound is perfect and the colour seems to be o.k. though perhaps it could be improved with more contrast.

First check the PL802 luminance output valve on the left side, and the voltages in this stage to see whether the circuit is otherwise fault-free. If everything seems to be in order here transfer attention to the i.f. panel, where VT6 which drives the contrast control, and its input coupling capacitor C36 (50μ F), are suspect. If necessary check the final i.f. transistor VT4.

ITT VC200 CHASSIS

When the set was first bought some years ago it was noticed that the brightness control had to be advanced beyond three-quarters of full rotation before the picture appeared, and usually had to be set at maximum for good contrast. The picture was very good though, so we left things alone. Faces are now a little too dark for pleasant viewing with artificial lighting however. The screen is well lit without a signal.

Component tolerances can combine to give an inadequate brightness range on this chassis – this seems to be borne out by the variations in the brightness control resistor network found in production. Try reducing by half the value of the resistor (R169, $47k\Omega$) connected between the brightness control and chassis; if necessary, increase the value of the resistor (R165, $4.7k\Omega$) between the HT4 rail and the brightness control by one or two preferred values.

PYE 169 CHASSIS

There's sound and a full-sized picture, but it's very dim. The contrast control works, and the brightness control has some effect. The line timebase valves have all been renewed and the h.t. lines are present – slightly high.

The voltage-dependent resistor between the brightness control and chassis sometimes changes value to cause this trouble. It's type E299/DD/P352. A check is to raise the normal voltage range of the brightness control by connecting a 100k Ω resistor in parallel with R35 which is between the HT3 rail and the other end of the brightness control. If this doesn't do the trick, check the voltages in the video output stage.

PYE 731 CHASSIS

The picture suffers from a high-frequency flicker, taking about two hours to settle down after switch on.

The trouble is very often due to the over-voltage protection circuit preset control RV879 being incorrectly set. Adjust it and RV916/7 (fine and coarse h.t. setting respectively) as set out in the manual. If the trouble persists, R924 ($8.2M\Omega$), the trigger diac D892 and the thyristor rectifier D888 (type 2N4444 with heatsink now the recommended type) are suspect.

HITACHI CNP192

This set gives a reasonable picture though there are some minor faults. First there's a slightly shaded band down the left-hand side of the screen. The verticals tend to bend to the right, and there's a slight purple patch at the top right-hand corner, noticeable mainly on monochrome.

The purple patch is likely to be due to tube magnetisation, which should be removed by repeated use of the set's degaussing circuit. If not, it can be cured by using an external degaussing coil. If the verticals tend to quiver as well as bending to the right, check the setting of the line oscillator coil T701 (line hold) and the flywheel sync discriminator diodes CR32/33. When adjusting T701, earth terminal B2 (input to the flywheel sync phase splitter) with an 0.1μ F capacitor. If the bending increases towards the edge of the screen and there's a tendency to pincushion distortion there could be a fault on the small side pincushion correction board. Correction adjustment is provided by R627 and L601 which are mounted just above the board. Unless you're sure that the vertical bending is associated with pincushion distortion however these controls should be left alone. The narrow band down the left-hand side could be due to a fault in the line output stage, but can sometimes be caused by a weak aerial input signal, especially if the lead is trailing close across the back of the set.

PYE 693 CHASSIS

There's a good picture on BBC-1 and -2, but on ITV the field slips and rolls rapidly. The fault is not due to the appearance of advertisements but occurs mainly when the picture contains a large white horizontal patch. Switching to either BBC programme will restore a steady picture and may restore ITV on switching back, but the picture will roll again as soon as the critical picture content occurs on ITV. The signal strength is good, and adjusting the field timebase controls has no effect on the fault.

This problem can be caused by the preset contrast control RV3 on the i.f. panel being over-advanced. It's more likely however that the trouble is in the sync separator stage. The most likely culprit here is the base bias resistor R33 (4.7M Ω) which tends to increase in value. If necessary, also check the load resistor R35 (82k Ω), the transistor itself (VT7, BC147) and the two diodes D3 and D4. All these are on the right-hand side of the panel.

ITT/STC VC4 CHASSIS

The trouble with this set is excessive buzz on 625 lines.

Replace the ratio detector diodes D1 and D2, using OA90s or OA91s, and the reservoir capacitor C103 (6.4μ F, 4.7μ F will do). Then carefully adjust the balance control R111 and the cores of the 6MHz tuned coils L56, L58 and L55 for minimum buzz. L56 and L58 are in the large rear can, while L55 is the top core in the can nearest the mains switch – of which beware!

TELEVISION OCTOBER 1978

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THORN 8800 CHASSIS

After about six hours the touch-tuned channels start to flash from 1 to 6 in short bursts. The overload cut-out then operates. If this is reset, the same thing happens after about a quarter of an hour. Resetting the cut-out will then result in it opening each time the set is switched on again.

If there's no sign of sparking or arcing around the c.r.t. base, anode connector or the line output stage, it's likely that the e.h.t. rectifier is faulty. First make sure that the c.r.t. aquadag is well bonded to the spark gap on the tube base however.

PHILIPS 11TG190AT

There's no raster on this set, the c.r.t. first anode voltage being 12V instead of 315V. The line output transformer and the diode and capacitor which produce the c.r.t. first anode supply have been replaced – with the capacitor removed the voltage rises to about 80V and a dim raster with vertical bars appears. The line output transistor voltages seem to be correct.

You don't say whether the voltage regulator is working normally. Check the current through the 2A fuse – should be about 1.5A. If this is low, check the three transistors in the regulator circuit – the AC128 is the most likely culprit. Make sure that the output is 11V (set by R4043) – measure between the collector of T1513 (AD149) and chassis. Also ensure that the replacement line output transformer has the same colour coding for the wiring – different suppliers are not too careful about this. Check the diodes in the line output stage – X2013/4/5/6. Is the sound section working? If not, there could be a heavy current drain here. Another suspect is the boost capacitor C2096. The system switching could be in need of cleaning of course.

DECCA 30 CHASSIS

There's colour loss on this set. The picture appears in full colour when the set is first switched on, but once the set's got warm the colour fades out, leaving a good monochrome picture. During the course of the evening the colour may return for a short period, but will then fade out again. Another decoder panel was tried, but the trouble remains.

This sort of trouble is usually due to intermittent failure of the second chrominance amplifier TR206, the delay line driver TR207 or the crystal. TR206's emitter is decoupled by an electrolytic C224 $(33\mu F)$ which can sometimes play tricks. Another electrolytic worth checking is the colourkiller reservoir capacitor C232 which is also $33\mu F$. If your're sure that the replacement panel is o.k. however check whether the 25V supply line is correct during the fault, and ensure that the leads to the colour control are making good contact. If these points are in order, concentrate on the pulse feed to the decoder via PD10: if the pulses are mistimed, distorted or absent the result will be no colour.

THORN 1590 CHASSIS

There are five dark vertical bars, each an inch wide and an inch apart, superimposed on the picture. They are still present with no signal.

If there's no damping resistor across the line linearity coil L15 try adding one (560 Ω). If this doesn't do the trick, check the 95V supply reservoir capacitor C111 (1 μ F) which is a non-electrolytic type in later production sets. Further possibilities are the flyback blanking clipper diode W15 and the 300V supply reservoir capacitor C110 (10 μ F).

GRUNDIG 1500GB

When the set is first switched on a weak, negative monochrome display appears, with weak field and line hold. A strong colour picture with good field and line lock comes on after a couple of minutes.

This problem is usually traceable to poor joints in the early vision i.f. stages. If you are lucky, you'll find the cause of the trouble on the luminance delay line or one of the small post-detector chokes -L351 or those in the i.f. can. The fault might be buried in the rather inaccessible i.f. strip however. Careful tapping and probing should tie it down.

