

46
MARCH 1988

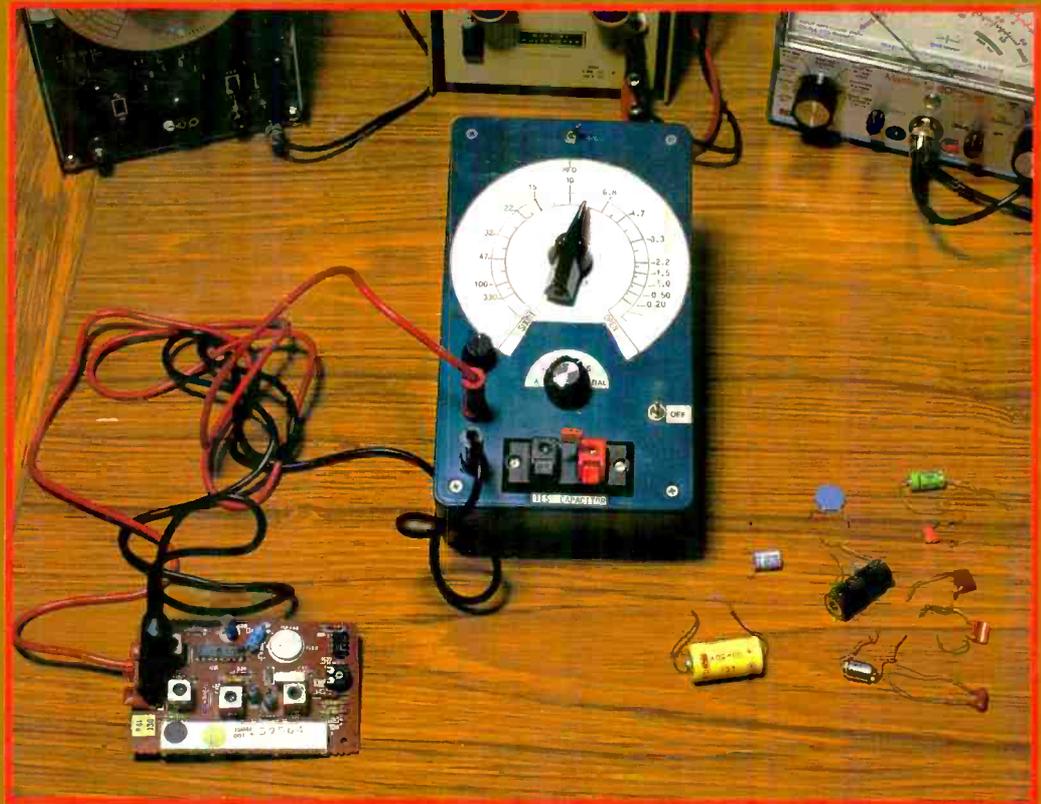
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TELEVISION

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The Art of Fault Finding
Fast-shutter Video Cameras
Digital Stereo Sound Systems
TV Fault Finding • VCR Clinic**

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MKV PAL COLOUR TEST GENERATOR
FOR DOMESTIC TV & VCR.

TEST
DEMONSTRATIONS
AT 172
WEST END LANE



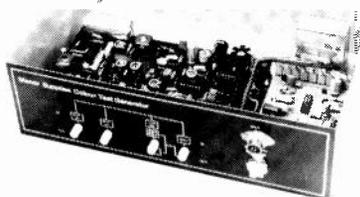
- ★ 40 different patterns and variations.
- ★ Broadcast transmission accuracy (fully interlaced sync pulses with correct picture blanking).
- ★ EBU colour bars, BBC colour bars, whole rasters & split bars (specially useful for VCR service), white, yellow, cyan, green, magenta, red, blue and black.
- ★ Chequerboard.
- ★ Mono outputs with border castellations, cross hatch, grey scale, vertical lines, horizontal lines and dots. UHF modulator output plugs straight into receiver aerial socket.
- ★ Additional video output for CCTV & VCR.
- ★ Facilities for sound output.
- ★ Easy to build kit, standard parts. Only 2 adjustments. No special test equipment required.
- ★ Mains operated with stabilised power supply.
- ★ All kits fully guaranteed with back-up service.
- ★ Also available with VHF Modulator.

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Case (10"×6"×2¼") app. **£8.60**
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DEC. 1982

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- ★ Output at UHF, applied to receiver aerial socket.
- ★ In addition to colour bars R-Y, B-Y etc.
- ★ Cross-hatch, grey scale, peak white and black level.
- ★ Push button controls, battery or mains operated.
- ★ Simple design, only five i.c.s on colour bar P.C.B.

PRICE OF MK 4 COLOUR BAR GENERATOR KIT
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THORN TX10, PHILIPS G11 PRESTEL, TELETEXT
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Scan Frame, Decoder **£5.00** p.p. **£2.00**.
PHILIPS G11 IF PANEL (New) Less Tuner **£2.50** p.p. **£1.30**
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PHILIPS HANDSETS Ex rental, text, Untested, KT Text/Video Type, **£3.50**
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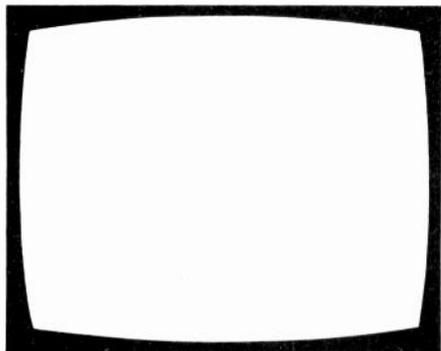
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TELEVISION

March
1988

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Issue 449

On sale February 17th

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INDEXES

Indexes to Vols. 35 and 36 are available at 80p each from the Editorial Office (address above).

QUERIES

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

this month

- 333 Leader**
- 334 Practical Computer Programming, Part 3** *Mike Phelan*
This time a look at computer languages, what they do and how they go about it, with some common programme writing routines.
- 336 More Troubles** *Les Lawry-Johns*
Never a dull moment – either the sets or their owners bring problems along.
- 338 Wide-range Capacitance Bridge** *David Botto*
Designed with the needs of the service department in mind, this bridge has five ranges covering 5pF to 2,000µF, with a sixth range for matching resistors, capacitors, etc. Resistance ranges can easily be added. There are also two squarewave test signal outputs. The unit is easy to build and uses readily available components.
- 344 Letters**
- 347 A Low-cost TVRO Installation, Part 1** *Roger Bunney*
The aim was to achieve an efficient satellite TV receiving system at minimal cost, sacrificing ease of operation to optimum performance. Details of the equipment and a method of adapting a patio mount to obtain azimuth adjustment.
- 350 TV Fault Finding**
Reports from Mick Dutton, D.H. Davies, Hugh MacMullen, Joseph Cieszynski, Roger Burchett and Philip Blundell, Eng. Tech. Plus a note on variac repair by John de Rivaz, B.Sc. (Eng.).
- 352 Teletopics**
News, comment and developments.
- 354 Long-distance Television** *Roger Bunney*
Reports on DX conditions and reception plus news from home and abroad.
- 356 A Professional Institution for TV Technicians** *Ian Channing*
The Society of Electronic and Radio Technicians' Incorporated Practitioners in Radio and Electronics Division provides a professional service for servicing personnel.
- 357 Fast-shutter Video Cameras** *Eugene Trundle*
Many video cameras with solid-state image sensors now have electronic shutter operation to minimise blur with fast-moving subjects. How the sensor and shutter system work.
- 362 The Art of Servicing** *B. A. Berry*
The art lies in the diagnostic steps that can be taken to localise the cause of a fault before any test equipment is brought into play.
- 363 Next Month in Television**
- 364 VCR Clinic**
Reports from Steve Beeching, T. Eng., R.S. Narwan, Khalied Kwimry, Christopher Holland, Alfred Damp and Eugene Trundle.
- 366 Dual-Channel TV Sound Systems, Part 3** *Geoff Lewis, B.A., M.Sc.*
Details of various digital sound systems including Dolby ADM, NICAM 728 and the MAC/Packet variants.
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TC8A30	3.44	UPC1168C	3.20
TC9A00	2.20	UPC1176C	2.53
TC9A10	2.20	UPC1177H	3.15
TC9A40	1.89	UPC1178C	4.21
TCP4621AF6	13.87	UPC1180C	1.84
TDA440	2.20	UPC1181H	1.00
TDA1002	1.95	UPC1182H	1.00
TDA1003A	5.50	UPC1183H	2.48
TDA1005A	2.50	UPC1185H	3.45
TDA1005	3.60	UPC1186H	1.60
TDA1010	3.30	UPC1188H	4.99
TDA1011	4.00	UPC1190G	1.20
TDA1035	4.70	UPC1198C	4.00
TDA1037	2.95	UPC1200V	1.18
TDA1044	4.37	UPC1211V	2.70
TDA1060A	4.44	UPC1212V	1.34
TDA1083	1.68	UPC1215V	1.66
TDA1170S	3.00	UPC1216V	1.20
TDA1190	3.50	UPC1217G	2.24
TDA1190P	3.50	UPC1218H	1.80
TDA1236	3.44	UPC1223C	2.20
TDA1270	3.95	UPC1225H	2.00
TDA1327	1.70	UPC1226C	1.50
TDA1352B	1.60	UPC1227V	1.20
TDA1412	95	UPC1230H	4.39
TDA1415	1.40	UPC1238	2.50
TDA1470	4.67	UPC1245V	1.35
TDA1770	5.60	UPC1277	4.81
TDA1908A	1.95	UPC1350C	4.15
TDA2002	75	UPC1353C	4.76
TDA2003	1.00	UPC1365C	6.38
TDA2004	1.60	UPC1356C2	2.08
TDA2006	1.45	UPC1367	2.00
TDA2010	2.40	UPC1358H	1.88
TDA2140	5.95	UPC1360C	2.20
TDA2151	3.25	UPC1363C	2.16
TDA2020	4.66	UPC1368H2	2.58
TDA2030	2.80	UPC1370C2	2.15
TDA2270	1.65	UPC1382C	1.08
TDA1870	6.46	UPC1384	3.78
TDA2523	3.40	UPC1394C	3.07
TDA2524	2.25	UPC1447H	58
TDA2525	4.00	UPC41C	2.80
TDA2526	2.70	UPD557H	2.46
TDA2532	2.90	UPD553C16	20.76
TDA2540	95	UPD7519G	17.13
TDA2541	3.84	UPD7538C020	11.06
TDA2560	1.15	UPD546C107	22.28
TDA2576A	3.75	UPD547C049	11.18
TDA2577	4.73	U05G	1.27
TDA2578A	5.12	V11N	4.27
TDA2581	3.95	10E2	1.43
TDA2582	2.60	10V05	8.74
TDA2593	2.95		
TDA2600	6.90		
TDA2610	3.20		
TDA2611A	2.35		
TDA2640	2.90		
TDA2652	7.31		
TDA2653A	5.90		
TDA2680	3.40		
TDA2690	2.72		
TDA3190	2.20		
TDA3330	2.21		
TDA3500	6.90		
TDA3560	6.00		
TDA3561A	6.66		
TDA3562	8.60		
TDA3571	3.75		
TDA3650	3.85		
TDA3651A	4.50		
TDA3652	6.00		
TDA3810	3.86		
TDA3950	4.37		
TDA4420	5.55		
TDA4500	8.24		
TDA4503	5.68		
TDA4600	2.95		
TDA4600-2D	2.95		
TDA8180	4.00		
TDA9503	4.21		
TEA1009	1.86		
TL494CN	6.57		
UPC554	2.63		
UPC566H	75		
UPC575C2	89		
UPC576H	1.90		
UPC585	3.06		
UPC587C2	2.34		
UPC1025H	2.15		
UPC1026H	90		
UPC1028H	90		
UPC1032H	58		
UPC1042C	1.56		
UPC1156H	2.45		
UPC1158H	3.50		
UPC1163H	2.48		

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Many of our transistor prices are also reduced. Ask For List.

E.G.	
BC328	0.06
BC328	0.06
BD124P	0.50
BD131	0.27
BU208A	0.70
BU326A	0.85
TIP 31C	0.24
TIP 32C	0.27
TIP 41C	0.25
TIP 112H	0.40

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30FL2	1.70
DY802	98
DY86/7	66
ECC81	1.50
ECC82	98
ECC83	1.07
ECC84	80
ECC85	98
ECC88	1.35
ECC80	1.30
ECF82	88
EC	

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E180	2.45
E240	3.45
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E180	3.50
L750	3.65
VCC360	6.59
VCC480	7.50

VIDEO BELT KITS

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VKIT 1	JVC	HR3300-3320-3360	
	TCE	8903-3V00-16/22	
VKIT 2	PANASONIC	NV7000-7200	1.45
VKIT 3	SONY	SLC5-7	2.25
VKIT 4	SONY	SL8000-8500-8600	3.60
VKIT 5	SONY	SL3000UB	2.10
VKIT 6	PANASONIC	NV3000B	1.99
VKIT 7	SANYO	9300P	2.75
VKIT 8	PANASONIC	NV2000B	1.45
VKIT 9	PANASONIC	NV8600-8610-V011	1.50
VKIT 10	TOSHIBA	V8600	1.45
VKIT 11	SHARP	VC7300	1.50
VKIT 12	SHARP	VC6300-6600	1.80
VKIT 13	SANYO	VT5000	0.95
VKIT 14	SANYO	VT5300	1.85
VKIT 15	JVC	HR7650-3V31	2.00
VKIT 16	HITACHI	5000	1.90
VKIT 17	SHARP	8300	1.76
VKIT 18	SHARP	9300	1.07
VKIT 19	HITACHI	V18000	1.45
VKIT 20	HITACHI	VT11-33	1.50
VKIT 21	HITACHI	9500	1.12
VKIT 22	SONY	SLC6	1.90
VKIT 23	SANYO	5500	1.05
VKIT 24	PANASONIC	NV300-333	1.55
VKIT 25	TOSHIBA	V7540	1.90
VKIT 26	JVC	HR7000	0.96
VKIT 27	THORN	3V29/HR7200	1.75
VKIT 28	AMSTRAD	7000	1.45
VKIT 29	PANASONIC	NV777	1.80
VKIT 30	SONY	T9	2.20
VKIT 31	TOSHIBA	9600	1.20

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1409221	CTV1409	15.00
151175	VCR5200	17.00
150583	VCR7000	10.00
150878	VCR9000	10.00

FIDELITY

FD09193	Txt.	32 butt.	15.90
FD09820	IS500	12 butt	13.81
FD09156	F14R	12 butt	13.81
FD09111	AVS	14 butt	13.75
FD09141	CTV14S	4 butt.	13.75
	20R/22R/140R		

GRUNDIG

RTP20/VRC112	TP16-21-21VHR	IR	13.50
RTP05/VRC138	TP8-12C-120E	IR	13.50
RTP06/IR107N	TP160-160E	IR	13.50
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306	IR8650	22.65
CVC45 RG5	VS8262	25.00
CVC32 RG15	VS8573	25.00

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T725	TX9	NON TXT IR	16.50
T731	TX9/10/100	TXT/STEREO IR	16.50
T732	TX10	TXT IR	16.50
T736	TX9/10/100	TXT IR	16.50
T739	TX100		16.50