GEC C2110 SERIES

The set behaves perfectly for long periods, with a good colour picture, then it flicks and a greenish tinge appears. It then flicks back to normal colour. These flicks between normal and greenish colour seem to be more prevalent when the set has thoroughly warmed up, but can occur at any time.

The fault could be due to several different things, but we've usually found it to be due to the small $2.2k\Omega$ preset control P303 (set G – Y level) which feeds pin 11 of the chrominance demodulator i.c. (IC301, TBA990) on panel PC457. Moving the body of the control with a finger is generally sufficient to establish its guilt, although a dry-joint to the panel could be the cause.

THORN 1590 CHASSIS

There's brightness trouble on this set, sometimes an intermittent change in brightness level, more often a slow change in the brightness, leaving the picture over bright. The brilliance and contrast controls are o.k., and there's no detectable change in the voltage fed to the brightness control. The voltage at the collector of the video output transistor is on the high side, while the d.c. voltage at the cathode of the c.r.t can be seen to be changing very slowly. The board has been checked for cracks and dry-joints and the 95V supply reservoir capacitor has been replaced.

The fact that the voltage change can be measured at the c.r.t. cathode suggests that the trouble is in the video circuit. We suggest you replace the output transistor's collector load resistor R51 ($6.8k\Omega$) and if necessary check by substitution the video output transistor VT9 and the preceding, d.c.-coupled emitter-follower VT6. Other possibilities are C36 (4.7μ F) which smooths the bias applied to VT6 and C51 (100μ F) which is in series with the slider of the contrast control. Use of a hairdryer and freezer aerosol may help locate the culprit. If you are unlucky, the c.r.t. could be faulty with a grid-cathode leak.

ITT CVC5 CHASSIS

The trouble with this set is intermittent poor focus. On one recent occasion the focus was so bad that the picture seemed to be broken up. I've checked the high-value (4.7M Ω) resistors in series with the focus VDR and the 2.2M Ω resistor in series with the c.r.t.'s focus electrode visually and for dry-joints, but they seem to be in order.

It's still worth changing these three resistors since they can be responsible for this trouble. The symptom is often due to invisible corona discharge and leakage at the two spark gaps associated with pin 9 on the c.r.t. base panel however. Clean them with methylated spirit, and slightly enlarge them with a small file. Make sure that pin 9 is making good contact with its socket.

ITT VC200 CHASSIS

It takes anything up to an hour for the picture to reach the correct brightness. It's very dull, and out of focus around the edges. The line output stage has been checked thoroughly, and new valves have been fitted. Valve voltages seem to be correct but the c.r.t. first anode voltage is about 450V instead of the 660V quoted on the circuit. The brightness control has to be fully advanced. The focus control measures about $1.5M\Omega$ instead of $2M\Omega$.

The focus potentiometer often does fall in value, reducing the c.r.t.'s first anode voltage. Under normal circumstances however we find that the c.r.t. first anode voltage rarely



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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 Thorn monochrome mains/battery portable, Model 3845 (1690 chassis), would work for hours on end on its loop aerial without trouble. Sound and vision sensitivity were both remarkably high, and the picture was of good quality in all but difficult areas. Every now and again however the screen would gradually brighten, and the contrast would decrease until eventually the picture was only vaguely discernible below the high screen brightness.

Sometimes the effect would clear on its own, either gradually as it started, or suddenly, the screen then clearing and the contrast reverting to normal. The fault condition sometimes occurred a short period after switch-on, or during a programme sequence after the set had been working for several hours.

After operating normally on the test bench for most of a morning the symptom suddenly occurred. Quick adjustments were made to the controls in an endeavour to gain some idea of the whereabouts of the fault. It was found that the range of brightness control was curtailed when the fault was present, and that the contrast control had hardly any influence at all on the "brightened-out" picture in the background. Before further tests could be made the fault cleared!

The fault lasted a little longer the next time, allowing measurements to be made at the tube base connector. It was found that both the cathode and grid potentials were on the low side, particularly the cathode potential, which tended to fluctuate with brightness change more than would be expected as a result of picture signal brightness changes. At this stage a test prod was unwittingly knocked against the tube neck and the fault cleared.

It was found that the fault could be cleared by switching the set off and then on again quickly. Various video output attains the 660V claimed. The symptoms you quote suggest that the c.r.t. is almost certainly low emission. Reactivation may improve it for a while, but a regunned tube would be a lasting cure.

THORN 8500 CHASSIS

The trouble with this set is that there are horizontal shadows, varying in width, across the picture.

If the bars are not "lined up" with the picture features (smearing), check the a.g.c. smoothing capacitor C111 (10 μ F). If the effect is heavy, picture-dependent smearing, check the luminance coupling capacitor C174 (3.3 μ F).

stage components, including the BF391 transistor, were replaced but the fault would still occur. The components and the printed circuit board in this area were subjected to heat and freezing liquid, but the fault could not be encouraged to develop in this way.

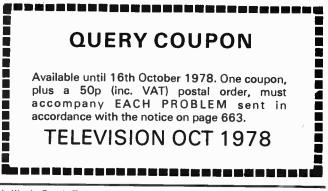
What was the most likely cause of the trouble, and what significant clue, if any, was overlooked by the service technician? See next month for the solution and for a further item in the series.

SOLUTION TO TEST CASE 189 ---- Page 608 last month ----

Receivers using an ECC82 multivibrator field generator are very susceptible to small changes in value of the anode load resistors, particularly the resistors connected to the anode of the second triode section, i.e. in the field charging circuit. This is one reason why a VDR is used to stabilise the supply against load variations. It's not possible to determine whether a resistor is subject to such value variations merely by measuring it with an ohmmeter; neither is it possible to achieve a sensible reading by measuring the anode potential with a $1,000\Omega/V$ meter!

The symptom described is very often caused by slight electrical inconsistency in one of the resistors in series with the height control. The only way to prove this is to extract the suspect component and solder in a replacement.

It was discovered that the $560k\Omega$ resistor (R526) connected to the top of the height control was causing the trouble, a good quality replacement completely curing the effect. It was not possible to detect any fault in the extracted resistor by making an ordinary ohmmeter test: a fair current has to flow through the resistor before the fault occurs.



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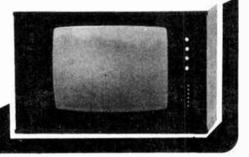
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5Z3	1.40	6GH8A	0.80	30PL13	1.30	ECH81	0.55	KT88	6.75	QQV03	/10
5Z4G	0.75	6GK 5	0.75	30PL14	1.50	ECH84		P61	0.60		2.0
5/30L2	0.90	6GK6	2.00	50CD60	3	ECL80	0.55	PC86	0.80	QV06/2	0
SAC7	0.70	6GU7	0.90		4.00	ECL82	0.60	PC88	0.80		4.7
SAG7	0.70	6H6GT	0.50	85A2	1.40	ECL83	1.50	PC92	0.65	R10	5.0
6AH6	0.70	6J5GT		807	1.10	ECL86	0.64	PC97	0.75	R 19	0.7
SAK5	0.45	6J6	0.35	5763	3.65	EF22	1.00	PC900	0.65	UABCE	20
SAM8A	0.70	6JU8A	0.90	AZ31	1.00	EF40	1.00	PCC84	0.39	UNDER	0.4
AN8	0.78	6K7G	0.50	AZ41	0.50	EF41	1.00	PCC85	0.47	UAF42	
5AQ5	0.75	6K8G	0.50	DY51	2.00	EF80	0.40	PCC89	0.49		
SAR5	1.05	6L7(M)		DY86/7		EF83	1.70	PCC18	90.60	UBC41	
6AT6	0.60	607G	0.75	DY802		EF85	0.45	PCF80	0.80	UBC81	
SAU6	0.55	6SA7	0.70	E80CF		EF86	0.52	PCF82	0.45	UBF80	
SAV6	0.65	6SG7	0.70	E88CC		EF89	0.55	PCF86	0.57	UBF89 UC92	
5AW8A		6SJ7	0.70	E80F E188CC	5.50	EF91	0.70	PCF200		UCC85	0.5
6AX4	0.75	6U4GT		EI88CC	5.00	EF92	0.70	PCF20			
68A6	0.75	6V6G	0.50	E280F		EF 183	0.50	PCF801		UCF80	
				EA50	0.40	EF 185	0.50	PCF802		UCH42	
6BC8	0.90	6X4	0.95	EABC8		EH90	0.75	PCF80		UCH81	
6BE6	0.70	6X5GT			0.48		2.50	PCF806		UCL82	
6 BH 6	1.10	9D7	0.70	EAF42		EL34		PCH20		UCL83	
6 B J6	0.75	10C2	0.70	EAF80		EL41	L00	PCL82		UF41	0.7
SBK7A		10DE7		E891	0.25	EL81	L00	PCL82		UF42	1.0
SBN8	1.50	10F I	1.00	EBC41		EL84	0.48	PCL83		UF80	0.4
5BQ7A		10F18	0.65	EBC81		EL95	0.95	PCL84		UF85	0.5
58R7	1.00	10P13	0.80		1.00	EL360	2.50	PCL80		UF89	0.5
5 8R 8	1.25	10P14	2.50	E8F89		EL506	2.00	PFL200		ULAI	0.9
68W6	3.75	12AT6		EC86	0.84	EL509	2.50	PL33	1.00	UL84	0.9
6 8W7	0.65	12AU6		EC88	0.84	EM80	1.00	PL35	0.80	UM80	1.0
6 8 Z 6	1.50	12AV6		EC92	1.00	EM81	1.00	PL30	0.80	UY41	0.7
6C4	0.50	128A6		EC97	0.75	EM84	1.00	PL81A		UY85	0.7
6C9	2.00	128E6	0.85	ECC33		EM87	1.45			U19	4.0
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6CL6	0.75	19G6	6.50	ECC82		EY87/6		PL95	1.00	U301	1.0
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6CM7	1.00	20P I	1.00	ECC84	0.50	EY500	1.45	PL508	L85	U801	1.0
6CU5	0.90	20P4	0.84	ECC85	0.50	EZ40	1.00	PL509	3.10	X41	1.0
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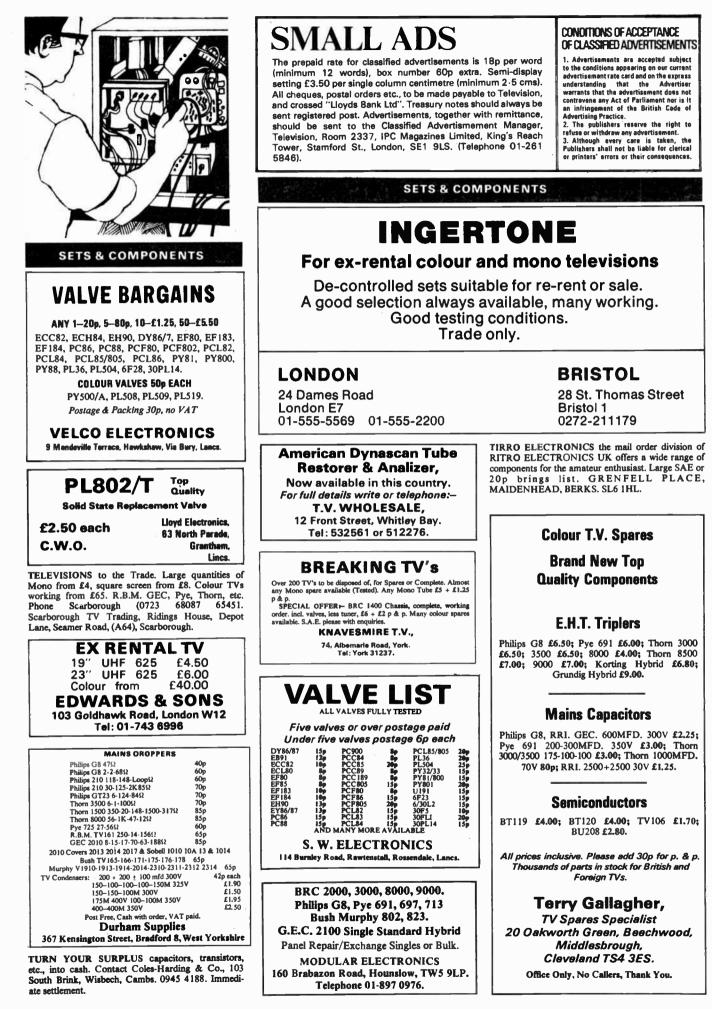
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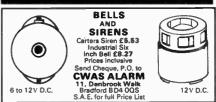
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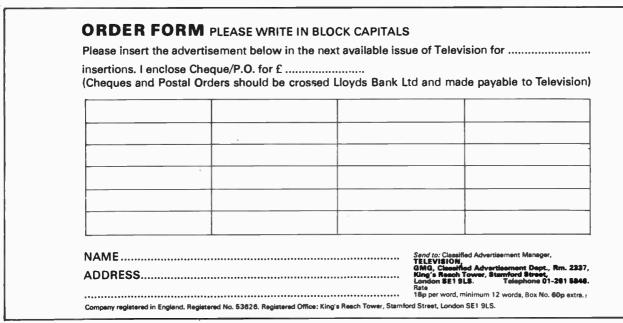
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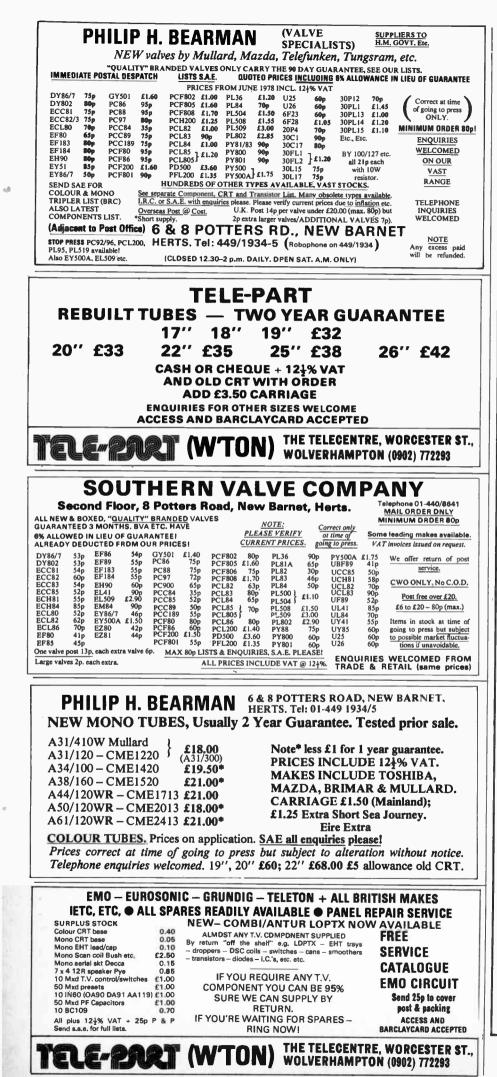
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Transistor BF180-1	16172 RCA BT119 Type	£1.00	CEI		າດາ		
UHF Tuner Unit			JEI			MPONI	
with AE Socket &	AT1025/08 Blue					ANGE CLO	
Leads. G.E.C.	Lateral Ass.	25p				AY, ESSEX	
Rotary Type £1.35 New	E1222	15p				ice only –	1
New VHF/UHF	BSY95A	7 1 p	Ľ			ent only. Than plies in U.K. on	
Varicap Units	2N930	7 1 p				D 12 1 % VA	•
AEG £3.00	4.7NF 5kV	1 0 p		I LLAU			
TRAN	OUTPUT ISFORMERS ms new and gu	uarante	(No E. ed DISC	DNO TRA xtra for Carriage COUNT FOR TRADE.	2)	ORMER @ 12 1 2% TOTAL	£7·45 -93 £8·38
BUSH TRAN	ISFORMERS	uarante	(No E. ed DISC	xtra for Carriage N COUNT FOR	2)	֎ 12 <u></u> 12% TOTAL	.93
BUSH TV102C TV128 TV TV103 or D TV134 TV TV105 or D TV135 or R TV TV105 TV TV135 or R TV TV107 TV141 TV TV TV108 TV145 TV TV TV1120 TV161 TV TV TV115 or C TV165 TV TV115 or C TV165 TV TV118 TV175 TV TV123 TV176 TV	ISFORMERS ms new and gu	DM35 DM36 DR41 DR41 DR45 DM55 DM56 DM56 DR56 DR56 DR56 DR56 DR10 DR101 DR101 DR121	(No E. ed DISC	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V159 V173 V159 V173 V1910 V1910 V1910 V1914 V2014 or S V2015D V2015S	VAT	@ 12 ¹ / ₂ % TOTAL PS 00u 19TG170a all models to 05u 19TG179a 00u G19T211a 20u G19T211a 20u G19T212a G19T314a 08u G19T215a	.93
BUSH TV102C TV128 TV TV103G or D TV134 TV TV105 or D TV135 or R TV TV105 or D TV135 or R TV TV105 or D TV135 or R TV TV105 r TV135 or R TV TV105 r TV135 or R TV TV105 r TV135 or R TV TV106 TV135 or R TV TV107 TV141 TV TV108 TV145 TV TV113 TV165 TV TV115 or C TV165 TV TV115 R TV171 TV TV123 TV176 TV TV124 TV178 TV TV125 or U TV181 or S TV	DECCA 183 or D 183 or D 183 or D 183 or D 185 S 185 S 186 or D 186 or D 186 or D 186 or D 1865 S 191D 193D 193S 193S 193 193 193 198 307 198 313 315	DM35 DM36 DR41 DR41 DR45 DM55 DM56 DM56 DR56 DR56 DR56 DR56 DR10 DR101 DR101 DR121	(No E. ed DISC DR123 DR202 DR303 DR404 DR505 DR606 661V-SRG MS170C MS2001 MS2400 MS2400 MS2404 MS2404 MS2420	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V179 V173 V179 V173 V179 V179 V1910 V1913 V1910 V1913 V2014 or S V2015D V2015S V2015S V2015S V2016S V2017S	PHILU PHILU 17TG1 17TG1 17TG1 17TG2 17TG3 17TG3 19TG10 all mod 19TG10 PYE	12½% TOTAL 19TG170a all models to G19T211a G19T212a G19T212a G19T215a els to G20T230a all models to G20T328 21TG102u C19T2u	•93 £8•38 21TG106u 21TG107u 21TG109u 23TG111a all models to 23TG170a all models to 23TG176a G24T230a all models to G24T310