PHILIPS

G11	IR170/843	TXT IR	13.50
G11	(KONIG)	TXT IR8435	22.20
G11	(KONIG)	TXT 2 FUNCTION VS8518	18.75
G11	(KONIG)	NON TXT VS8263	21.50
G11	31 BUTTON	691-17181 (PHILIPS)	US 27.00
KT330	(KONIG)	NON TXT IR8331	15.85
KT330	(KONIG)	TEXT IR8420	17.90
KT330/35/40	RC5		25.00

JVC

TP843	TXT IR	13.50
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GEC

GEC/HITACHI	9300/V4001	9.93
GC56520831	C1404H-C1656H	30.00
GCA512220	C1653	22.00
GCA512230	C2086H, C2087H	28.50
GCA510710	C2067H	28.50
GCA514620	C2089H, C2090H	21.00
	C2889H, C2290H	
GCA510870	C2069, C2269H	27.50

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REFURBISHED HEADS (Exchange)

Equivalents Chart in Catalogue

THORN NEW LIFE (Most VHS types) 22.95
THORN NEW LIFE (National Panasonic) 24.95

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VS5	3HSSV	21.95
VS10	3HSSV	21.95
VS77	3HSSV	21.95
VS88	3HSSV	21.95
VS7100	3HSSV	21.95
VS7200	3HSSV	21.95
VS9300	3HSSV	21.95
VS9500	3HSSV	21.95
VS9700	3HSSV	21.95
VS9800	3HSSV	21.95

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3V01	3HSSV	21.95
3V06	3HSSV	21.95
3V16	3HSSV	21.95
3V22	3HSSV	21.95
3V23	3HSSV	21.95
3V24	3HSSV	21.95
3V29	3HSSV	21.95
3V30	3HSSV	21.95
3V31	3HSSV	21.95
3V35	3HSSV	21.95
3V36	3HSSV	21.95
8903	3HSSV	21.95

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VT7000	3HSSHA	25.50
VT8000	3HSSHA	25.50
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VT8700	3HSSHA	25.50
VT9000E	3HSSHA	25.50
VT9300	3HSSHA	25.50
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VT9700	3HSSHA	25.50
VT9900	3HSSHA	25.50

ORION

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HRD220	3HSSV	21.95
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HR3300	3HSSV	21.95
HR3320	3HSSV	21.95
HR3330	3HSSV	21.95
HR3350	3HSSV	21.95
HR3360	3HSSV	21.95
HR3366	3HSSV	21.95
HR3366	3HSSV	21.95
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PV764	PS3BS	23.95
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N830	3HSSV	21.95
N831	3HSSV	21.95
N832	3HSSV	21.95
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PV2300	PS3BS	23.95
PV2400	PS3BS	23.95

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SLC7	PS3BS	23.95
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SLC9	PS5B3S	39.95
SLC20	PS4B2S	29.95
SLC24	PS4B2S	29.95
SLC30	PS4B2S	29.95
SLC33	PS4B2S	29.95
SLC40	PS4B2S	29.95
SLT50	PS5B3S	39.95
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NV322	3HSSN	21.95
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NV480	3HSSU2N	36.97
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384	3HSSSP	26.95
385	3HSSSP	26.95
386	3HSSSP	26.95
387	3HSSSP	26.95
388	3HSSSP	26.95
481	3HSSSP	26.95
482	3HSSSP	26.95
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9100	3HSSSP	26.95
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9500	3HSSSP	26.95
9600	3HSSSP	26.95
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V57	3HSSV	21.95
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PHILIPS

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6460	3HSSU1N	25.99
6520	3HSSU1N	25.99

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SONY SLC9	49.39
SONY SLC5.6.7	49.39
SHARP 3300/9700	56.00
TOSHIBA 9600 (upper assy)	14.50

HITACHI VT33E/GEC 4004 35.62
HITACHI VT11/GEC 4100 35.62
HITACHI 9300/9435/9500 53.00
SANYO 5000/4700/5300 53.00
PHILIPS V2000/V2023 64.00
PHILIPS 1700 71.00

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SONY 24	18	5	

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CM7243 Second Set Amp	14.03
CM7093 Three Set Amp	16.83
CM7063 Dist. Amp VHF/UHF	25.77
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CM9006 VHF/UHF Diplexer	4.17
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BV 6V BATTERY FOR EUROBELL	3.75
*Price includes Multi Adaptor to use with "C" type bell boxes	
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12V 2.6A	7.87
12V 6A	10.73
12V 1.5A	7.77

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S22 DYNABLAST (127db)	18.14
S13 SOUND BOMB 1 (104db)	3.37
S14 SOUND BOMB 2 (111db)	5.17
S15 SOUND BOMB 3 MULTITONE	4.50
S16 P228 (105db)	4.61
S17 MIKRO (110db)	5.28
S18 362 PIEZO (110db)	7.80
M801 12V MUSICAL BUZZER	1.56
802 722 BUZZER	0.60
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C12 5 TERM SURFACE	0.59
C13 4 WIRE SURFACE SLIMFIT	0.62
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C9 ROLLER SHUTTER CONTACTS PLASTIC	2.28

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C240 Element	2.75
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CS 17W Iron 240v	6.40
CS240 Element	2.75
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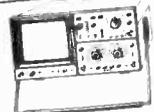
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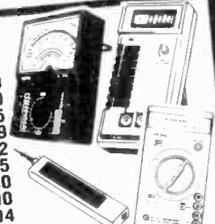
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1790/1	7.95			LA7801	2.90	TDA1044	2.95	TD2670ZD	3.30	BU426A	1.35							MC13002	3.95	TDA1044	2.95	TD2671	3.35	BU500	1.95							SA11250	3.85	TDA1170S	1.80	TD2672	4.50	BU508A	1.75							SA11251	4.95	TDA1180P	2.65	TD2673	2.80	BU508D	1.95							SA11252	3.95	TDA1190Z	2.95	TD2674	2.95	BU526	2.20							SA11253	4.95	TDA1190Z	2.95	TD2675	2.60	BU807	1.30							SA11254	3.95	TDA1190Z	2.95	TD2676	1.70	BU807	1.30							SA11255	3.95	TDA1190Z	2.95	TD2677	1.70	BU807	1.30							SA11256	3.95	TDA1190Z	2.95	TD2678	1.70	BU807	1.30							SA11257	3.95	TDA1190Z	2.95	TD2679	1.70	BU807	1.30							SA11258	3.95	TDA1190Z	2.95	TD2680	1.70	BU807	1.30							SA11259	3.95	TDA1190Z	2.95	TD2681	1.70	BU807	1.30							SA11260	3.95	TDA1190Z	2.95	TD2682	1.70	BU807	1.30							SA11261	3.95	TDA1190Z	2.95	TD2683	1.70	BU807	1.30							SA11262	3.95	TDA1190Z	2.95	TD2684	1.70	BU807	1.30							SA11263	3.95	TDA1190Z	2.95	TD2685	1.70	BU807	1.30							SA11264	3.95	TDA1190Z	2.95	TD2686	1.70	BU807	1.30							SA11265	3.95	TDA1190Z	2.95	TD2687	1.70	BU807	1.30							SA11266	3.95	TDA1190Z	2.95	TD2688	1.70	BU807	1.30							SA11267	3.95	TDA1190Z	2.95	TD2689	1.70	BU807	1.30							SA11268	3.95	TDA1190Z	2.95	TD2690	1.70	BU807	1.30							SA11269	3.95	TDA1190Z	2.95	TD2691	1.70	BU807	1.30							SA11270	3.95	TDA1190Z	2.95	TD2692	1.70	BU807	1.30							SA11271	3.95	TDA1190Z	2.95	TD2693	1.70	BU807	1.30							SA11272	3.95	TDA1190Z	2.95	TD2694	1.70	BU807	1.30							SA11273	3.95	TDA1190Z	2.95	TD2695	1.70	BU807	1.30							SA11274	3.95	TDA1190Z	2.95	TD2696	1.70	BU807	1.30							SA11275	3.95	TDA1190Z	2.95	TD2697	1.70	BU807	1.30							SA11276	3.95	TDA1190Z	2.95	TD2698	1.70	BU807	1.30							SA11277	3.95	TDA1190Z	2.95	TD2699	1.70	BU807	1.30							SA11278	3.95	TDA1190Z	2.95	TD2700	1.70	BU807	1.30							SA11279	3.95	TDA1190Z	2.95	TD2701	1.70	BU807	1.30							SA11280	3.95	TDA1190Z	2.95	TD2702	1.70	BU807	1.30							SA11281	3.95	TDA1190Z	2.95	TD2703	1.70	BU807	1.30							SA11282	3.95	TDA1190Z	2.95	TD2704	1.70	BU807	1.30							SA11283	3.95	TDA1190Z	2.95	TD2705	1.70	BU807	1.30							SA11284	3.95	TDA1190Z	2.95	TD2706	1.70	BU807	1.30							SA11285	3.95	TDA1190Z	2.95	TD2707	1.70	BU807	1.30							SA11286	3.95	TDA1190Z	2.95	TD2708	1.70	BU807	1.30							SA11287	3.95	TDA1190Z	2.95	TD2709	1.70	BU807	1.30							SA11288	3.95	TDA1190Z	2.95	TD2710	1.70	BU807	1.30							SA11289	3.95	TDA1190Z	2.95	TD2711	1.70	BU807	1.30							SA11290	3.95	TDA1190Z	2.95	TD2712	1.70	BU807	1.30							SA11291	3.95	TDA1190Z	2.95	TD2713	1.70	BU807	1.30							SA11292	3.95	TDA1190Z	2.95	TD2714	1.70	BU807	1.30							SA11293	3.95	TDA1190Z	2.95	TD2715	1.70	BU807	1.30							SA11294	3.95	TDA1190Z	2.95	TD2716	1.70	BU807	1.30							SA11295	3.95	TDA1190Z	2.95	TD2717	1.70	BU807	1.30							SA11296	3.95	TDA1190Z	2.95	TD2718	1.70	BU807	1.30							SA11297	3.95	TDA1190Z	2.95	TD2719	1.70	BU807	1.30							SA11298	3.95	TDA1190Z	2.95	TD2720	1.70	BU807	1.30							SA11299	3.95	TDA1190Z	2.95	TD2721	1.70	BU807	1.30							SA11300	3.95	TDA1190Z	2.95	TD2722	1.70	BU807	1.30							SA11301	3.95	TDA1190Z	2.95	TD2723	1.70	BU807	1.30							SA11302	3.95	TDA1190Z	2.95	TD2724	1.70	BU807	1.30							SA11303	3.95	TDA1190Z	2.95	TD2725	1.70	BU807	1.30							SA11304	3.95	TDA1190Z	2.95	TD2726	1.70	BU807	1.30							SA11305	3.95	TDA1190Z	2.95	TD2727	1.70	BU807	1.30							SA11306	3.95	TDA1190Z	2.95	TD2728	1.70	BU807	1.30							SA11307	3.95	TDA1190Z	2.95	TD2729	1.70	BU807	1.30							SA11308	3.95	TDA1190Z	2.95	TD2730	1.70	BU807	1.30							SA11309	3.95	TDA1190Z	2.95	TD2731	1.70	BU807	1.30							SA11310	3.95	TDA1190Z	2.95	TD2732	1.70	BU807	1.30							SA11311	3.95	TDA1190Z	2.95	TD2733	1.70	BU807	1.30							SA11312	3.95	TDA1190Z	2.95	TD2734	1.70	BU807	1.30							SA11313	3.95	TDA1190Z	2.95	TD2735	1.70	BU807	1.30							SA11314	3.95	TDA1190Z	2.95	TD2736	1.70	BU807	1.30							SA11315	3.95	TDA1190Z	2.95	TD2737	1.70	BU807	1.30							SA11316	3.95	TDA1190Z	2.95	TD2738	1.70	BU807	1.30							SA11317	3.95	TDA1190Z	2.95	TD2739	1.70	BU807	1.30							SA11318	3.95	TDA1190Z	2.95	TD2740	1.70	BU807	1.30							SA11319	3.95	TDA1190Z	2.95	TD2741	1.70	BU807	1.30							SA11320	3.95	TDA1190Z	2.95	TD2742	1.70	BU807	1.30							SA11321	3.95	TDA1190Z	2.95	TD2743	1.70	BU807	1.30							SA11322	3.95	TDA1190Z	2.95	TD2744	1.70	BU807	1.30							SA11323	3.95	TDA1190Z	2.95	TD2745	1.70	BU807	1.30							SA11324	3.95	TDA1190Z	2.95	TD2746	1.70	BU807	1.30							SA11325	3.95	TDA1190Z	2.95	TD2747	1.70	BU807	1.30							SA11326	3.95	TDA1190Z	2.95	TD2748	1.70	BU807	1.30							SA11327	3.95	TDA1190Z	2.95	TD2749	1.70	BU807	1.30							SA11328	3.95	TDA1190Z	2.95	TD2750	1.70	BU807	1.30							SA11329	3.95	TDA1190Z	2.95	TD2751	1.70	BU807	1.30							SA11330	3.95	TDA1190Z	2.95	TD2752	1.70	BU807	1.30							SA11331	3.95	TDA1190Z	2.95	TD2753	1.70	BU807	1.30							SA11332	3.95	TDA1190Z	2.95	TD2754	1.70	BU807	1.30							SA11333	3.95	TDA1190Z	2.95	TD2755	1.70	BU807	1.30							SA11334	3.95	TDA1190Z	2.95	TD2756	1.70	BU807	1.30							SA11335	3.95	TDA1190Z	2.95	TD2757	1.70	BU807	1.30							SA11336	3.95	TDA1190Z	2.95	TD2758	1.70	BU807	1.30							SA11337	3.95	TDA1190Z	2.95	TD2759	1.70	BU807	1.30							SA11338	3.95	TDA1190Z	2.95	TD2760	1.70	BU807	1.30