BUSH TV102C TV128 TV TV103G or D TV134 TV TV105 or D TV135 or R TV TV105 or D TV135 or R TV TV105 or D TV135 or R TV TV105 r TV135 or R TV TV105 r TV135 or R TV TV105 r TV135 or R TV TV106 TV135 or R TV TV107 TV141 TV TV108 TV145 TV TV113 TV165 TV TV115 or C TV165 TV TV115 R TV171 TV TV123 TV176 TV TV124 TV178 TV TV125 or U TV181 or S TV	Decca 183 or D 185 S 185 S 186 or D 186 or D 186 or D 1865 S 191D 193D 1933 1933 1938 307 1938 207 1938 207 2030 C11.00 0. 8ASE 00062 81454	DM35 DM36 DR41 DR45 DR45 DR45 DR55 DR61 DR55 DR61 DR100 DR121 DR122 T418 TO T By Chas VC1	(No E. PCR 123 DR 123 DR 202 DR 303 DR 404 DR 506 DR 506 SofortV-SRG MS2000 MS2400 MS2400 MS2400 MS2401 MS2401 MS2401 MS2401 MS2401 Sis: VC52	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V173 V179 V1910 V1913 V1914 V2014 or S V2015D V2015S V2015S V2015S V2015S V2016S V2017S V2017S V2019 V2023 V2027 V2021 V2021 V2021	PHILII PHILII 17TG11 17TG11 17TG21 17TG31 17TG31 17TG31 17TG31 17TG31 17TG31 17TG31 17TG31 17TG31 17TG31 17TG14 17TG34	12 12 % TOTAL 19TG170a all models to G19T210a G19T210a G19T210a G19T212a G19T212a G19T215a els to 64a 21TG100u 21TG102u 0F 58 64 81 38 60 75 84 9 61 76 85 0 62 77 86	•93 £8.38 21TG106u 21TG107u 21TG107u 21TG109u 23TG111a all models to 23TG176a 23TG176a 23TG176a 23TG176a 624T230a all models to 624T310 93 161 94 150 170 95/4 155 171 96 155 171
BUSH TV102C TV128 TV TV103 or D TV134 TV TV105 or D TV135 or R TV TV105 T TV138 or R TV TV106 TV138 or R TV TV107 TV141 TV TV108 TV145 TV TV112C TV66 TV TV115 or C TV66 TV TV122 or U TV171 TV TV123 TV176 TV TV124 TV181 or S TV BUSH A816 CHASSIS TV TV BAIRD PLEASE QUORE PART N PLATE 4133, 4123, 4140 OR TT CVC1 TO CVC20 CHASS PHILIPS G8 CHASSIS TT DECCA CS1730 GS1830 DECCA 30 SERIES BRADFORD CHASSIS	DECCA 183 or D 183 or D 183 or D 183 or D 183 S 185 S 185 S 185 S 186 or D 191D 193D 193D 193B	DM35 DM36 DR41 DR45 DR49 DR45 DR49 DR45 DR55 DR61 DR95 DR100 DR100 DR100 DR100 DR100 DR121 DR101 DR121 T418 TO T KB-ITT By Chas VC1 VC2 VC3 VC1 VC1 VC1 VC1 VC1 VC1 VC1 VC1 VC1 VC1	(No E. ed DISC DR123 DR202 DR303 DR404 DR505 DR606 566TV-SRG MS2001 MS2400	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V159 V173 V159 V173 V1910 V1913 V1914 V2014 or S V2015S V2015S V2015S V2015S V2015S V2016S V2017S V2019 V2023 V2027 V2027 V2021	PHILUI 17TG1 17TG1 17TG1 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG1 17TG2 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG2 17TG3 1	 12¹/₂% TOTAL PS DOu 19TG170a all models to G19T217a COU G19T217a C	•93 £8.38 21TG106u 21TG107u 21TG107u 21TG109u 23TG111a all models to 23TG164a 23TG176a 23TG176a 23TG176a G24T230a all models to G24T310 93 161 94 150 170 95/4 155 171 97 156 171/19 8 160 DUP A.V., Marconi, Ultra.
BUSH TV102C TV128 TV TV103 or D TV134 TV TV105 or D TV135 or R TV TV105 rd TV138 or R TV TV105 rd TV138 or R TV TV107 TV141 TV TV108 TV145 TV TV112 C TV165 TV TV113 rv165 TV TV TV123 TV176 TV TV123 TV176 TV TV124 TV178 TV TV125 or U TV181 or S TV BUSH A816 CHASSIS TV TV BAIRD PLEASE QUOTE PART N NORMALLY FOUND ON TX PLATE 4133, 4123, 4140 OR TV TV COLOUR TRANSFORMEF ITT CVC1 TO CVC20 CHASS PHILIPS G8 CHASSIS DECCA CS1730 GS1830 DECCA 30 SERIES BRADFORD CHASSIS	DECCA 183 or D DR1 183 S DR2 183 S DM3 185 S DM3 185 S DM3 186 or D DR20 1865 S DR21 191D DR24 191D DR32 307 DR33 313 DR30 313 DR32 307 DR33 313 DR34 315 EKCO C11.00 GEC 0. BKE 00062 BT455 IS 2000DST all models t 2084 2084 2047 2084 2044 2084 2104 or/1 2105 or/1 2104 or/1	DM35 DM36 DM39 DR41 DR49 DM55 DR56 DM56 DM56 DM56 DM56 DM56 DM56 DR71 DR100 DR101 DR121 DR121 DR121 DR121 DR121 MB4 DR121 CC3 VC4 VC3 VC4 VC51 Or quo NDES1	(No E. PC (No E. PC (No E.) PR-123 DR202 DR303 DR404 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR505 DR506 Sis: VC52	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V159 V173 V179 V1910 V1910 V1910 V1910 V1913 V1914 v2014 or S V20155 V20155 V20155 V20155 V20155 V20155 V20165 V20175 V20175 V20175 V20175 V2019 V2027 V2027 V2027 V2027 V20210 V2019 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2023 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2027 V20219 V2023 V2027 V20219 V2027 V20219 V2027 V2027 V20219 V2027 V2027 V2027 V2027 V2027 V2019 V2027 V207 V20	PHILII PHILII 17TG11 17TG11 17TG11 17TG21 17TG33 19TG10 19TG10 19TG10 PYE 11u 4 31F 4 32F 4 32F 4 32F 5 39F 5 SOBEL ST1960 ST197 ST290 ST297 100005 all model 1102	@ 12½% TOTAL Ps DOu 19TG170a D2u all models to DOu G19T217a DOu G19T215a Els to G2OT230a All models to G2OT328 21TG100u 21TG102u OF 58 64 SF 59 68 83 8 60 75 84 9 61 76 85 SO 62 77 86 3 63 80 92 L THORN GRC Ferguson, H.N. By Chassis: - - 800, 850, 90 Son, 1500, 1500, 1500, 1500, 1500, 1500, 1500, 1500, 1	•93 £8.38 21TG106u 21TG107u 21TG107u 21TG109u 23TG111a all models to 23TG176a 23TG176a 23TG176a 23TG176a 624T230a all models to 624T310 95/4 151 170/1 96 155 171 97 156 171/1 98 160 DUP A.V., Marconi, Ultra. 0.950/1,950/2, 70,980,981, 1500 (24''), 1591,1592,1600, el No.
BUSH TV102C TV12B TV TV102G D TV134 TV TV105G D TV135 or R TV TV105G D TV135 or R TV TV105G T TV138 or R TV TV105G T TV135 or R TV TV107 TV141 TV TV108 TV145 TV TV112C TV161 TV TV113 T TV165 TV TV113 T TV165 TV TV122 TV178 TV775 TV TV123 TV176 TV TV TV124 TV178 TV TV BUSH A816 CHASSIS TV TV BUSH A816 CHASSIS TV TV TV125 or U TV181 or S TV COLOUR TRANSFORMEE ITT CVC1 TO CVC20 CHASS PHILIPS	DECCA 183 or D DR1 183 S DM3 183 S DM3 185 S DM3 185 S DM3 185 S DM3 186 or D DR20 1865 S DR31 1915 DR30 193D DR30 193S DR31 193 DR32 307 DR33 313 DR34 215 EKCO C11.00 GEC 8ASE BT455 00062 BT455 IS 2000DST 2044 2047 2084 2104 or/1 2105 or/1 2105 or/1	DM35 DM36 DM39 DR41 DM45 DR49 DM55 DR61 DR71 DR100 DR101 DR101 DR121 DR121 DR122 T418 TO T KB-IJT By Chas VC1 VC2 VC3 VC4 VC1 VC51 Or quo to INDESI 20EG8 24EG8	(No E. ed DISC DR123 DR202 DR303 DR404 DR505 DR606 661TV-SRG MS2001 MS2001 MS2000 MS2400	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V173 V179 V1910 V1913 V1914 V2014 or S V2015S V2015S V2015S V2015S V2015S V2015S V2015S V2015S V2015S V2015S V2015S V2015S V2017S V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2023 V2017S V2019 V2023 V2017S V2019 V2015S V2016S V2015S V2016S V2015S V2016S V2015S V2016S V2017S V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2018 V2017S V2019 V2018 V2019 V2018 V200 V2018 V200 V20	PHILUI PHILUI 17TG1 17TG1 17TG1 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 17TG1 17TG2 17TG3 17TG3 17TG3 17TG3 17TG2 17TG3 17TG3 17TG2 17TG3 17TG2 17TG3 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG2 17TG3 17TG3 17TG2 17TG3 17TG2 17TG3 17TG1 17TG2 17TG3 17TG2 17TG3 17TG1 17TG1 17TG1 17TG2 17TG3 17TG1 17TG1 17TG1 17TG2 17TG3 17TG3 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG1 17TG2 17TG3 17TG1	 12¹/₂% TOTAL PS DOu 19TG170a all models to G19T217a DOu G19T217a COU G19T215a COU C20T230a all models to G20T328 C19T215a C20T328 C19T217a C20T328 C19T215a C20T328 C19T210a C19T215a C20T328 C19T215a C19T215a C100u C19T215a C100u C19T215a C100u C19T215a C19T215a	•93 £8.38 21TG106u 21TG107u 21TG107u 21TG109u 23TG111a all models to 23TG176a 23TG176a 23TG176a 23TG176a 624T230a all models to 624T310 95/4 151 170/1 96 155 171 97 156 171/1 98 160 DUP A.V., Marconi, Ultra. 0.950/1,950/2, 70,980,981, 1500 (24''), 1591,1592,1600, el No.
BUSH TV102C TV128 TV TV103G or D TV134 TV TV105G or D TV135 or R TV TV105G rD TV135 or R TV TV107 TV141 TV TV108 TV145 TV TV115 or C TV65 TV TV115 or C TV165 TV TV112 TV18 TV175 TV TV123 TV176 TV TV123 or U TV181 or S TV TV124 TV178 TV TV125 or U TV181 or S TV BUSH A816 CHASSIS D D BUSH A816 CHASSIS D D TV125 or U TV181 or S TV TV124 TV176 TV DORMALLY FOUND ON TX PLATE 4133.4123.4140 OR <	DECCA 183 or D 183 or D 183 S 185 S 186 or D 186 S 191 S 191 S 193 D 07 D 207 D 313 DR34 211.000 0. 8ASE 00062. 81454 81455 874555 15 2000057. 31 models t 2044 2044 2044 2044 2044 2044 2044 2044 205 or /1 <	DM35 DM36 DM39 DR41 DM45 DR49 DM55 DR61 DR71 DR100 DR101 DR121 DR122 T418 TO T KB-IJT By Chas VC1 VC2 VC3 VC4 VC1 VC51 Or quo to INDESI 20EG8 24EG8	(No E. PCR 123 DR 123 DR 123 DR 202 DR 303 DR 404 DISC DR 506 Soft V-SRG MS2000 MS2400 MS2	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V173 V179 V173 V179 V1910 V1913 V1914 V2014 or S V2015D V2015D V2015S V2015S V2015S V2016S V2017S V2016S V2017S V2017S V2019 V2023 V2027 V2017 V2019 V2023 V2027 V2017 V2019 V2023 V2027 V2017 V2019 V2023 V2027 V2017 V2019 V2023 V2027 V2016 V2015S V2016S V2015S V2016S V2017S V2017S V2017S V2017S V2018 V2017S V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2019 V2023 V2027 V2019 V2023 V2027 V2010 V2019 V2023 V2017S V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2028 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2023 V2027 V2018 V200 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V2018 V20	PHILU PHILU 17TG1 17TG1 17TG1 17TG3 17TG3 17TG3 17TG3 17TG3 17TG3 19TG11 17TG2 17TG3 17TG1 17TG3 1	@ 12 1/2% TOTAL Ps 000 19TG170a 020 all models to 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T215a 019T215a G20T328 200T328 21TG100u 21TG102u G19559 064a G20T328 21TG102u G1558 07 S4 9 G1 363 80 9 G1 07 S4 9 G1 07 S50/3, 960, 9 363 80 92 H HORN GRG Ferguson, H.N. 8y Chassis: - 800, 850, 900; 950/3, 960, 9 950/3, 960, 9 150, 1590; 1512, 1513. 0r qu	•93 £8.38 21TG106u 21TG107u 21TG109u 23TG111a all models to 23TG176a all models to 23TG176a G24T230a all models to G24T310 93 161 94 150 170 95/4 151 170/1 96 155 171 97 156 171/1 97 156 171/1 98 160 DUP A.V., Marconi, Ultra. 0, 950/1, 950/2, 1591, 1592, 1600, el No. td., o 1 pm.