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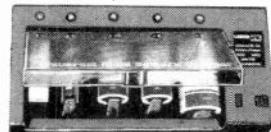
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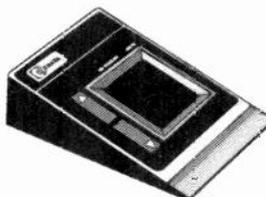
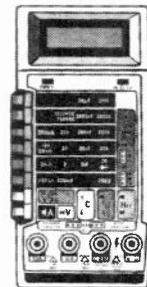
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AC107	40p	BD434	30p	BRV49	38p	TIP110	47p			PCH200	9p	CA-3011	110p	LA-4520	230p	STK-441	740p	TDA-2009	200p	ZSC-733	30p	OPTO ELECTRONICS	
AC127	25p	BD435	31p	BRV56	33p	TIP111	50p	AY1109	40p	PCL81	62p	CA-3012	150p	LA-4512	120p	STK-443	740p	TDA-2010	140p	ZSC-828	25p	ZEN 5777	
AC128K	21p	BD437	28p	BS574	33p	TIP112	50p	AY1110	40p	PCL82	62p	CA-3013	150p	LA-4515	230p	STK-444	740p	TDA-2011	140p	ZSC-829	25p	OC971	
AC141K	30p	BD438	28p	BS575	33p	TIP115	45p	AY1126	45p	PCL85	80p	CA-3018	75p	LA-4520	500p	STK-459	610p	TDA-2532	120p	ZSC-1060	90p	ORP62	
AC142K	30p	BD440	40p	BSK29	19p	TIP117	50p	AY1133	40p	PCL86	80p	CA-3019	75p	LA-4520	500p	STK-460	610p	TDA-2532	120p	ZSC-1061	200p	ORP60	
AC153K	23p	BD441	40p	BT109A	40p	TIP118	50p	AY1136	40p	PCL87	80p	CA-3020	75p	LA-4520	500p	STK-461	610p	TDA-2532	120p	ZSC-1062	200p	ORP61	
AC176	22p	BD441	40p	BT109B	40p	TIP121	45p	AY1176	85p	PL83	62p	CA-3028A	95p	LA-4520	500p	STK-465	800p	TDA-2600	580p	ZSC-1116	410p	DISPLAYS	
AC176K	28p	BD442	40p	BT109	90p	TIP122	47p	AY1179	35p	PL86	120p	CA-3035	230p	LA-4520	500p	STK-501	580p	TDA-2600	580p	ZSC-1116	410p	MAN 72	
AC187	21p	BD533	50p	BT116	80p	TIP125	47p	AY1182	32p	PL82	62p	CA-3036	230p	LA-4520	500p	STK-563	480p	TDA-2600	580p	ZSC-1117	50p	MAN 74	
AC187K	28p	BD534	38p	BT119	100p	TIP126	50p	AY1184	35p	PL84	80p	CA-3036	230p	LA-4520	500p	STK-025	420p	TDA-2600	580p	ZSC-1173	80p	MAN 4640	
AC188	21p	BD535	38p	BT120	100p	TIP127	50p	AY1187	32p	PL84	80p	CA-3045	360p	LA-4520	500p	STK-029	430p	TDA-2600	580p	ZSC-1213	30p	MAN 8910	
AC188K	28p	BD535	38p	TIP138	60p	TIP141	90p	BY1196	20p	PL95	80p	CA-3046	360p	LA-4520	500p	STK-030	430p	TDA-2600	580p	ZSC-1214	50p	DL 747	
AC187K	28p	BD535	38p	TIP146	99p	TIP142	90p	BY1206	11p	PL50	110p	CA-3052	190p	LA-4520	500p	STK-039	410p	TDA-2600	580p	ZSC-1279	30p	COMPUTER	
ACV19	48p	BD537	38p	BT151	58p	TIP145	65p	BY207	11p	PL50	110p	CA-3059	200p	LA-4520	500p	STK-040	560p	TDA-2600	580p	ZSC-1308	90p	IC 5	
AD142	100p	BD538	40p	BT152	58p	TIP146	65p	BY208	13p	PL58	200p	CA-3059	200p	LA-4520	500p	STK-049	570p	TDA-2600	580p	ZSC-1308	350p		
AD149	60p	BD538	40p	BU100A	110p	TIP147	100p	BY210	22p	PL59	450p	CA-3065	300p	LA-4520	500p	STK-050	570p	TDA-2600	580p	ZSC-1317	32p		
AD161	35p	BD675	40p	BU104	100p	TIP2955	42p	BY223	72p	PL81	90p	CA-3069	210p	LA-4520	500p	STK-059	620p	TDA-2600	580p	ZSC-1320	27p		
AD162	35p	BD676	40p	BU105	80p	TIP3054	42p	BY225	120p	PL81	90p	CA-3070	210p	LA-4520	500p	STK-060	620p	TDA-2600	580p	ZSC-1320	27p		
AD164	200p	BD678	38p	BU108	100p	TIP3055	42p	BY226	120p	PL81	90p	CA-3070	210p	LA-4520	500p	STK-060	620p	TDA-2600	580p	ZSC-1320	27p		
AF124	50p	BD678	38p	BU110	110p	TIS43	45p	BY227	19p	PL81	90p	CA-3070	210p	LA-4520	500p	STK-060	620p	TDA-2600	580p	ZSC-1320	27p		
AF125	50p	BD678	38p	BU111	140p	TIS44	40p	BY228	32p	PL81	90p	CA-3070	210p	LA-4520	500p	STK-060	620p	TDA-2600	580p	ZSC-1320	27p		
AF126	50p	BD678	38p	BU124	60p	TIS61	15p	BY228	32p	AN-127	230p	CA-3088Q	250p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1509	110p		
AF127	50p	BD680	40p	BU124	60p	TIS61	15p	BY228	32p	AN-127	230p	CA-3088Q	250p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1509	110p		
AF128	50p	BD680	40p	BU124	60p	TIS61	15p	BY228	32p	AN-127	230p	CA-3088Q	250p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1509	110p		
AF129	50p	BD680	40p	BU124	60p	TIS61	15p	BY228	32p	AN-127	230p	CA-3088Q	250p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1509	110p		
AF139	30p	BD681	45p	BU204	75p	TIS90	15p	BY299	28p	AN-136	250p	CA-3130E	40p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1678	120p		
AF239	30p	BD682	45p	BU205	70p	TIS91	15p	BY299	28p	AN-136	250p	CA-3130E	40p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1678	120p		
AF239	30p	BD682	45p	BU205	70p	TIS91	15p	BY299	28p	AN-136	250p	CA-3130E	40p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1678	120p		
AF239	30p	BD682	45p	BU205	70p	TIS91	15p	BY299	28p	AN-136	250p	CA-3130E	40p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1678	120p		
AF239	30p	BD682	45p	BU205	70p	TIS91	15p	BY299	28p	AN-136	250p	CA-3130E	40p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1678	120p		
AF239	30p	BD682	45p	BU205	70p	TIS91	15p	BY299	28p	AN-136	250p	CA-3130E	40p	LA-4520	500p	STK-1039	550p	TDA-2600	580p	ZSC-1678	120p		
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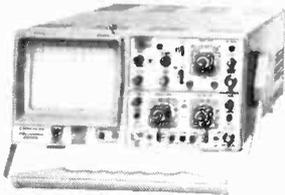
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 - Time Base 0.25/cm - 20ns/cm
 - Trigger DC-40MHz AC, DC, HF, LF, (TV Frame)
 - Active TV Sync. Sep.
 - Invert both channels
 - Variable hold-off 10:1
 - Calibrator
 - Plus many more features

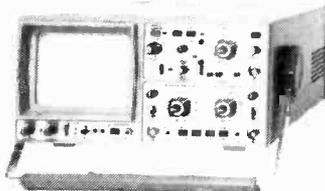
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Including two probes

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SPECIFICATION

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- Time Base 1 25s/cm - 10ns/cm
- Delayed Sweep 100ns - 0.1s
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- Overscan LED indicators
- Calibrator
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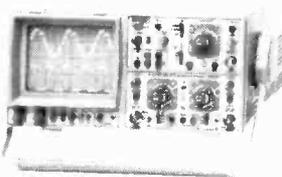


HM205 20MHz Digital Storage FREE Securicor Delivery

SPECIFICATION

- Digital Storage
- Analogue Real Time (Same as 203-6)
- Bandwidth DC-20MHz
- Sens. Ch1, Ch2, 2mV/cm
- Trigger DC-40MHz AC, DC, HF, LF, (TV Frame)
- Active TV Sync. Sep.
- 100KHz Sample Rate
- 2 x 1K Storage
- Storage Range, 1ms-5s/cm
- Variable hold-off 10:1
- Calibrator
- Plus many more features

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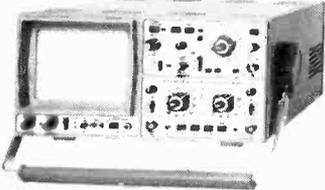


FREE Securicor Delivery HM605 60MHz Multi-function

SPECIFICATION

- Bandwidth DC-60MHz
- Sens. Ch1, Ch2, 1mV/cm
- Delay Line
- Delayed Sweep 100ns - 0.1s
- Trigger DC-80MHz AC, DC, HF, LF, (TV Frame)
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- Switchable Calibrator
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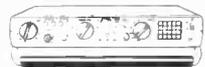
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- Digital tuning display (3 digits) for direct frequency readout.
- Accurate 10 turn tuning potentiometer.
- Built-in loudspeaker enables monitoring of sound in AM/FM.
- Meter measurement in voltage and dB from 20µV (26dB/µV).
- Continuity tester 0-500 ohms.
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- Sound output

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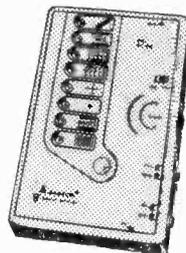
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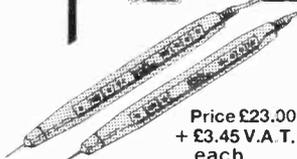
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- 31 - 1 key switch with key
- 32 - 2 humidity switches
- 34 - 96 x 1 metre lengths colour-coded connecting wires
- 36 - 2 air spaced 2 gang tuning condensers
- 37 - 2 solid dielectric 2 gang tuning condensers
- 38 - 10 compression trimmers
- 41 - 6 rocker switch 10 amp mains SPST
- 43 - 5 Rocker Switches 10 amp SPDT Centre Off
- 44 - 4 Rocker Switches 10 amp DPDT
- 45 - 1 24 hour time switch mains operated (s.h.)
- 46 - 1 6 hour clock timeswitch
- 48 - 2 6V operated reed switch relays
- 49 - 10 neon valves - make good night lights
- 50 - 2 x 12V DC or 24V AC, 4 CO relays
- 51 - 1 x 12V 2 CO very sensitive relay
- 52 - 1 12V 4 C relay
- 55 - 1 locking mechanism with 2 keys
- 56 - 1 Miniature Unselector with circuit for electric jigsaw
- 57 - 5 Dolls House switches
- 60 - 5 ferrite rods 4" x 5/16" diameter aenals
- 61 - 4 ferrite slab aenals with L&M wave coils
- 62 - 4 200 ohm earpieces
- 63 - 1 Mullard Thyristor trigger module
- 64 - 10 assorted knobs 1/4" spindles
- 65 - 5 different thermostats, mainly bi-metal
- 66 - Magnetic brake - stops rotation instantly
- 67 - low pressure 3 level switch
- 69 - 2 25 watt pots 8 ohm
- 70 - 2 25 watt pots 1000 ohm
- 71 - 4 wire wound pots - 18, 33, 50 and 100 ohm
- 73 - 4 3 watt wire wound pots 50 ohm
- 77 - 1 time reminder adjustable 1-60 mins
- 78 - 5.5 amp stud rectifiers 400v
- 85 - 1 mains shaded pole motor 3/4" stack - 1/4" shaft
- 86 - 2 5" all fan blades fit 1/4" shaft
- 87 - 2 3" plastic fan blades fit 1/4" shaft
- 88 - mains motor suitable for above blades
- 89 - 1 mains motor with gear box 1 rev per 24 hours
- 91 - 2 mains motors with gear box 16 rpm
- 93 - 4 11 pin moulded bases for relays
- 94 - 5 B7G valve bases
- 95 - 4 skirted B9A valve bases
- 96 - 1 thermostat for fridge
- 98 - 1 motorised stud switch (s.h.)
- 101 - 1 2 1/2 hours delay switch
- 103 - 1 6V mains power supply unit
- 104 - 1 4 1/2V mains power supply unit
- 105 - 1 5 pin flex plug and panel socket
- 107 - 1 5" speaker size radio cabinet with handle
- 109 - 10 1/4" spindle type volume controls
- 110 - 10 slider type volume controls
- 112 - 1 heating pad 200 watts mains
- 114 - 1 1W amplifier Mullard 1172
- 115 - 1 wall mounting thermostat 24V
- 118 - 1 leak effect extension 5" speaker cabinet
- 120 - 2 p.c.b. with 2 amp full wave and 17 other recs
- 122 - 10 mtrs twin screened flex white p.v.c. outer
- 132 - 2 plastic boxes with windows, ideal for interrupted beam switch etc.
- 155 - 3 varicap push button tuners with knobs
- 188 - 1 plastic box sloping metal front, 16 x 95mm, average depth 45mm
- 241 - 1 car door speaker (very flat) 6 1/2" 15 ohm made for Radiomobile
- 243 - 2 speakers 6" x 4" 15 ohm 5 watt made for Radiomobile
- 266 - 2 mains transformers 9V 1/2A secondary split primary so ok also for 115V
- 267 - 1 mains transformer 15V 1A secondary p.c.b. mounting
- 330 - 2 6V 0.6V mains transformer 3A p.c.b. mounting
- 350 - 40 double pole leaf switches
- 365 - 1 7uf 660V 50Hz metal cased condenser
- 453 - 2 2 1/4in. 60ohm loudspeakers
- 454 - 2 2 1/4in. 80hm loudspeakers
- 463 - 1 mains operated relay with 2 sets c/o contacts
- 464 - 2 packets resin filler/sealer with cures
- 465 - 3 5A round 3 pin plugs will fit item 193
- 466 - 4 7 segment 1 e.d. displays
- 470 - 4 pc boards for stripping, lots of valuable parts
- 480 - 1 3A double pole magnetic trip, saves repairing fuses
- 498 - 4 1000uf 25V axial electrolytic capacitors
- 504 - 1 Audax PM 8" speaker 15 ohm 5 watt rating
- 515 - 100 4BA 1 1/2" cheesehead plated screws and 100 4BA nuts
- 541 - 1 pair stereo tape head as in cassette recorder/players
- 546 - 1 bridge rectifier 600V international rectifier ref 3SB 100
- 548 - 2 battery operated relays (3-6V) each with 5A c/o contacts 2 pairs
- 563 - 2 lithium 3V batteries (everlasting shelf life)

OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's dozen range and you become entitled to a free gift with each dozen packs.

A classified list of these packs and our latest "News Letter" will be enclosed with your goods, and you will automatically receive our next news letter.



THIS MONTH'S SNIP

3 1/2 floppy Disk Drive, made by the Chicon Company of Japan. Beautifully made and probably the most compact device of its kind as it weighs only 600g and measures only 104mm wide, 162mm deep and has a height of only 32mm. Other features are high precision head positioning - single push loading and eject - direct drive brushless motor - 500K per disc - Shugart compatible interface - standard connections - interchangeable with most other 3 1/2 and 5 1/4 drives Brand new with copy of makers manual Offered this month at £26.50 post and VAT included.

CASE - adaptable for 3" or 3 1/2" FDD, has room for power supply components price only £4 includes circuit of PSU. Our Ref 4P8

POWER SUPPLY FOR FDD - 5V and 12V voltage regulated outputs, complete kit of parts will fit into case 4P3 price £8 or with case £11.

MULLARD UNILEX AMPLIFIERS

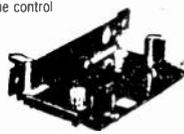
We are probably the only firm in the country with these now in stock Although only four waits per channel, these give superb reproduction. We now offer the 4 Mullard modules - i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for £6.00 plus £2 postage For prices of modules bought separately see 20 FOUNDERS.

CAR STARTER/CHARGER KIT

Flat Battery! Don't worry you will start your car in a few minutes with this unit - 250 watt transformer 20 amp rectifiers, case and all parts with data case £17.50 post £2.

MINI MONO AMP

on p.c.b. size 4" x 2" (app) Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp Brand new, perfect condition. Offered at the very low price of £1.15 each or £13 for 12.



LIGHT BOX

This when completed measures approximately 15" x 14" The light source is the Philips fluorescent "W" tube. Above the light a sheet of fibreglass and through this should be sufficient light to enable you to follow the circuit on fibreglass PCBs. Price for the complete kit, that is the box, choke, starter, tube and switch and fibreglass is £5 plus £2 post, order ref 5P69

TANGENTIAL HEATERS

We again have very good stocks of these quiet running instant heat units. They require only a simple case, or could easily be fitted into the bottom of a kitchen unit or book case etc. At present we have stocks of 1 2kw, 2kw, 2.5kw, and 3kw. Prices are £5 each for the first 3, and £6.95 for the 3k. Add post £1 50 per heater if not collecting. CONTROL SWITCH enabling full heat, half heat or cold blow, with connection diagram. 50p for 2kw, 75p for 3kw.