BUSH TV102C TV128 TV TV103G or D TV134 TV TV105 or D TV135 or R TV TV107 TV141 TV TV108 TV145 TV TV115 or C TV65 TV TV115 or C TV165 TV TV113 TV16 TV TV TV123 TV176 TV TV TV124 TV178 TV TV TV125 or U TV181 or S TV BUSH A816 CHASSIS TV TV BUSH A816 CHASSIS TV TV TV125 or U TV181 or S TV TV124 TV178 TV178 TV TV125 or U TV181 or S TV TV125 or U TV181 or S TV	DECCA 183 or D DR1 183 S DM3 183 S DM3 185 S DR20 186 or D DR20 186 S DR21 186 S DR23 191 S DR30 193 D DR30 193 D DR31 193 D DR33 307 DR33 315 EKCO C11.00 GEC 8ASE 00062 8T455 BT455 S 2000DST 2044 2044 2047 all models t 2084 2104 or /1 2105 or /1 105 or /1	DM35 DM36 DM39 DR41 DM45 DR49 DM55 DR61 DR71 DR100 DR101 DR121 DR122 T418 TO T KB-IJT By Chas VC1 VC2 VC3 VC4 VC1 VC51 Or quo to INDESI 20EG8 24EG8	(No E. ed DISC DR123 DR202 DR303 DR404 DR505 DR606 S66TV-SRG 6777TV-SRG MS2001 MS2400 MS2400 MS2400 MS2400 MS2400 MS2400 MS2401 MS2400 MS24	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V159 V173 V1910 V1910 V1910 V1910 V1913 V1914 v2014 or S V2015S V2015S V2015S V2015S V2015S V2015S V2016S V2017S V2015 V2017S V2017S V2019 V2027 V2010 V2019 V2027 V2019 V2027 V2019 V2019 V2015 V2015S V2017S V2017S V2017S V2017S V2018S V2018S V2019 V2017S V2019 V2017S V2019 V2018S V2019 V2018S V2019 V2018S V2019 V2018S V2019 V2018S V2019 V200 V200 V200 V200 V200 V200 V200 V20	PHILII PHILII 17TG11	@ 12 1/2% TOTAL Ps 000 19TG170a 020 all models to 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T210a 000 G19T215a 019T215a G20T328 200T328 21TG100u 21TG102u G19559 064a G20T328 21TG102u G1558 07 S4 9 G1 363 80 9 G1 07 S4 9 G1 07 S50/3, 960, 9 363 80 92 H HORN GRG Ferguson, H.N. 8y Chassis: - 800, 850, 900; 950/3, 960, 9 950/3, 960, 9 150, 1590; 1512, 1513. 0r qu	•93 £8.38 21TG106u 21TG107u 21TG109u 23TG111a all models to 23TG176a all models to 23TG176a G24T230a all models to G24T310 93 161 94/150 170/1 95/4 151 170/1 95/4 151 170/1 97 156 171/1 97 156 171/1 98 160 DUP A.V., Marconi, Ultra. 0.950/1,950/2, 1591,1592,1600, el No. td.,
BUSH TV102C TV128 TV TV103G or D TV134 TV TV105G or D TV135 or R TV TV105G rD TV135 or R TV TV107 TV141 TV TV108 TV145 TV TV115 or C TV65 TV TV115 or C TV165 TV TV112 TV18 TV175 TV TV123 TV176 TV TV123 or U TV181 or S TV TV124 TV178 TV TV125 or U TV181 or S TV BUSH A816 CHASSIS D D BUSH A816 CHASSIS D D TV125 or U TV181 or S TV TV124 TV176 TV DORMALLY FOUND ON TX PLATE 4133.4123.4140 OR <	DECCA 183 or D DR1 183 or D DR2 183 or D DR2 183 SS DM3 185S DM3 185S DM3 185S DR3 186 or D DR20 1865 DR23 191D DR24 191S DR30 193D DR30 193B DR31 193B DR32 307 DR33 313 DR34 200062 BT455 8T455 BT455DST IS 2000DST all models t 2044 2044 2104 or /1 2105 or /1 2105 or /1 H MON-FRI 9 am to 12.30 130 pm to 4.30 130 pm to 4.30	DM35 DM36 DR41 DR49 DR41 DR49 DR45 DR49 DR45 DR45 DR55 DR61 DR95 DR100 DR101 DR121 DR121 DR121 T418 TO T KB-ITT By Chas VC1 VC2 VC3 VC4 VC1 VC51 Or quoi to INDESI 20EGB 24EGB	(No E. ed DISC DR123 DR202 DR303 DR404 DR505 DR606 566TV-SRG MS170C MS2400 MS2400 MS2400 MS2400 MS2401 MS2404 MS2404 MS2404 MS2404 MS2404 MS2404 MS2404 MS2404 MS2404 MS2404 MS2404 MS2400	xtra for Carriage COUNT FOR TRADE. MURPHY V843 all models to V979 V153 V159 V173 V179 V1910 V1913 V1914 V2014 or S V20155 V20155 V20155 V20155 V20155 V20155 V20155 V20155 V20165 V20175 V2019 V2023 V2027 V2019 V2023 V2027 V2019 V2023 V2019 V2019 V2019 V2019 V2018 V2015S V2019 V2018 V2019 V2018 V2019 V2018 V2019 V2018 V2019 V2019 V2019 V2019 V2019 V2019 V2019 V2019 V2018 V2019 V2018 V2019 V2018 V2019 V2019 V2019 V2018 V2019 V200 V200 V200 V200 V200 V200 V200 V20	PHILIN PHILIN 177G11 177G11 177G21 177G31 177G33 197G10	 12 ¹/₂% TOTAL PS DOU 19 TG 170a all models to G19 T2 17a G19 T2 17 G19 G10 G19 G1	•93 £8.38 21TG106u 21TG107u 21TG107u 21TG109u 23TG111a all models to 23TG176a 23TG176a 23TG176a 23TG176a 624T230a all models to 23TG176a 624T310 93 161 94 150 170/1 95/4 151 170/1 96 155 171 97 156 171/1 98 160 DUP A.V., Marconi, Ultra. 0, 950/1, 950/2, 70, 980, 981, 1591, 1592, 1600, el No. td., o 1 pm. 05.30 pm.

World Radio History

AD 161-162	pair 60p
40 M/A	
160 M/A 250 M/A	
800 M/A	20MM Fuses
1 Amp	Mixed Values Anti Surge
1-15 Amp 1-6 Amp	and
2 Amp	Quick B' wv
2·5 Amp 3 Amp	30 tea £1.00
3·15 Amp	
4 Amp	
3500 Thorn Triplers	
LP1193/1 Mallard	£2.50
TK25KC15BL Ex Panel Pye	£1.50
TS2511TBH GEC	£4.00
TS2511TBK Rank	823 £4.00
TS2511TDT Thorn	£4.00
TS2511TBQ Pye	£1.50
TS2511TCE	£3.00
TS2511TCF	£3.00
1730 Decca	£1.00
Mains Droppers 69R + 161R Pye	40p
Rank/Bush Mains I	
302R/70R/6R2	40p
147R + 260R Pye	40p
Thorn Mains Dropp 80R/6R/054R/720	
Thorn Mains Dropp 6R + 1R + 100R	bers 35p
Thorn Mains On/O	
Switches, Push But Rotary	ton or 15p
Thorn 2000 & 3000	
Hearing Aid Extern	al
Loudspeaker Unit	£2.00
470M/100v Focus Unit 3500 T	25p
Thorn 8500 Focus	
4 Push Button UHI	
1400 - 1500 Series a	nd 8500 £3.50
D.P. Audio Switch	7 1 2
4 Push Button Unit	
Varicap 7 Push Button Unit	£1.00
Varicap	£2.00
RIZ243619 Replace for ELC 1043	ement
UHF Varicap new	£2.50
BF127 BC350	BF194
BF264 BF178 BF180 BF257	BF184 BC460
BF181 BF137	BF395
BF182 BC161 BC300 BF185	BC263B BF273
	EACH
)/40v
)/63v
	2183
2N2222	
	EACH
BF336 MJE2021 90V 80	30p V } 15p
SJE5451 5A	FACH
90V 661 NPN 80W 5A 660 PNF	PAIR
EHT lead & anode	cap 25p

50 Mixed Diodes	£1.00
1N5349 Diode	10p
	ACH
400 MFD/350V	50p
Mullard UHF T/Units	£1.50
300 Mixed Condensers 300 Mixed Resistors	£1.50 £1.50
30 Pre-sets	50p
100 W/W Resistors	£1.50
40 Mixed Pots 20 Slider Pots	£1.50 £1.50
Mixed Components 11b	
BD116 TIP115	30р 25р
TIP117	25p 25p
TIP120	20p
100 Mixed Electrolytics	
1000 MFD to 4 MFD	£2.50
120 Mixed Pack of Electrolytics & Paper	
Condensers	£1.20
BYX 38/600R	50p
·1 MFD 400	5p
-1 MFD 2000v -1 MFD 800v	15p
-01 MFD1000v	
-047 MFD1000v	8p
-47 MFD 630v	EACH
-0047 MFD 1000v -0022 MFD 1500v	
200+200+100M 325v	40p
470+470M 250v	40p
100+200M 325v 200+200+100+32M 33	30p 50v 70p
150+200+200M 300v	50v 70p 50p
800M 250v	20p
600M 300v	
400M 400-	£1.00
400M 400v 800+800M 250v	£1.00 60p
800+800M 250v 300+300+100+32+32	£1.00 60p 300v £1
800+800M 250v 300+300+100+32+32 200+100+100M 350v	£1.00 60p 300v £1 70p
800+800M 250v 300+300+100+32+32	£1.00 60p 300v £1 70p 25p 25p
800 + 800M 250v 300 + 300 + 100 + 32 + 32 200 + 100 + 100M 350v 100M 450v 33/450v 47M 450v	£1.00 60p 300v £1 70p 25p 25p 25p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v	£1.00 60p 300v £1 70p 25p 25p 25p 25p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 35p 20p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 35p 20p 20p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 35p 20p 20p 30p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 25p 25p 35p 20p 30p 50p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2.2/63v 10M 40 220M 10v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 25p 25p 35p 20p 30p 50p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2.2/63v 10M 40 2.2M 10v 2.2M 100v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 25p 25p 35p 20p 30p 50p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2.2/63v 10M 40 2.2M 100v 22M 100v 5p	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 25p 35p 20p 20p 30p 50p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 22M 350v 22M 350v 2-2/63v 10M 40 2-2/63v 2-2/63v 10M 40 2-2M 100v 5p	£1.00 60p 300v £1 70p 25p 25p 25p 25p 35p 20p 30p 50p
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2.2/63v 10M 40 220M 10v 2.2M 100v 22M 100v 22M 100v 5p 4.7M 63v EACH Plessey Green Condens 2200M 16v 1000	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 35p 20p 30p 50p v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 22M 350v 22M 350v 22M 350v 22M 350v 22M 350v 22M 10v 2-263v 10M 40 2-263v 10M 40 2-263v 100v 2-263v 100v 2-263v 100v 2-263v 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 2-200 100v 1000v 1000 1	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 20p 20p 30p 50p v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 6800M 40v 100M 350v 22M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 2-2/63v 10M 40 2-2/63v 10V 2-2/63v 10V 2-2/63v 10V 2-2/10V 2-2/10V 2-2/10V 2-2/0V	£1.00 60p 300v £1 70p 25p 25p 25p 25p 25p 25p 35p 20p 20p 30p 50p v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 22M 100v 22M 100v 22M 100v 50 4-7M 63v EACH Plessey Green Condens 2200M 10v 1000M 10v 500M 63v 1000M 63v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 20p 30p 50p v v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 20M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 2200M 16v 1000 1000M 35v 1000 3000M 16v 1500 4700M 25v 1000 3000M 63v 1500 3000M 63v 1500	£1.00 60p 300v £1 70p 25p 25p 25p 35p 20p 30p 50p v v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 25v 1000 300M 16v 1500 3000M 16v 1500 3000M 16v 1500 3000M 16v 1500	£1.00 60p 300v £1 70p 25p 25p 25p 35p 20p 30p 50p v v v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 22M 100v 22M 100v 5p 4-7M 63v Plessey Green Condens 2200M 16v 1000M 25v 1000M 63v 1000M 63v 1000M 63v 1000M 63v 1000M 63v 1000M 63v 1000M 10v 1000M 63v 1000M 10v	£1.00 60p 300v £1 70p 25p 25p 25p 35p 20p 30p 50p v v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 22M 100v 22M 100v 22M 100v 22M 100v 200M 16v 1000M 10v 300M 16v 1000M 63v 3000M 16v 3000M 10v 300M 100v 3000M 25v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 20p 30p 50p v v v i ers 0M 50v 0M 25v 0M 10v 0M 25v 0M 10v 0M 25v 0M 50v 0M 25v 0M 10v 0M 25v 0M 50v 0M 25v 0M 10v 0M 40v 0M 16v 0M 16v 0M 10v 0M 10v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 2-2M 100v 2-2M 100v 2-2M 100v 2-2M 100v 50 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000M 63v 1000M 63v 1000M 63v 1000M 63v 3300M 10v 3300M 10v 3300M 25v 1000M 63v 3000M 25v 1000M 40v	£1.00 60p 300v £1 70p 25p 25p 25p 25p 20p 30p 50p v v v k ers DM 50v DM 25v DM 10v DM 25v DM 10v DM 25v DM 16v M 63v
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 20M 10v 2-2M 100v 22M 100v 22M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 63v 1000 3000M 16v 1500 300M 10v 1500 300M 10v 1500 300M 16v 1000 1000M 63v 1000 300M 10v 1000 300M 10v 1000 300M 10v 1000 300M 10v 1000 300M 25v 1000 300M 25v 1000M 40v 6 Push Button Unit for	£1.00 60p 300v £1 70p 25p 25p 25p 20p 30p 50p v v i ers DM 50v DM 25v DM 10v DM 25v DM 10v DM 25v DM 16v DM 16v M 63v 12½p EACH
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 22M 100v 22M 100v 22M 100v 22M 100v 50 4.7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 63v 1000 3000M 16v 1500 300M 16v 1000 300M 25v 1000M 63v 1000M 40v 1 6 Push Button Unit for Varicap Thorn 4000	£1.00 60p 300v £1 70p 25p 25p 25p 20p 30p 50p v v i ers DM 50v DM 25v DM 10v DM 25v DM 10v DM 25v DM 16v DM 50v DM 16v M 63v 12½p EACH £2.00
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 100v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 10v 1500 4700M 25v 1000 680M 63v 1500 30001 16v 1500 30001 16v 1500 30001 16v 1500 30001 63v 1000 30001 63v 1000 30000 463v 1000 1000M 40v 10 6 Push Button Unit for Varicap Thorn 4000 6 Push Button Unit witl Cable Form for 1590 set	£1.00 60p 300v £1 70p 25p 25p 25p 20p 20p 30p 50p v v I ers DM 50v DM 25v DM 10v DM 25v DM 10v DM 25v DM 10v DM 16v M 63v 12p EACH £2.00 h ies
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 10v 1500 4700M 25v 1000 680M 63v 1500 3000M 16v 1500 300M 10v 1000 300M 10v 1000 300M 16v 1000 300M 16v 1000 300M 10v 1000 300M 10v 1000 300M 10v 1000 1000M 63v 1000 300M 25v 1000 1000M 40v 1 6 Push Button Unit for Varicap Thorn 4000 6 P	£1.00 60p 300v £1 70p 25p 25p 25p 20p 20p 30p 50p v v v t Ers 0M 50v 0M 25v 0M 10v 0M 40v 0M 25v 0M 10v 0M 50v 0M 16v 0M 16v M 63v 12‡p EACH £2.00
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 100v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 16v 1500 4700M 25v 1000 680M 63v 1000 30001 16v 1500 30001 16v 1500 30001 16v 1500 30001 16v 1000 30001 16v 1000 30001 63v 1000 300001 63v 1000 300001 60v 100 10000M 40v 10 6 Push Button Unit for Varicap Thorn 4000 6 Push Button Unit witl	£1.00 60p 300v £1 70p 25p 25p 25p 20p 20p 30p 50p v v t Ers 0M 50v 0M 10v 0M 25v 0M 10v 0M 25v 0M 10v 0M 40v 0M 50v 0M 50v 0M 50v 0M 10v 0M 40v 0M 50v 0M 10v 12}p EACH £2.00 h iiss £1.00
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 16v 1500 4700M 25v 1000 680M 63v 1500 3000M 16v 1500 300M 10v 1000 300M 10v 1000 300M 16v 1500 300M 16v 1000 300M 25v 1000 1000M 40v 10 6 Push Button Unit for Varicap Thorn 4000 6 Push Button Unit witl Cable Form for 1590 set for Varicap Tuner VHF Varicap Units New	£1.00 60p 300v £1 70p 25p 25p 25p 20p 20p 30p 50p v v t ers 0M 50v 0M 25v 0M 10v 0M 40v 0M 25v 0M 10v 0M 40v 0M 50v 0M 10v 0M 50v 0M 10v 0M 40v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M
800+800M 250v 300+300+100+32+32 200+100+100M 350v 100M 450v 33/450v 47M 450v 680M 100v 680M 100v 680M 100v 680M 100v 6800M 40v 100M 350v 22M 350v 33000 10v 15000 40v 2-2/63v 10M 40 200M 10v 2-2M 100v 5p 4-7M 63v EACH Plessey Green Condens 2200M 16v 1000 1000M 16v 1500 4700M 25v 1000 680M 63v 1000 30001 16v 1500 30001 16v 1500 30001 16v 1500 30001 16v 1000 30001 16v 1000 30001 63v 1000 300001 63v 1000 300001 60v 100 10000M 40v 10 6 Push Button Unit for Varicap Thorn 4000 6 Push Button Unit witl	£1.00 60p 300v £1 70p 25p 25p 25p 20p 20p 30p 50p v v t ers 0M 50v 0M 25v 0M 10v 0M 40v 0M 25v 0M 10v 0M 40v 0M 50v 0M 10v 0M 50v 0M 10v 0M 40v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M 50v 0M 10v 0M