FANS & BLOWERS

5" £5 + £1.25 post 6" £6 + £1.50 post. 4" x 4" Muffin equipment cooling fan 115V £2.00 4" x 4" Muffin equipment cooling fan 230/240V £5.00 9" Extractor or blower 115V supplied with 230 to 115V adaptor £9.50 + £2.00 post. All above are ex computers but guaranteed 12 months 10" x 3" Tangential Blower. New. Very quiet - supplied with 230 to 115V adaptor on use two in series to give long blow £2.00 + £1.50 post or £4.00 + £2.00 post for two.

9" MONITOR

Ideal to work with computer or video camera uses Philips black and white tube ref M24/306V. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and E-T circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. The VDU comes complete with circuit diagram and has been line tested and has our six months guarantee. Offered at a lot less than some firms are asking for the tube alone, only £16 plus £5 post

LOW COST OSCILLOSCOPE - kit to convert our 9" monitor into an oscilloscope with switched time bases to allow very high and very low frequency waveforms to be observed and measured. Signal amplitudes from as low as 10mV and as high as 1kV can easily be observed and measured. Ideal for servicing, also for investigating TV, radio and audio circuits. Kit contains all the parts for the conversion and the power supply to operate from mains £25 our ref 25P3.

TELEPHONE LEAD

3 mtrs long terminating one end with new BT, flat plug and the other end with 4 correctly coloured coded wires to fit to phone or appliance. Replaces the lead on old phone making it suitable for new BT socket. Price £1 ref BD552 or 3 for £2 ref 2P164

COMPACT FLOPPY DISC DRIVE EME-101

The EME-101 drives a 3" disc of the new standard which despite its small size provides a capacity of 500K per disc, which is equivalent to the 3 1/2" and 5 1/4" discs. We supply the Operators Manual and other information showing how to use this with popular computers: BBC, Spectrum, Amstrad etc All at a special snp price of £27.50 including post; and VAT. Data available separately £2, refundable if you purchase the drive

POWERFUL IONISER

Generates approx 10 times more IONS than the ET1 and similar circuits. Will refresh your home, office, shop, workshop etc. Makes you feel better and work harder - a complete mains operated kit, case included £11.50 + £3 P&P.

NEW ITEMS



Some of the many described in our current list which you will receive with your parcel.

SUPER WATER PUMP - Approx 1/2hp mains operated originally intended to operate a £300 shower unit at a controlled pressure - but of course suitable for many other water or liquid moving operations - where a good flow at a constant pressure is required - Price £25 each V.A.T. and Post Paid. Our Ref. 25P2

VERY USEFUL MULTITESTERS - These have all usual ranges AC & DC volts - DC MA and OHMS etc but an unusual and very useful feature is a "low OHMS" range. Very useful for checking dry joints etc. They are ex G.P.O., and may have faults but we test and guarantee the movement to be O.K. Price £3 each. Ref. 3P30

AGAIN AVAILABLE - 12" mini fluorescent tubes - Price £1 each Ref BD314

POWER PACK OR AMPLIFIER CASE - Size approx 10" x 8 1/4" x 4 3/4" plated steel - with ample perforations to cooling. Front panel has on/off switch and E.E.F. mains inlet plug with built in RF filter - undoubtedly a very fine case which would cost at least £50 from regular sources, our price is £5 each and £3 post. Ref. SP111

MINIATURE PCB THUMB WHEEL SWITCH - Matt black edge switch engraved white on black - gold plated, make before break contacts - size approx. 25mm high 8mm wide 20mm deep - made by the famous Cherry Company and designed for easy stacking - Price £1 each. Ref. DB601

EDGE METER - miniature, whole size approx. 37mm x 13mm 100ua Ird - centre zero scaled 0 to -10 and 0 to +10 Price £1 each Ref. DB602

LARGE 2 SPEED MOTOR - 1hp at 2500rpm and 1/4hp at 200rpm - continental make, intended originally to power an industrial machine - regular price over £60, our Price £15 plus £5 carriage. Ref. 15PS

RUBBER FEET - Stick on - ideal for small instruments and cabinets - pack of 56 for £1 Ref. BD603

CLEANING FLUID - Extra good quality - intended for video and tape heads - regular price £1 50 per spray can - our Price - 2 cans for £1. Ref. BD604

DON'T FREEZE UP! - We have had the strongest winds for over 200 years and who knows may be in for coldest winter, so if you have not already protected your water pipes you should do so now - our heating wire wound around the pipes will do this and will cost only about 50p per week to run - 15 metres (minimum length to connect to 220/240v mains). Price £5. Our Ref. SP109

PIEZO ELECTRIC FAN an unusual fan, more like the one used by Madame Butterfly, than the conventional type, it does not rotate. The air movements is caused by two vibrating arms. It is American made, mains operated, very economical and causes no interference. So it is ideal for computer and instrument cooling. Price is only £1 each Ref. BD605.

SPRING LOADED TEST PRODS - heavy duty, made by the famous Bulgin company. Very good quality. Price four for £1. Ref. BD599

CURLY LEAD - four core, standard replacement for telephone handset, extends to nearly two metres. Price £1 each Ref. BD599.

TELEPHONE BELLS - these will work off our standard mains through a transformer, but to sound exactly like a telephone, they then must be fed with 25Hz 50v. So with these bells we give a circuit for a suitable power supply. Price 2 bells for £1 Ref. BD600.

ULTRA SENSITIVE POCKET MULTIMETER - 4k ohms per volt - 11 ranges - carry one of these and so be always ready to test ac/dc volts to 1000, DC milligrams and have an ohms range for circuit testing - will earn its cost in no time. Price only £7 Ref. 7P2

BLOW YOUR ROOF OFF 140 watt speaker systems - new type you must not hide! They have golden cones and golden surrounds and look really "Boofiful" 12" Woofer, Midrange and Tweeter and comes with a crossover at a special introductory price of £49, carriage paid. Two sets for £95 carriage paid. 140w Woofer only £35 carriage paid.

ASTEC PSU, Mains operated switch mode so very compact (6 1/2" x 4" x 2" approx. L) Outputs: +5 Volts 3.5 amp +12 Volts 1.5 amp - 5 Volt 1.5 amp. Brand new. Normal price £30+ our price only £10 Ref. 10P24

APPLIANCE THERMOSTATS - spindle adjust type suitable for convector heaters or similar. Price 2 for £1 Ref. BD582

COMPUTERS

Big consignment of computers expected in mid March, various makes and numbers, write or phone for details

NOVEL NIGHT LIGHT - plugs into a 13A socket. Gives out a surprising amount of light, certainly enough to navigate along passages at night or to keep a nervous child happy. Very low consumption, probably not enough to mawe the meter. Price £1. Ref. BD563

CASE WITH 13A PRONGS - to go into 13A socket, nice size and suitable for plenty of projects such as car battery trickle charger, speed controller, time switch, night light, noise suppressor, dimmers etc. Price - 2 for £1 Ref. BD565.

SPEAKER EXTENSION CABLE - twin 0.7mm conductors so you can have long runs with minimum sound loss and for telephone extensions or burglar alarms, bells, intercoms, etc. 250m coil only £3 plus £1 post. Ref. 3P28.

ALPHA-NUMERIC KEYBOARD - this keyboard has 73 keys with contactless capacitance switches giving long trouble free life and no contact bounce. The keys are arranged in two groups, the main area field is a QWERTY array and on the right is a 15 key number pad, board size is approx. 13" x 4" - brand new but offered at only a fraction of its cost namely £3, plus £1 post. Ref. 3P27.

TELEPHONE EXTENSIONS - it is now legal for you to undertake the wiring of telephone extensions. For this we can supply 4 core telephone cable, 100m coil £8 50. Extension BT sockets £2.95. Packet of 500 plastic headed staples £2. Dual adaptor for taking two appliances from one socket £3.95. Leads with BT plug for changing old phones 3 for £2

MODULAR SWITCH - Panel mounting highest quality and ideal where extra special front panel appearances is required, can be illuminated if required p.d.t. and latching. Price - 2 for £1. Ref. BD607

WIRE BARGAIN - 500 metres 0.7mm solid copper binned and p.v.c covered. Only £3 + £1 post. Ref. 3P31 - that's well under 1p per metre, and this wire is ideal for push on connections.

INTERRUPTED BEAM KIT - this kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components - relay photo transistor, resistors and caps etc. Circuit diagram but no case. Price £2. Ref. 2P15.

3-30V VARIABLE VOLTAGE POWER SUPPLY UNIT - with 1 amp DC output. Intended for use on the bench for experimenters, students, inventors, service engineers etc. This is probably the most important piece of equipment you can own. (After a multi range test meter) It gives a variable output from 3-30 volts and has an automatic short circuit and overload protection, which operates at 1.1 amp approximately. Other features are very low ripple output, a typical ripple is 3mV pk-pk, 1mV rms. Mounted in a metal fronted plastic case, this has a voltmeter on the front panel in addition to the output control knob and the output terminals. Price for complete kit with full instructions is £15. Ref. 15P7.

TRANSMITTER SURVEILLANCE (BUG) - tiny, easily hidden, but which will enable conversation to be picked up with FM radio. Can be housed in a matchbox. All electronic parts and circuit. Price £2. Ref. 2P52.

J & N BULL ELECTRICAL

Dept. T.V., 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT.

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & Bcard orders accepted. Brighton (0273) 734648 or 203500.

EAST CORNWALL COMPONENTS



1987 CATALOGUE available - range of components greatly increased - over 136 pages fully illustrated. Price £1.00 per copy (free upon request with orders over £15). Credit Tickets (3), Special Offer Sheets, Order Form and Pre-Paid Envelope. Order your copy now.

MARCH SPECIAL OFFER

Displays logic state of each gate of TTL, CMOS, etc. Devices in light and sound. Pulse enlargement capability allows detection down to 25 nsec. Comprehensive instruction manual. Working voltage: 4-16V d.c. Input impedance: 1 Mohm. Max. input frequency: 20 MHz. Thresholds: Hi - 70% Vcc. Lo - 30% Vcc.



ONLY
£7.99

SPECIAL OFFER DRASTICALLY REDUCED PRICE - 13A TEST PLUG

This device is extremely useful for testing your 13A sockets and telling you what, if anything is the fault. Simply plug the test plug into the socket and observe the amber lights.

PRICE 99p EACH
10 OFF 90p EACH

BT APPROVED EQUIPMENT

Master Socket (Flush)	£2.90	Wiring Tool	50p
Master Socket (Surface)	£2.75	Plug	25p
Secondary Socket (Flush)	£1.90	Dimmer Phone	£2.00
Secondary Socket (Surface)	£1.85	Voiceout Phone	£2.04
B.T. Cable (per metre)	15p	Conversion Kit & Line Jack Cord with Plug	£1.25
Extension Lead 5 Mtr	£3.90	Wiring Kit	£6.90

PANEL METERS

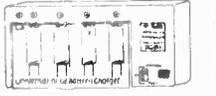
A comprehensive range of good quality, cost effective, moving coil panel meters. Cut-out required is 38mm. All plastic, black and white finish with four nuts and bolts. Features: All the meters have a mirrored scale; a reading can be taken from any angle. Illuminated scales, by two bright lamps. These require a 6V supply.

0.50A 4K3	PANELM1	£4.90	0-1A 3R	PANELM6	£4.90	
0.100A 3K75	PANELM2	£4.90	0-2A 3R	PANELM7	£4.90	
0.500A 430R	PANELM3	£4.90	0-25V DC	196R	PANELM8	£4.90
0.100A 1K1	PANELM4	£4.90	0-30V DC	196R	PANELM9	£4.90
10mA 196R	PANELM5	£4.90	0-10 Mtr	196R	PANELM10	£4.90

BATTERY CHARGER (Universal Nickel Cadmium)

An attractive nickel cadmium battery charger ideal for charging the rechargeable batteries detailed below. The charger will charge all the sizes listed: AAA, AA, C, D and PP3 and up to four AAA, AA, C and D types and one PP3 can be charged at the same time. The charger has a hinged plastic dust cover for easy viewing. The five battery positions have L.E.D. charge indicators. The unit also has a switch allowing batteries to be checked for current state of charge.

Power: 240V A.C.
Dimensions: 210 x 100 x 50mm
ORDER CODE
BAT CHARGE
1 + £4.50
10+ £4.25
100+ £3.75



SAFELOC

AAA	£1.25	£1.20 ea/10	FOR QUICKLY AND SAFELY TESTING EQUIPMENT ON
AA	90	85 ea/10	MAINS VOLTAGE, SIMPLY
C	2.10	1.90 ea/10	CONNECT WIRE TO CUPS
D	2.50	2.20 ea/10	AND CLOSE LID. £6.75
PP3	4.10	3.90 ea/10	

ORVX PORTASOL GAS SOLDERING IRON

A miniature, pocket size gas soldering iron, compact and convenient for use in many areas of soldering where mains power is inaccessible and trailing leads are a hindrance. The strong, rugged casing will hold sufficient liquid butane gas* for 60 minutes; continuous use before refilling. A fuel regulator can control the gas output to give tip temperatures up to 400°C (equivalent to 60W). Four nickel plated brass soldering bits are offered separately in varying sizes, each with an integral catalyst. The iron is supplied with the 24mm bit fitted. Bits have a simple screw fitting into the iron and run with a flameless gas flow. The iron comes complete with a protective cap, pocket clip and flint igniter (cigarette lighter style). Instructions for use are included.