Thorn 1590 Mains Lead &	TBA920Q	£2.00	
On/Off Switch & Control	SN76003N	£1.50	
Panel with 3 Slider Pots £1.00	SN7660N	£1.00	
Reject VHF Varicap Units	1N4148	3р	
UHF 50p		7p	
AE Isolating Socket &	BF274	5p	
Lead 45p		10p	
6 Position 12.5k V/Resistors	BY184 BY187	25p 50p	
Units for Varicap 50p		-	
EHT Rectifier Sticks	TAA550 TBA396	20р £1.00	
Used in Triplers	TBA510Q	£1.00	
x80/150 10p	TBA480Q	£1.00	
CSD118xMH (EACH	TBA550Q	£1.50	
CSD118xPA 12p	TBA720A TBA790B131	£1.50 £1.00	
3 Off G770/HU37 EHT Rec.	TBA800	95p	
Silicone, used in Tripler 15p	SN76115N	£1.00	
Bridge Rectifiers 3 Amp 40p		£1.50	
1A 100v 20p 2A 100v 25p		£1.00 £2.00	
W005M 20p		£1.00	
BY127 10p	SN76544N	50p	
1N4005 20 for £1.00	SN76640N	£1.00 £1.00	
1N4006 20 for £1.00 1N4007 20 for £1.00	TD 4 130 4	£1.00 50p	
1N4007 20 for £1.00 BYX94 1200v 1 Amp.	TCA270Q	£2.00	
15 for £1.00	main	£1.00	
BB105 UHF			
BA 182 Varicap Diodes	Star Aerial Amps	£4.00	
BB103 VHF 12 for 60p		EACH	
BY176 £1.00		40p	
BA248 7p		50p	
BY133 10p BYX55/350 10p		£1.25	
BY210/400 5		£2.00	
BY206 15p	BU105	£1.00	
BT106 95p	00100/01	£1.00	
BT116 95p	00203	£1.00 £1.75	
BY212 15p 12 Kv Diodes 2 M/A 30p		£1.75	
18 Kv BYF3123 Silicone 30		200	
160PF 8Kv 100M 50v	2N3055	40p	
270PF 8Kv 330M 10v	BRC1693 Thorn	60p	
1000PF 10Kv 330M 25v	BD138	20p	
1200PF 10Kv 330M 35v 1000PF 12Kv 330M 50v	BD252	20p	
160M 25v 330M 63v	Audio O/P Trans.		
220M 25v 470M 25v	RCA16572 }	40p	
1000M 16v 470M 35v 220M 35v 470M 40v	RCA16573 \$	PAIR	
220M 40v 47/63	SCR957 BRC4443	<u>65p</u> 65p	
220M 50v 300PF 6Kv		25p	
470M 25v 8M/350v 22M 315v 10p EACH	TICIOS Thumistors	EACH	
		50p	
SN76533N £1.00 TBA990 £1.00		7р	
SN76660N 50r	BD610)	50p	
SN 76650N £1.00	NUTE OOGG	PAIR 50m	
TBA560Q £2.00 TBA540Q £1.00		50p 50p	
TBA54Q £1.0		10p	
TIS91 25			
TAD100 £1.0 SAB550 £1.5			
TBA530 £1.0	0 1. 16 -1.	£1.00	
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