YR802	1.00	PCF800	1.25
CV850	2.55	PCF802	1.10
EA4015	2.85	PCF805	2.05
E180F	6.55	PCF806	1.25
EABC80	1.05	PCF808	1.05
EA442	1.55	PC182	1.05
EB91	1.35	PC183	2.55
EB4C1	3.50	PC184	1.05
EA90	0.80	PC186	0.95
ECC81	1.05	PC188	2.55
ECC82	0.95	PC1805	1.10
ECC83	1.20	PD500	2.95
ECC84	0.85	PFL200	1.90
ECC85	1.00	PL33	1.55
ECC86	1.45	PL36	1.80
ECC189	0.90	PL37	1.80
ECC80	1.25	PL95	2.05
ECC82	0.90	PL504	1.55
ECC83	1.95	PL508	2.75
ECC85	3.80	PL519/509	5.30
ECC81	1.45	PL802	5.55
ECC84	1.55	PL918/800	1.15
ECC85	0.80	PY82	1.80
ECC86	1.80	PY88	0.85
EF80	1.00	PY500A	2.25
EF86	1.85	PY801	0.95
EF90	2.80	UABC90	1.30
EF96	1.70	UAF42	0.90
EF183	0.95	UBC41	4.35
EF184	1.05	UBC81	1.75
EH90	1.00	UCC85	0.80
EL34	3.45	UHC40	1.25
EL36	2.30	UHC42	5.65
EL81	7.00	UOH81	2.05
EL84	2.40	UJL82	1.85
EL85	5.00	UJL83	3.30
EL86	6.95	UF41	1.30
EL509	7.90	UF89	2.55
EL519	8.00	UL82	1.30
EM80	0.90	UY95	2.65
EM84	1.80	UY21	1.20
EM14	2.60	YG11	2.65
EY51	0.95	GAT6	1.30
EY86/87	0.70	GAU6	1.05
EY88	0.80	GC4	1.05
EY90A	2.55	GH8A	2.65
EZ41	2.85	GI8T	2.55
EZ81	0.85	KG7G	2.05
GY501	1.45	KG8G	2.80
GZ32	1.25	KD6G	1.55
K766(G.E.C.)	18.00	K64	6.55
K777	11.50	30FL2	1.75
K788(G.E.C.)	19.00	30FL2	1.65
PC88	1.45		

PRICE £16.00 EACH SPARE TIPS £4.00 EACH

22g. Non-corrosive Multi-core Solder. 500gm reel. £4.99 each - 10 Reels. £3.75 each

SOLDER - 60% TIN 40% LEAD

CS 18W, as above	10.90
Antex 15W iron	5.40
Antex 18W iron	5.60
Antex 25W iron	5.90
Antex elements	8.20
Antex bits	1.15
Antex stands	2.20
Soldersucker	1.48
Spare nozzles for Soldersucker	0.65

SERVICE AIDS

Goldknele Degreasing	1.78	Aero Duster	1.55
Solvent	1.18	Super 40	1.94
Switch Cleaner Lubri	1.78	Rapid Fire Extinguisher	3.45
Supa Freeze-it	1.46	Silicone Grease Tube	1.82
Foam Cleanser	1.26	Silicone Grease Spray	1.48
Video/Tape Head Cleaner	1.48	Heat Sink Compound	1.20
Plastic-Seal	1.40	Solda-Mop	1.14
Aero-Klene	1.16	Light Gauge 0.08mm	0.80
Anti-Static Spray elist	1.28	Standard gauge 1.2mm	0.78
Excel Polish	1.24	Industrial reel 1.2mm	2.96

RESISTORS - CARBON FILM 5%

1/4W 1R0 to 10M (E12 Range)	2p each	15p/10	75p/100
1/2W 2R2 to 10M (E24 Range)	2p each	15p/10	75p/100
1W 10R to 2M2 (E12 Range)	5p each	40p/10	3.00/100
2W 10R to 2M2 (E6 Range)	8p each	60p/10	5.00/100

RESISTOR KITS - each value individually packed

1/4W pack 10 each value E12 - 10R to 1M 610 pieces	4.50
1/4W pack 5 each value E12 - 10R to 1M 305 pieces	2.95
1/4W pack Popular - 10R to 10M 1000 pieces	6.50
1/2W pack 10 each value E12 - 2R2 to 2M2 330 pieces	7.75
1/2W pack 5 each value E12 - 2R2 to 2M2 365 pieces	4.70
1/2W pack Popular - 2R2 to 10M 1000 pieces	9.50
1W pack 5 each value E12 - 2R2 to 1M 353 pieces	13.75
2W pack 5 each value E6 - 10R to 2M2 317 pieces	21.75

ADDITIONAL KITS

DISC CERAMIC 50V ZENER DIODES 5mA	125 pieces	£3.50
ELECTROLYTICS R	100 pieces	£7.25
FUSES Q/BLOW 20mm	80 pieces	£3.75
FUSES T/BLAY 20mm	80 pieces	£7.50
PRE-SET POTS-H	120 pieces	£8.75
PRE-SET POTS-V	120 pieces	£6.74

T.V. AERIAL ACCESSORIES

Co-Ax Cable 75 Ohm 100 Metre Reel	£12.50
1+ 10+	
Co-Ax Metal Plug	20p, 18p
Co-Ax Line Socket	25p, 22p
Co-Ax Line Connector	12p, 10p
Co-Ax In-Line Splitter	80p
TV/Video/Computer Combiner	£3.09
Indoor Amplifier	
Improves signal 3 times	£13.66
Second Set Amplifier	
Improves signal to 2 sets 50%	£12.72
CB Interference Suppressor	
Minimises CB interference on TV	£4.45
TV/FM Diplexer	
Separates UHF TV signals from FM radio signals	£3.78

MAINS SWITCHES

Single 1 Way (1 Gang 1 Way)	0.85
Single 2 Way (1 Gang 2 Way)	1.20
Twin (2 Gang 2 Way)	2.00
Triple (3 Gang 2 Way)	2.85

MAINS SOCKETS

13A Single Unswitched	1.50
13A Single Switched	2.18
13A Twin Unswitched	2.50
13A Twin Switched	3.98

EXTENSION MULTI SOCKETS

All 13A, FUSED WITH NEON INDICATOR	
2-WAY	£2.75 each £2.50ea/5
3-WAY	£3.80 each £3.50ea/5
4-WAY	£3.99 each £3.75ea/5
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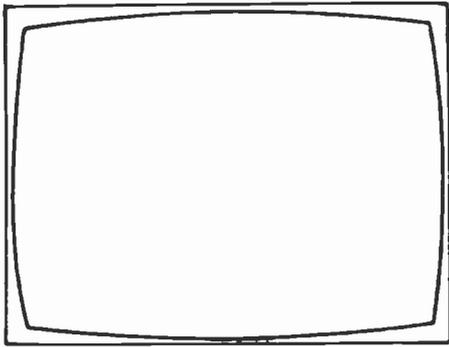
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SAS560S	1.85	AF116	2.10	BD633	0.10
SAS560S	1.85	AF121	0.56	BD634	0.10
SAS560S	1.85	AF124	0.70	BD635/A/B	0.10
SAS560S	1.85	AF125	0.50	BC262	0.26
SAS560S	1.85	AF126	0.50	A B	0.29
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TELEVISION

The Japanese Onslaught

EDITOR

John A. Reddihough

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COVER PHOTO

This month's cover photograph shows the wide-range capacitance bridge in use on the bench – see article on pages 338-342.

CORRECTION

We apologise to Peter Richards for an error that occurred in his letter in the January issue. Velocity is measured in metres sec⁻¹ or metres/sec. Metres/sec⁻¹ as printed is incorrect.

Yours truly does not subscribe to the determinist theory of history, preferring the cock-up theory – that accident and miscalculation play a large part in determining the course of events. This seems to be self-evident since even the best laid plans are prone to come unstuck. There have, nevertheless, been times when one has been tempted to think that the onslaught by Japanese consumer electronics manufacturers on the European market has been part of a deep-laid plan, possibly co-ordinated by the at times sinister looking hand of the Japanese Ministry of International Trade and Industry. Quite how well co-ordinated it has been we'll probably never know. We certainly know its effects, but when these are analysed you tend to get back to the general muck-up view of things.

A powerful article in a recent issue of the *Financial Times*, by Fred Burton of the University of Manchester Institute of Science and Technology, argues that Europe has in the main been following self-defeatist policies in the consumer electronics manufacturing field. He questions the advantages claimed for encouraging investment by Far Eastern manufacturers in European production facilities – that local production is enhanced, jobs are created, exports are increased and that benefits accrue from technology transfer and the effects Japanese manufacturers have on local component suppliers. He points out for example that employment in consumer electronics manufacturing in Europe fell from 250,000 in 1975 to 120,000 in 1985, adding the qualification that productivity increase contributed to this. He suggests that technology transfer is insignificant – that although Japanese companies account for 20 per cent of CTV and 90 per cent of VCR production in Europe (before Philips VHS machines?), research, design and development are all carried out in the Far East – fewer than fifty Europeans are engaged in development work for Japanese concerns, none on research. Technology transfer, he concludes, “is confined to job training and technical instruction to suppliers”. He feels that encouraging Japanese manufacturers to set up in Europe by giving them incentives and subsidies has been of only short-term benefit, the main aim being to achieve import substitution.

When you look at what has happened in the UK one is inclined to be suspicious. Toshiba took over the old Rank manufacturing facility, Hitachi did the same with the GEC plant, Sanyo likewise with Pye and Mitsubishi with the Tandberg (UK) plant. Sony, Panasonic and others have started up afresh on green-field sites. But the fact is that of the plants that were taken over by and large only the buildings were retained, the old manufacturing facilities being stripped out. One could argue whether all this would have happened had the UK industry been fundamentally sound, with adequate investment, modern production facilities and, the end product, well designed equipment built to last. For various reasons that belong to history, the UK consumer electronics industry was not in a particularly healthy condition when the Japanese onslaught started. What's left of it is rapidly being taken over, again largely by overseas companies, in an attempt to salvage something – one thinks of Thomson's take-over of the Ferguson CTV plants and the current question mark over Fidelity (see Teletopics).

What the Japanese have all along sought is a presence in Europe to avoid possible trade barriers and duties – the same policy was followed in the USA, where the major Japanese manufacturers long ago set up manufacturing facilities. The concern of Japanese manufacturers at the possibility of being excluded from the European market is understandable. Have their efforts been successful? As an insurance policy maybe, but financially the answer seems to be no. To return to Fred Burton's research, he comments that “throughout Europe Far Eastern subsidiaries have shown a return on sales below three per cent, with Sony, Hitachi, Sanyo and Mitsubishi declaring large losses on their UK operations”. The time scale of this economic performance is not stated, but the fact remains that these European plants have hardly been a resounding success as regards profitability. Perhaps this is once again a part of the Japanese view that market share is the all-important thing.

Fred Burton concludes that to transform Far Eastern investment in Europe so that it contributes to the long-term economic welfare of the region various conditions should be laid down, for example that there should be a greater research and development element. It's difficult however to see how this could be put into effect.

Europe has not entirely lost out in the TV field. The development of the MAC satellite TV transmission standard and its implications for receiver manufacture, work on videotext systems, digital sound systems and tube technology (45AX) are all of major significance, comparable to anything being achieved in Japan where the emphasis at the moment seems to be on digital video processing (a field where Europe led initially). Now that European setmaking has been substantially rationalised – the take-overs by Thomson and Nokia and Philips' collaboration with Grundig – the manufacturing side of the industry should be a lot healthier. There doesn't at present seem to be too much cause for alarm. Basically what I'd say we've seen over the years has been a messy series of moves by various companies trying for either short- or long-term success, in other words the muck-up theory of events. What could, in retrospect, be said is that had a more determined effort been made to rationalise UK TV setmaking back in 1979, when the National Economic Development Council produced a plan, we might still have had an indigenous UK TV industry. But then again we might not: remember the grossly overvalued pound in the early 80s?

Practical Computer Programming

Part 3

Mike Phelan

Having discussed microprocessors and operating systems without going into fine detail it's time for us to tackle the subject of computer languages. A microprocessor chip feeds itself with a stream of highs and lows, i.e. ones and zeros, which it finds in various memory locations. It's told where to look by these highs and lows, the process being started by a program held in a permanent piece of memory (ROM). The first instruction will be found at a fixed location (address) that's used by the particular type of microprocessor. The computer's operating system looks after directing information to the screen, printer, disk or tape, etc., and running the various programs.

The computer language BASIC, which most home computers use in various forms, is itself held in ROM and is loaded when the machine is powered. With a business machine the language in use is loaded from a disk, either a floppy removable one, typically with a capacity of 360kb or 1.2Mb, or a fixed Winchester type with a storage capacity of 5-100Mb. With this type of machine the operating system is also loaded when the machine is powered. It may carry out other tasks such as loading a program automatically. To do this the operating system looks for the presence of a particular file on the disk: the file will contain a list of commands which the operating system understands. With the DOS operating system this file is called AUTOEXEC.BAT; with CP/M the file is called PROFILE.SUB.

The final result of preparing a program which a computer can carry out is a list of numbers to be fed to the microprocessor. These numbers must be held in memory so that they are accessible while the program is being run. Clearly one would have to be something of a masochist to laboriously design and write a program in this form, as a list of binary numbers. The task would be prone to error, tedious and impossible for anyone, including the author, to understand at a later date. Even so, in the pioneering days of computers this was the way in which programs were written!

The purpose of a computer language is to convert these numbers, i.e. instruction bytes, into a more readable form. The basic instructions in binary number form are known as machine code. They can be considered as the "lowest" level of computer language – the level that a microprocessor understands directly. The next step up is to use a program called an assembler.

Assembler

An assembler expects the user to write his program using meaningful mnemonics for the instructions. These are written in the form of a text file, using a word processor or editor – the latter is a form of word processor without some of the more advanced features found with word processors. The assembler is then run: it reads the file and converts the mnemonics into instruction bytes. Comments can be included in the text file – known as source code – to enable others to understand how the program works. The important point is that every mnemonic represents one instruction.

The source code shown in Table 1 is for a program to change the border colour on the screen of a machine that

uses an 8086/8088 microprocessor – an IBM or similar machine. There are several points of interest. It will be seen that the most-used mnemonic is MOV. This indicates that data is to be moved between registers in the microprocessor chip and/or memory addresses. The things that follow MOV are the destination and source of the data. Items in the right-hand column are comments that don't appear in the assembled code. The more observant will notice that it takes five steps to multiply a number by ten! The mnemonics used are decided upon by the microprocessor manufacturer: most producers of assembler software adhere to the standards. A note for frightened would-be programmers: this file has been shown purely as a matter of interest – it's programming at the deep end.

High-level Languages

What we need is a language more like English, one that has single commands to carry out often used instructions such as the multiplication by ten just mentioned. The more akin it is to English the easier the program will be to understand – there's no point in making things unnecessarily difficult.

The most common high-level general-purpose language is BASIC. As mentioned in Part 2 BASIC is itself a program which may be stored on disk or in ROM. If on disk it must be loaded into RAM in the computer for a BASIC program to be written or run.

To write a program we type in lines of text, using words known to BASIC. The interpreter in the computer stores these words in shortened form by assigning a number to each word. This process is known as tokenising. We can then "save" (store) the program on disk or run it there and then. If neither is done the program will be lost at switch off, since it's stored only in RAM. Tokenising is not seen by the user, to whom the program consists of lines of text.

With BASIC each line can contain several instructions – this is not the case with some languages. When the program is run the interpreter converts each instruction into the relevant machine code for the microprocessor used in the computer. One BASIC instruction can produce hundreds of bytes of machine code, so the use of a high-level language speeds up programming no end. The interpretation process slows down a program's running speed however. Two other factors that reduce the running speed are the syntax and error checking that the interpreter performs.

Compiler

One solution to this speed limitation is the use of a compiler. The program is first written and tested in the normal way. It's then fed to the compiler which does all the syntax checking then turns the program into machine code once only instead of each time the program is run. In this way the file can be run without BASIC being present. Another advantage is that if the program is being sold commercially the source code is not released – it would therefore be very difficult to alter or "borrow" any of the program.

Many high-level languages are available only in compiler

form. Programs can thus be tested only by compiling then running them. Some errors will be thrown out by the compiler, but you can find you've written a valid program that doesn't do what you want.

Use of an interpretive language means that small sections of program can be tested quickly. In addition, most interpreters have a command mode in which instructions can be executed directly from the keyboard without being stored as a program. BASIC and dBase II/III are both of this type.

Control Structures

Most languages have things called control structures. To explain this, a program is basically a series of instructions which are executed in order. Quite often however we want the program flow to change, depending on things like a keyboard input from the user. For example, suppose we have a program that prints a one-hundred page list of customers on request. We wouldn't want all this if we only wished to find out whether Mrs. Bloggs was in arrears with her rental. Clearly in these two cases the program has to be put into effect in different ways: a control structure enables this to be done, by changing the sequence in which program lines are called up.

Most if not all high-level languages use "condition" and "iteration".

Condition

The condition control structure uses the words "if then else". If the result of the expression following the if is true, any commands on the same line, up to else, are performed. If the result is false, commands following else on the same line are performed. The else is optional. For example, we might have the line IF X = 2 THEN PRINT "X is two" ELSE PRINT "X is not two".

Some dialects of BASIC use a better if construction that's shared by other languages, as follows:

```
IF (expression)
  commands
  commands
  commands
ELSE
  more commands
  more commands
  more commands
END IF.
```

This is much better, as it allows for more lines of commands than the simpler version.

Iteration

There are several varieties of iteration, which is used if we want to perform a group of commands several times. This is also known as looping. Consider a program that prints a message on the screen ten times (whatever use this might be!). It would be cumbersome to program the line PRINT "This is the message" ten times. Instead, we enter:

```
FOR J = 1 to 10
PRINT "This is the message"
NEXT J
```

which is known as a for/next loop. The action is that we use a variable, J in this instance, though we could have called it X, Y, Z or FRED. The value of J starts as one, then the

Table 1: Source code example.

Code (hex)	Mnemonics	Comments
8A0E8000	MOV CL,(0080)	;get tail length
80F902	CMP CL,02	;has tail at least 1 digit
7230	JB 0139	;no tail
80F903	CMP CL,03	;has tail 2 digits?
772B	JA 0139	;tail 3 or more digits
740D	JZ 011D	;tail 2 digits - value
8A168200	MOV DL,(0082)	;move single digit up
88168300	MOV (0083),DL	;to same address as >9
33C0	XOR AX,AX	;clear accumulator
E90F00	JMP 012C	;process 1 digit
A08200	MOV AL,(0032)	;get tens digit
2C30	SUB AL,30	;ascii to int
D0E0	SHL AL,1	;2n
8AD0	MOV DL,AL	;park it
D0E0	SHL AL,1	;4n
D0E0	SHL AL,1	;8n
00D0	ADD AL,DL	;10n in al
8A168300	MOV DL,(0083)	;get units digit
80EA30	SUB DL,30	;a to i
00D0	ADD AL,DL	;tens + units
BAD903	MOV DX,03D9	;port number
EE	OUT DX,AL	;bang!
C3	RET	

message is printed. When the interpreter reaches the NEXT J line it increases the value of J by one and checks whether it has yet reached ten. If not the program reverts to the line following the FOR. Otherwise it continues with the line following NEXT. Thus all the lines between FOR and NEXT are performed a set number of times. Some languages don't have this feature.

Two other forms of iteration are found in many languages and in some versions of BASIC. They both rely on repeating a process until an event occurs instead of carrying out repetition a fixed number of times. There's a slight difference between the two structures, though it's not a vital one.

The first is the REPEAT/UNTIL loop. Here's an example, in BASIC:

```
REPEAT
INPUT "Please enter your name, 999 to end";a$
PRINT a$
UNTIL a$ = "999"
```

This is a nonsensical example but serves to illustrate the idea. The program will repeatedly ask for and print the name until you enter 999. The UNTIL line carries out the test. If the expression returns a false result the program goes back to the REPEAT. Thus the instruction(s) within the loop are always carried out at least once even if the condition is true to start with.

The other type of iteration differs in that the loop is repeated while a condition is true. Here's an example in dBase III:

```
DO WHILE .NOT. EOF()
? name,addr,telno
SKIP
ENDDO
```

The test .NOT. EOF() simply checks whether the end of a file has been reached. SKIP moves through the file a record at a time. Don't worry about this: the significant point is that the test is carried out at the beginning of the loop instead of the end.

CASE Structure

These control structures are mandatory for any computer language. There's another very useful one that's missing in BASIC. This is the CASE structure. Consider a program with a menu of choices from which the user has to choose a number or letter. With BASIC we would probably carry out an IF test on all the possible choices, or adopt some equally complicated method. The CASE structure eliminates this problem. Here's an example, in language C:

```
switch (choice)
{
  case 1: command; break;
  case 2: another command; break
  case 3: yet another; break
}
```

Much neater, isn't it? This particular section of code carries out different commands on the value of a variable

"choice". The word "break" is a part of language C to prevent execution of more than one command at this point.

Threaded Interpretive Languages

Before closing this time we must mention another class of languages altogether. BASIC, C etc. are all procedural languages, i.e. the interpreter or compiler reads a list of instructions sequentially or in a sequence determined by a control structure. This other class of languages is called threaded interpretive – the best known example is FORTH. With these the language consists of a number of named routines known as words. You don't really write a program, but instead define new words in terms of existing ones, ending with a single word that executes the program. An application written in FORTH is really an extension of FORTH rather than something separate. We'll have more to say about FORTH next month, when we come to consider the suitability of these various languages for different applications.

More Troubles

Les Lawry-Johns

Well here we are again, tapping all the wrong keys and making a mess of everything. How the editor puts up with it I just don't know. Poor old Stan from SEME is also on the rocks. He can't do much driving, so we have to phone our orders in and make sure he gets the credit. One way or another we all seem to be up against it. Perhaps we're being tested. Like I was when this chap brought in a fairly new 14in. Fidelity portable, a CTV140 I think.

The Fidelity Portable

It didn't want to work at all, and I didn't suspect the line output transformer as I would have done with the earlier ZX2000 chassis. When I had switched it off however I checked between the line output stage feed resistor and chassis. The reading was 20Ω. Probably the BY127 efficiency diode in parallel with the line output transistor (BU508A). I peered inside and failed to see it. Someone had taken it out and fitted it underneath, as I discovered when I withdrew the panel. On closer inspection I found that it was fitted the wrong way round. So I removed it and checked again. The low reading was still present. I was about to bawl at the line output transformer when I thought I'd better check the transistor first. It was the BU508A that was causing the trouble, so I apologised to the transformer and fitted a nice new transistor and put the diode in the right way round.

When I switched the set on again I was rewarded with a nice, clear picture. On fitting the rear cover I saw a label attached. Rapid Repairs. Oh well, that explained it all. These Rapid Repairs people have been going around lately causing havoc. Not Rapid Repairs, actually, but you know who I mean – don't you?

Before I Forget

Time to thank those of you who've written in to wish me a rapid recovery from the brain shut-down that's been troubling me of late. I'd like to thank in particular Ken Muir of Maidstone. He suggested that a book called "Service with a Smile", illustrated by Giles and containing

some of my articles, ought to be published. Articles other than the Red Baron one. What was wrong with the Red Baron? Thanks to E.V. Hurran for the tip about vitamin E. Must try this. In reply to David Botto of Bournemouth, thanks, I've stopped taking the tablets – they seemed to make my head spin round instead of being hazy. Also John Wakely of SW19 – sorry I took so long to acknowledge your letter.

Mr. Cole's ITT

Mr. Cole came in moaning his head off about his old ITT CVC5 I'd repaired before Christmas.

"It's gorn again. Now don't get me wrong, I'm not moaning, but it shouldn't have gone again so quickly, should it?"

"It depends on what's wrong with it."

"There's no sound. Here's the bill you gave me."

I looked at the bill. It said "replace the boost capacitor, 0.47μF 1kV, and test".

"That's got nothing to do with the sound" I said.

"Course it has. You did the set, didn't you? And it shouldn't have gone again so quickly."

So I told him to leave it with me to check over. I suspected the PCL86 audio valve but it turned out to be the loudspeaker. A new one put everything right and the sound was crisp and clear. I wrote on the bottom of the previous bill "fit new loudspeaker, previous one has given 15 years' service, £5".

When he came back he had a big smile on his face. I showed him his speaker and the bill and his smile faded.

"I'm not paying you any more money and that's that."

"O.k. Leave the set here and I'll sell it to get my money back."

"Not likely" he said as he tried to lift the set up. He couldn't, since I'd brought it in. "Help me get it to the car" he panted.

"Not likely" I said. "Pay your fiver or clear off."

So he paid his fiver and I picked up the set and put it in the car. If I'd known I'd have made it a tenner.

Boozy Tessa

Tessa now has three saucers of sherry a night. Zeb won't drink but there's no doubt that Tessa's a drunkard. H.B. is on the wagon and says Tessa takes after her dad (you know who). All I have is a few scotches, only a few . . .

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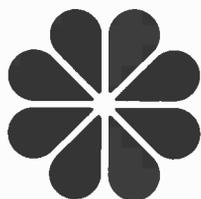
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Wide-range Capacitance Bridge

David Botto

Servicing TV sets and VCRs presents plenty of problems for the service engineer, not the least of which is checking suspect capacitors, especially of the smaller values. You may stock a comprehensive range but there always seem to be calls for the odd values that are not to hand. It's also a good idea to check new capacitors before they are soldered into the circuit – they have been known to be faulty!

Despite this, in the writer's experience relatively few TV/VCR service departments seem to possess an instrument that will measure capacitance accurately. You'll find that the capacitance bridge described in this article will be in constant use on the bench, saving you hours of time and a lot of tension and frustration.

Features

The instrument has five ranges, covering from 5pF to 2,000 μ F. There's also a sixth range which is useful for accurately matching in value two or more resistors, capacitors or other components. Resistance ranges can be included if required. In addition a handy choice of two squarewave signal outputs is available for checking the sound circuitry in TV sets, VCRs, etc.

Because bench space is always at a premium the instrument has been designed for compactness: it measures 7.5 x 4.33 x 2.22in. (19 x 11 x 5.6cm). Battery operation was chosen for three main reasons. First so that the instrument can be carried easily for field servicing, without the need to hunt around for a spare mains socket in the customer's home. Secondly because the tester is more convenient to handle without trailing leads, and can easily be moved to any part of the workshop. And finally because mains operation would increase the size and weight considerably. Since it's in operation only when a measurement is being made the batteries enjoy a long life.

Principle of Operation

Understanding the principles of operation helps in obtaining the best results from any instrument. The capacitance tester design is based on the well-known principle of the Wheatstone bridge. Fig. 1 shows the basic circuit. Resistors R1 and R2 have the same value. R3 and R4 also have the same value. With a d.c. voltage applied across points W and X, current will flow via the resistive potential divider chains R1/2 and R3/4. Since the voltages at Y and Z will be the same, no current will flow through the meter. If the ohmic value of R3 or R4 (or alternatively of R1 or R2) is altered the bridge will no longer be balanced and the meter's reading will deflect from centre zero to give either a positive or a negative reading. For example, if R3 is reduced in value voltage V3 will decrease and voltage V4 will increase; with voltages V1 and V2 remaining the same. The d.c. voltage at Z is now higher than that at Y. The bridge is unbalanced and the meter gives a positive reading – see Fig. 2. For the bridge to be balanced again the value of R1 must be decreased so that voltages V1 and V3 are exactly equal.

In Fig. 3 resistors R1 and R2 have been replaced with a linear potentiometer. Ratio 1 corresponds with R1 in Figs. 1 and 2 while Ratio 2 corresponds with R2. The unknown

R corresponds with R3 and the standard R with R4. The bridge circuit can now be used to measure resistance. An accurate resistor of known value is connected across terminals A and B. The resistor whose value is to be measured is connected across terminals C and D. If the two resistors are of equal value and the slider of the potentiometer is at track centre the meter will indicate zero voltage. If however the value of the unknown resistor differs from that of the known, fixed value resistor the potentiometer's slider will have to be moved up or down for the bridge to be balanced and give a zero reading on the meter. The value of the unknown resistor can now be obtained from the formula: unknown R = ratio 1 x (standard R/ratio 2).

For example, suppose the value of the standard resistor is 10 Ω , ratio 1 is 80 Ω and ratio 2 20 Ω . This gives us 80 x

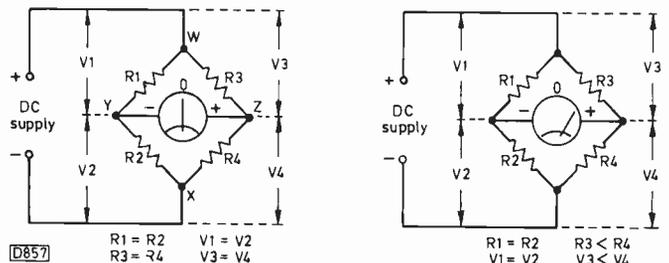


Fig. 1 (left): Wheatstone bridge in the balanced condition.

Fig. 2 (right): Unbalanced Wheatstone bridge.

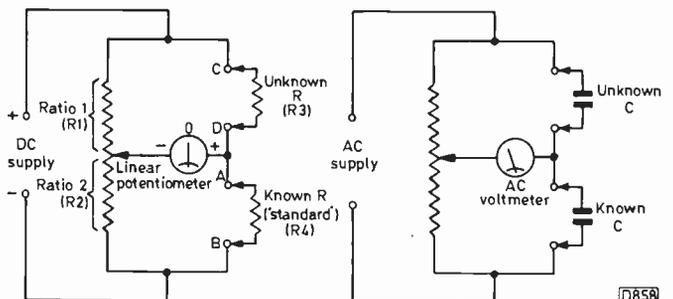


Fig. 3 (left): Wheatstone bridge with balance potentiometer.

Fig. 4 (right): Bridge for measuring capacitance.

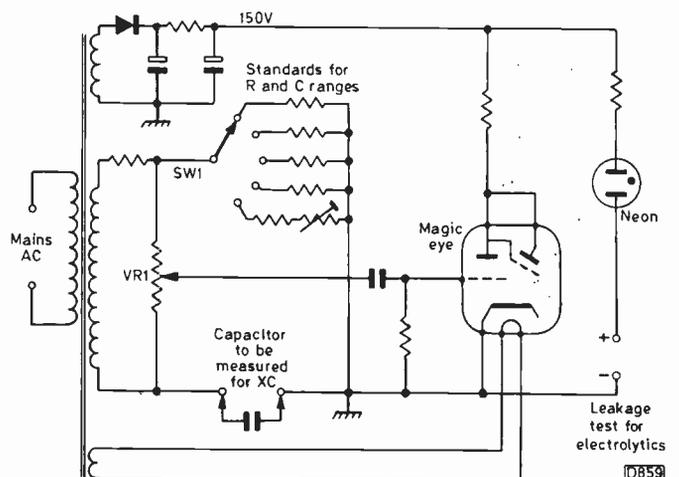


Fig. 5: Basic circuit arrangement used in the Hunt's Capacitance Analyser.

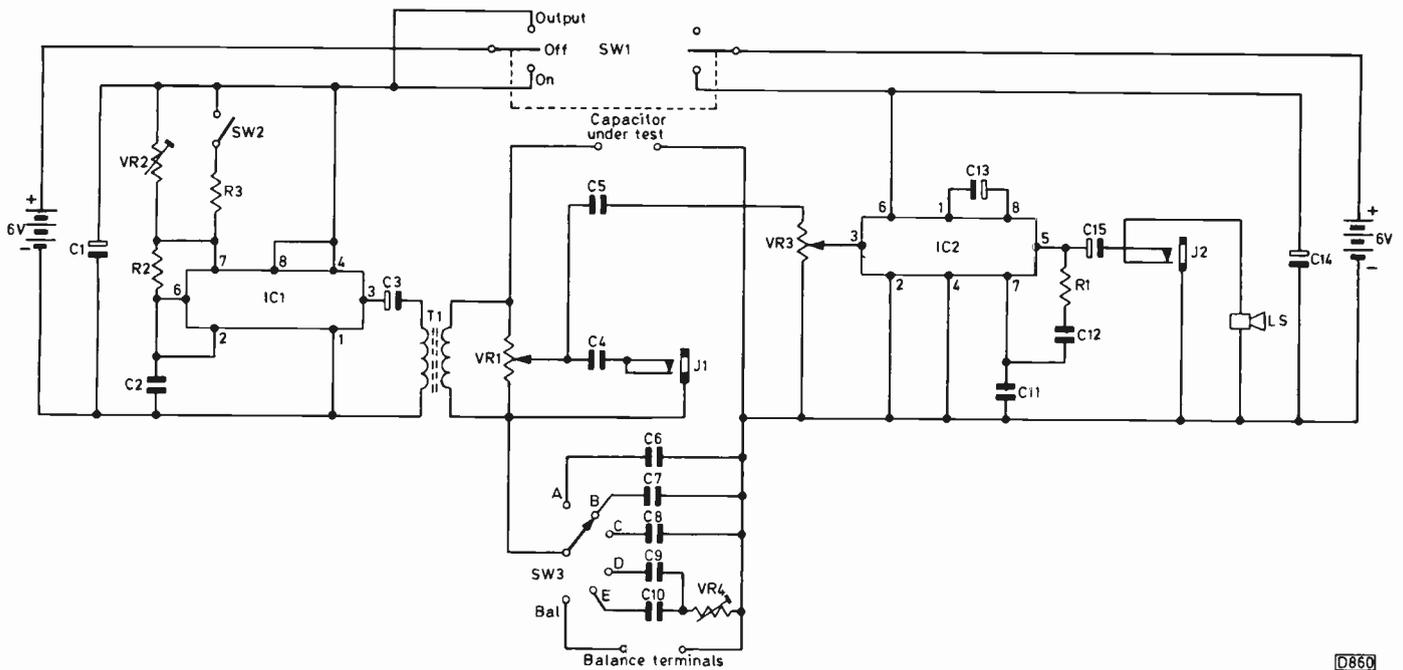


Fig. 6: Circuit of the wide-range capacitance bridge.

$(10/20) = 40$, i.e. the value of the unknown resistor is 40Ω . With a set of standard resistors, resistance values can be measured precisely over a number of ranges. In practice the potentiometer is fitted with a scale that's calibrated in resistance values, doing away with the need for any calculations.

A capacitor has an ohmic reactance value X_c that's given by the equation $X_c = 1/(2 \times 3.14159 \times f \times C)$, where f is the frequency and C the capacitance value. By using an a.c. source voltage instead of a d.c. one the ohmic reactance of a capacitor of unknown value can be balanced against that of a known value capacitor in a bridge circuit – see Fig. 4. In this way the Wheatstone bridge can be adapted to measure capacitance.

Hunt's Capacitor Analyser

In the 1940s and 50s capacitance bridges such as the Hunt's Capacitor Analyser were found in most radio service departments. Earlier versions were built into a stout oak case with a removable lid; later versions had metal cases. A magic-eye tuning indicator was used to show bridge balance and there was a scale marked with resistance and capacitance values so that measurements could be read off directly. The basic circuit is shown in Fig. 5. Because the mains-derived a.c. source voltage is a very stable 50Hz, resistors were often used as the capacitor standards. For example, at 50Hz the reactance of a $1\mu\text{F}$ capacitor is $3,180\Omega$ and that of an $0.1\mu\text{F}$ capacitor $31,800\Omega$. These instruments usually had a range of $0.0001 - 100\mu\text{F}$ and about $5\Omega - 10\text{M}\Omega$, which was quite adequate for servicing the valve radios of the time. These old bridges still give good service in a few workshops.

Circuit Description

The capacitance bridge that forms the subject of this article uses two inexpensive i.c.s. Fig. 6 shows the complete circuit. A sinewave voltage is generally used to power a test bridge but experiments have shown that almost any type of a.c. waveform can be used. This circuit employs a 555 timer i.c. to provide a squarewave output. The arrangement has

the advantage of being simple, few components being required. The 555 chip's frequency of oscillation is determined by the value of C_2 ($0.1\mu\text{F}$), R_2 ($1\text{k}\Omega$) and the setting of VR_2 . With SW_2 in the open position the frequency is 146Hz. When SW_2 is closed R_3 is connected in parallel with VR_2 and the frequency is increased to approximately 456Hz.

The squarewave oscillator's output is applied to the primary winding of transformer T_1 , whose secondary feeds the bridge. VR_1 is the calibrated balance potentiometer while capacitors C_6 - C_{10} are the standards against which the capacitor under test is balanced. Since resistance values can be accurately measured with a digital multimeter, resistance ranges were not included in the prototype. It's simple to add resistance ranges to the bridge if required. Use close-tolerance 0.5W resistors of $100\text{k}\Omega$, $10\text{k}\Omega$, $1,000\Omega$, 100Ω , and 10Ω as the standard balancing resistors. Fig. 7 shows the additional circuitry. The range covered is from $1\text{M}\Omega$ down to the resistance of five inches or less of 22 s.w.g. single-strand connecting wire! This last range is useful for checking the windings of low-resistance coils for shorted turns.

VR_1 is a linear, wirewound $10\text{k}\Omega$ potentiometer. Its balance point is detected by the LM386 audio amplifier which drives a 2in., 8Ω loudspeaker. The balance signal from the bridge is coupled by C_5 and the preset gain potentiometer VR_3 to pin 3 of the LM386 chip. When the correct balance point has been found there will be no output to the LM386 and thus no sound from the loudspeaker. The capacitance of the component being tested is then read directly from the calibrated scale.

The small control VR_4 is the power factor control. It's used on the two higher capacitance ranges to obtain a sharper null balance and to indicate the power factor of the capacitor being tested.

Two separate battery supplies are provided, one for the 555 oscillator and the other for the LM386 audio amplifier. This prevents unwanted coupling upsetting the accuracy of the bridge balance. Another advantage is that the batteries enjoy a longer life. It's important that the earth sides of the two supplies are not connected together.

Jack socket J_1 is the output for the squarewave test

signal: in this application VR1 acts as a gain control. J2 enables a scope to be connected to serve as a null point indicator, with the sound cut out.

Construction

Construction of the instrument is straightforward and the parts required are all readily available. The accompanying photographs show the finished appearance and internal layout of the tester. A plastic case is used – don't use a metal case because this could cause problems as a result of internal capacitances. A Tandy de luxe project case was used for the prototype, catalogue no. 270-224. Any similar plastic case is suitable.

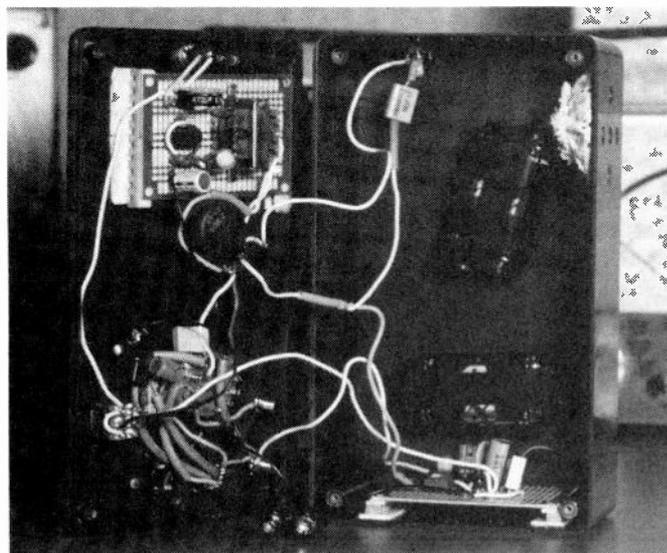
Fig. 8 shows the recommended layout for the controls and the terminals – the positions were chosen to avoid unwanted circuit coupling. The i.c.s are mounted on two separate experimenters' "perfboards", Tandy catalogue no. 276-150. Each perfboard is held in place securely with double-sided sticky pads (these are available from all good hardware shops). Use of these perfboards makes it unnecessary to etch your own PCBs, thus saving a great deal of time and effort. Make sure that the two battery holders are fitted to the bottom of the case securely – use a little Blue-Tack.

The accuracy of the bridge depends on the tolerance of capacitors C6-C10. C6 is a 100pF silver mica type accurate to ± 1 per cent. C7 and C8 are good quality capacitors that were found to be quite close to their stated values. C9 and C10 are small, 25V working electrolytics. Don't solder C9 and C10 into circuit until you've set up the other ranges.

T1 is an RS Components type T/T3 which happened to be in our stock (it's no longer listed). Any small audio driver transformer is suitable – don't use an output transformer. Twist together the two insulated wires from the transformer's secondary winding to the ends of the bridge arm.

The miniature on/off switch SW1 is a double-pole, double-throw type with three positions (on/off/on). Mark the off position clearly so that the instrument will not be accidentally left switched on while not in use.

Fig. 9 shows a full-sized calibrated scale which you can trace or copy, saving yourself a lot of work. The best material to use for this is white Bristol board, which should be available from your local art shop. In order to use the



Internal layout of the prototype. For external view see photograph on front cover.

scale as shown it's essential to fit the specified RS Components 10k Ω linear control (type 173-237). After final testing, cover the scale with a piece of stiff, clear plastic approximately 1/16in. or 1.5mm thick to keep it clean and free from accidental damage.

It's also an idea to fit four small self-sticking cushion feet to the bottom of the case. This will stop the instrument sliding about on the bench.

Setting up and Calibration

There's nothing difficult about setting up the capacitance bridge. Before you do so ensure that all the wiring and connections are in order. Then set the two preset controls VR2 and VR3 to their mid-positions and the balance control VR1 to mid-track. Turn the range switch SW3 to the balance position and SW2 to its 146Hz setting.

Connect the batteries and, if you've a frequency counter, plug it into jack socket J1 via a 10:0 isolating probe. Turn the power switch SW1 to the output position and if all is well the counter should give a reading in Hz. Adjust VR2 for an output at 146Hz. Close SW2 and the counter should give a reading in the region of 456Hz – this is not critical. Disconnect the counter. If you don't have one, set SW3 to position C, the power switch to on and adjust VR2 for a pleasant low-pitched buzz from the loudspeaker. Closing SW2 should produce a higher tone.

Note that a single scale is used for all five capacitance ranges. To calibrate the bridge, connect an accurate 0.1 μ F, 250V working capacitor across the test capacitor terminals and set SW3 to position C. Rotate VR1 until you find the position that gives the minimum output from the loudspeaker (use the 456Hz setting). VR3 should be adjusted for sufficient, not excessive, sound from the loudspeaker. When the null/minimum sound position has been found, set VR1's knob exactly to the centre position (10) on the scale. This should be at the control's mid-track position. If you now measure other capacitance values you should find that the accuracy of the scale is already quite good.

For correct calibration however you'll need a range of accurate capacitors with values between 3.3 μ F and 0.002 μ F – see Table 1. Notice that with the exception of the centre 10 position the calibration lines shown in Fig. 9 don't quite connect to the centre of the scale. Using range C, connect each test capacitor in turn to the test capacitor terminals and adjust VR1 for minimum sound. After each check link the calibration line to the edge of the scale – see Fig. 10. For this range the scale numbers have to be divided by one hundred: the centre 10 represents 0.1 μ F, 47 stands for 0.47 μ F, etc.

It's not necessary to calibrate all the other ranges once the C range has been calibrated correctly. It's best however to check the 5pF and 10pF balance points on the A range, using 2 per cent tolerance silver mica capacitors for the purpose.

The balance scale should be read as follows.

Range A: Centre scale 100pF. Scale numbers times ten (read in picofarads).

Range B: Centre scale 0.01 μ F. Scale numbers in μ F divided by 1,000.

Range C: Centre scale 0.1 μ F. Scale numbers in μ F divided by 100.

Range D: Centre scale 10 μ F. Scale reads in μ F directly.

Range E: Centre scale 100 μ F. Scale numbers in μ F multiplied by 10.

Two small 25V electrolytics are used as the standard capacitors in the D and E ranges. You can use the

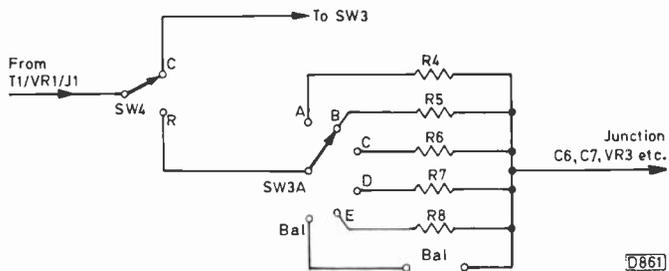


Fig. 7: Extra components required to add resistance ranges. SW3/SW3a comprise a two-pole, six-way switch.

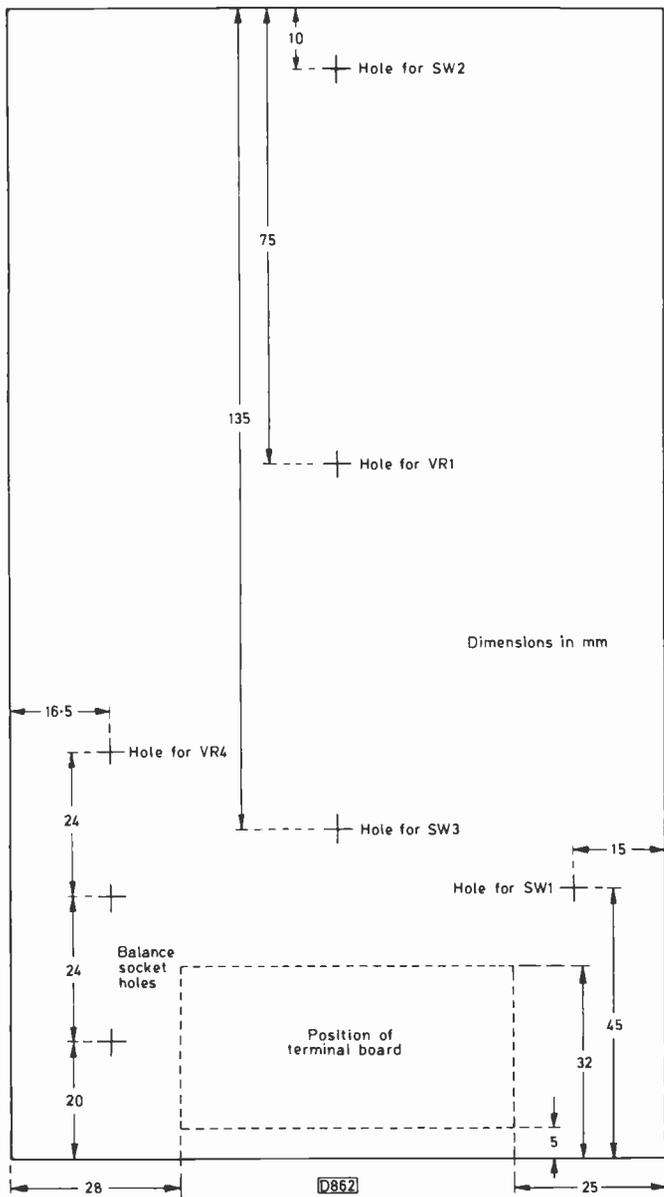


Fig. 8: Suggested drilling details for the case top. Hole sizes depend on the components used.

Table 1: Components for precise calibration.

Capacitors: 3.3 μ F, 1 μ F, 0.47 μ F, 0.33 μ F, 0.22 μ F, 0.15 μ F, 0.1 μ F, 0.068 μ F, 0.047 μ F, 0.033 μ F, 0.022 μ F, 0.015 μ F, 0.01 μ F, 0.005 μ F, 0.002 μ F, 10pF (silver mica 2%), 5pF (silver mica 2%).

Use range C. Divide scale numbers by 100.

Resistors: 3.3k Ω , 1k Ω , 470 Ω , 330 Ω , 220 Ω , 150 Ω , 100 Ω , 68 Ω , 47 Ω , 33 Ω , 22 Ω , 15 Ω , 10 Ω , 5 Ω , 2 Ω .

Use range B. All resistors should be close-tolerance types – gold 5% or better.

Components List

R1	10 Ω	0.25W
R2	1k Ω	0.25W
R3	39k Ω	0.25W
VR1	10k Ω	1W linear wirewound, RS173-237
VR2	470k Ω	miniature horizontal preset
VR3	10k Ω	miniature horizontal preset
VR4	1k Ω	miniature linear panel-mounting control
C1	470 μ F	25V tubular electrolytic
C2	0.1 μ F	150V tubular
C3	10 μ F	25V tubular electrolytic
C4	0.1 μ F	150V tubular
C5	0.05 μ F	150V tubular
C6	100pF	1% silver mica, RS 124-780
C7	0.01 μ F	polystyrene, RS 113-409
C8	0.1 μ F	100V epoxy cased ceramic plate, RS 125-733
C9	10 μ F	25V electrolytic
C10	100 μ F	25V electrolytic
C11	0.1 μ F	150V tubular
C12	0.1 μ F	150V tubular
C13	10 μ F	25V tubular electrolytic
C14	1 μ F	25V tubular electrolytic
C15	100 μ F	25V tubular electrolytic
IC1	555	timer
IC2	LM386	audio amplifier
T1	RS T/T3 or similar	audio driver transformer
SW1	Miniature DPDT on-off-on toggle switch.	Tandy 275-620 or similar
SW2	SPST microminiature toggle switch.	Tandy 275-624 or similar
SW3	Six-way two-pole rotary switch.	RS 327-658 or similar
Two 3.5mm jack sockets		
Miniature 8 Ω , 2in. loudspeaker		
Two penlight battery holders each to hold four batteries, plus snap-on connectors. Tandy 270-383 or similar		
Two perfboards. Tandy 276-150 or similar		
Plastic case, e.g. Tandy 270-224		
Self-sticking cushion feet. Tandy 64-2346 or similar		
Additional components for resistance ranges:		
R4	10 Ω	RS149-616, R5 100 Ω RS149-644, R6 1k Ω RS 149-694, R7 10k Ω RS149-818, R8 100k Ω RS 149-925
SW4	SPDT miniature switch	

accurately calibrated C range of the bridge to measure a number of 10 μ F and 100 μ F electrolytics, selecting two that have exactly the required values.

Resistance Ranges

If resistance ranges are to be added to the bridge you'll find that the additional figures required on the balance scale will be the mirror image of those used for the capacitance ranges. For proper calibration a range of close-tolerance resistors is needed – see Table 1. Check their accuracy first with a digital multimeter. The resistor to be checked is connected across the test capacitor sockets. Draw the ohms scale as shown in Fig. 9, with the same numerical values but as a mirror image. Mark it out on the outer edge of the capacitance scale, leaving room for calibration link lines. It's easily calibrated by selecting range B. Connect each of the resistors listed in Table 1 to the test sockets in turn. Adjust VR1 for minimum sound.

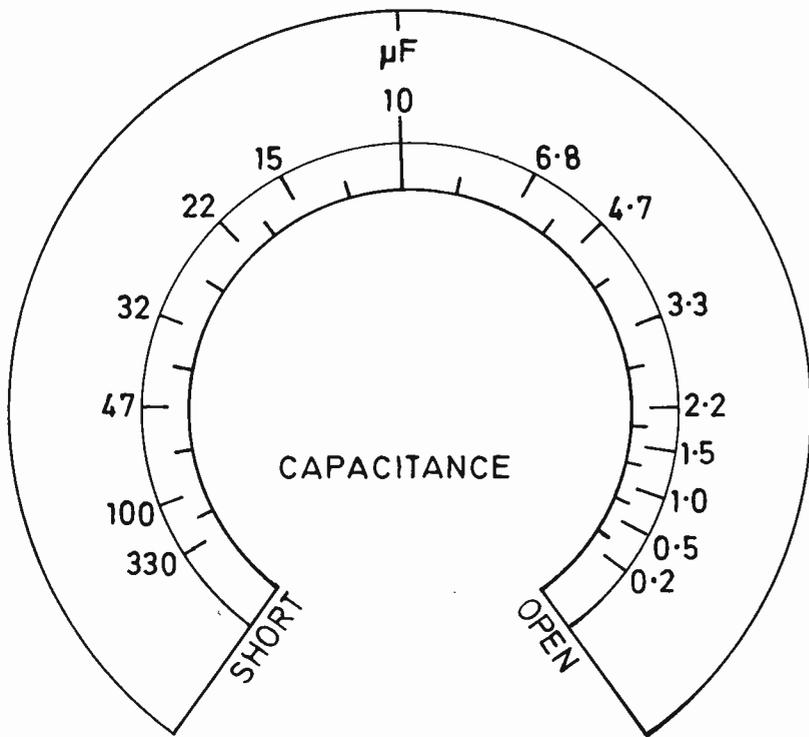


Fig. 9 (left): Full size calibrated scale for the bridge.

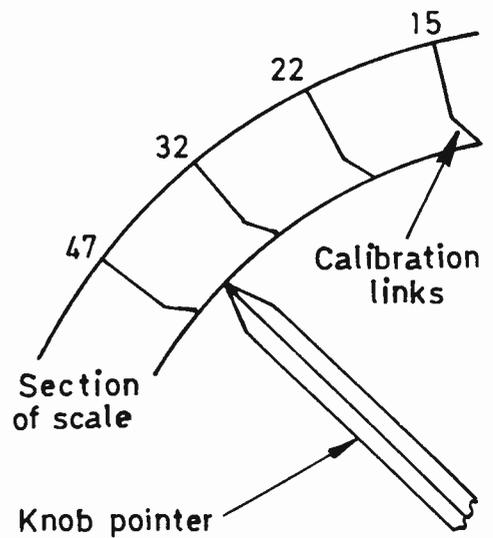


Fig. 10 (right): The "link" method of calibration, which allows for component variations.

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As you do so, mark in their numerical values – divided by ten – on the resistance scale.

If fitted, the resistance ranges read as follows.

Range A: Centre scale 10Ω. Scale reads directly in ohms.

Range B: Centre scale 100Ω. Scale numbers multiplied by ten.

Range C: Centre scale 1kΩ. Scale numbers multiplied by one hundred.

Range D: Centre scale 10kΩ. Scale numbers multiplied by one thousand.

Range E: Centre scale 100kΩ. Scale numbers multiplied by ten thousand.

Circuit Varnish

After calibration it's a good idea to apply a thin coat of circuit varnish to all solder tags, joints, etc. Don't spray the varnish on – use a small brush. This will help to ensure reliability in the long term.

Use

A capacitor to be tested can be connected to the test capacitor terminals directly or via test leads. In the latter case note that with small picofarad value capacitors the presence of the test leads might result in an incorrect reading.

Make sure that a capacitor is discharged before connecting it to the test terminals – especially in the case of large-value reservoir and smoothing capacitors.

Select the appropriate range with SW3, turn the scale pointer until the minimum volume note is heard from the loudspeaker, then read off the value from the scale. A balance point at the extreme left of the scale indicates a short-circuit while a balance point at the extreme right indicates an open-circuit.

A convenient feature of the bridge is that an oscilloscope can be connected to jack socket J2, enabling the balance

point to be observed visually with the sound cut out.

When checking electrolytic capacitors, note the normal position of the power factor control for the sharpest null balance. The term power factor relates to losses and leakage in a capacitor. If you find that the power factor control has to be turned well beyond the normal position the capacitor being tested is leaky.

You'll soon get used to reading the power factor and scale pointer figures. Measurements can be made using either oscillator frequency. The lower frequency is best for large-value capacitors, the higher frequency for picofarad values.

Some capacitors can be checked in circuit – disconnect the equipment from the mains supply first! In many cases however the measurement will be affected by other components in the circuit. The easiest way to isolate an in-circuit capacitor is to unsolder one of its leads and keep this clear of the printed circuit. Check the capacitor via your test leads, then resolder the lead if the capacitor tests good. This saves time and the frustration of struggling to replace capacitors in positions that are hard to get at.

The balance range is very helpful when you need matched components and don't have them to hand. Two components such as capacitors, coils, resistors, etc. can be matched exactly. One component is connected to the test capacitor terminals, the other to the balance terminals. When two components are matched correctly the bridge will balance with VR1's pointer at the half-way scale mark.

The two squarewave signals available are extremely useful for checking audio circuitry. Turn SW1 to the output position and plug a screened lead into jack socket J1. The lead should be at least a metre long so that the capacitance bridge's unscreened case is well away from the equipment under test. VR1 now acts as a volume control. If you connect a scope to J1 you'll see the squarewave output increase and decrease as the control is turned.

As you become accustomed to your capacitance bridge you'll find new uses for it.

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Letters

SERVICING INDUSTRY CHANGES

From the letters in your January issue it appears that many readers are aware of the changes taking place in the TV and video servicing industry. While it will take another couple of years for the new order of servicing to be fully established, anyone in the industry who doesn't recognise the changes will be left out in the cold.

Martin Blake's letter is significant in drawing attention to the new attitude being taken by many manufacturers. Rather than adopt the negative approach of rejecting Grundig products, he ought to take the initiative and contact Grundig and its dealers in his area. They may be all too willing to off-load some of their servicing. Reputable manufactureres are willing to support servicing organisations that are, in turn, prepared to invest in equipment and training. Grundig and JVC in particular do so. But why this new attitude and what does it involve?

Much of the TV and video equipment produced by the major manufacturers today is of very advanced design, incorporating complex microcomputer routines that make it possible to have access to internal functions via the microcomputer. Also we are seeing the first examples of equipment with field stores to give picture-in-picture and other features. There are Grundig VCRs with the ability to override emergency fault routines, JVC camcorders with the same facilities, Finlux TV sets with internal adjustments via the remote control handset, and both Sanyo and Toshiba VCRs with field stores. Without backing from the manufacturers, servicing this type of equipment will be beyond the service engineer. He won't stand a chance of repairing it and will end up returning the equipment to the customer – with a high probability of additional faults.

You may say it's all right for Steve because he has Grundig Pete to talk to. But there have been times when we've both been confused over a simple VS180 and have not known, after someone has had a go at it, in which of two panels or three switches the fault has lain.

Say that you are faced with a new Panasonic NVM5 and the contrast of the picture is slowly changing up and down again. Nowhere does it mention that this is normal in the high-speed shutter mode, or that in a certain new VCR the slow-motion tracking control is now the same knob as the normal one. It gets to the point where the operating procedures can be as confusing as the internal circuitry! When faced with a new, faulty product for the first time you may not even be able to operate it, let alone repair it.

There are other points in the same issue. The man with the battered Marina van who finds it less easy/viable to carry out field repairs, so that more have to be done on the bench. "Ex-valve set dabblers" complains that the magazine has changed from DIY towards the trade. There's no such thing as DIY video repairs. You can't swap syscon or LSI servo chips like you could valves. For one thing they don't plug in, and for another without very good quality soldering/desoldering equipment the print will be damaged and that will write off the PCB and the VCR or TV set for good.

There will be plenty of opportunities for enterprising engineers who are prepared to spend money on equipment and time on training to set up regional service

centres for their local dealers, because as time progresses and domestic electronic equipment becomes more complex most sales-orientated dealers will not be able to cope with their own servicing. Think about it . . .

*Steve Beeching,
Barnby, Newark.*

GRUNDIG'S NEW POLICY BACKED

I was amazed to see criticism of Grundig's new service policy when to me, a Grundig dealer of long standing, the company is now getting it right. It would take a full article to go into this in the depth it deserves, but I would sum it up as a policy of looking after those who look after you. If we look after the people who buy from us, and Grundig looks after us, that's as much as anyone is entitled to expect – but consider yourself fortunate if that's what you get.

In the past we had difficulty in getting through to Technical Information and Spares, mainly due to non-dealers taking up telephone time. Grundig has made every effort to give its dealers information through service courses, technical bulletins, etc., but there were still occasions when we had a query that couldn't be dealt with because Technical's phones were engaged while they answered simple queries from non-dealers because they hadn't been on courses etc.

Your correspondent refers to people who move from one district to another being unable to obtain service. There are bound to be some drawbacks with any system, but as more dealers become aware of the Grundig dealer support I would expect it to be only a matter of time before there's a Grundig dealer in every town.

What I am amazed about is that no one appears to be complaining about Philips. Its back-up is so poor as to be virtually non-existent. The company closed down all its service departments and appointed "specialist dealers". We approached one regarding an under guarantee compact disc player. They told us they knew no more than we did about these machines, so they might have to spend some time on the fault. Philips allow only £10 so we'd have to pay any additional costs ourselves. What sort of back-up is that? The profit margins rarely allow a 25 per cent mark up, so in the event of a problem arising the chance of a final profit is remote. We changed from dealing direct to dealing through a wholesaler, who at least looks after any under guarantee items.

When Philips sold its last V2000 series VCRs the company didn't run service courses but trained four/five engineers who operated from Manchester. Any faulty machines were sent there via Securicor. This was a short-sighted arrangement, since at the end of the day the dealer knows nothing of these machines – and now's the time one can expect them to start coming in for service. Perhaps Philips would care to tell us whether the bods in Manchester are still slaving away, or provide some helpful advice so that dealers can cope with any future problems.

*R. K. Caley,
R.K. Electrics of Ilfracombe.*

OBTAINING A VARIABLE AC SUPPLY

I read with great interest Albert Hitching's article in the November issue, describing a versatile bench transformer. During the course of my work as an electrical breakdown technician I visited a firm of hose equipment specialists who were electroplating small parts to fit on the end of high-pressure hoses. They were using a small battery

charger with lamps connected in series to set the current as required. They wanted a better method of doing this, but as always didn't want to spend much money. I fitted an MK dimmer unit in series with the primary winding of the transformer and chucked out all the lamps. MK states that some of its dimmers can be used to control transformer loads in this way provided a 470kΩ resistor is connected across the transformer's primary winding.

I've since used this idea to control a bench isolating transformer. This gives me any voltage I require and also a nice slow start to anything I'm working on. With fuses fitted where needed this seems to be a safe arrangement, though maybe some of your contributors who write with all those letters after their names will pull the idea to bits. But that's life – it works!

*S. J. Searle,
Colchester, Essex.*

A NEW TYPE OF COWBOY

The cowboys have struck in Huddersfield town centre. Not the normal rusty van/run-down shop type of cowboys but a new breed – fast sales talk and expensive shop type cowboys. They are causing considerable distress to all respectable dealers. Their prices seem to be reasonable to Joe Public, but what they are selling should have been scrapped a decade ago. The main point that's causing concern is that they are advertising these second-hand goods as bankrupt stock, with no guarantee.

I've met countless victims of these con-merchants, people who have bought a TV set or VCR that broke down several days later and were told by these "professionals" that they would not carry out the repairs required. When outraged customers take a stronger line and talk about consumer protection they are told where they can go.

I've tried to repair several of these bankrupt stock items and have been amazed that they worked in the first place. People like this not only upset their customers but tend to give the impression that all second-hand TV firms are the same. Something must be done to stop these cowboys. They might be in your town next.

*J. P. Roebuck, Britannia Electronic Industries,
Huddersfield.*

REPAIRS TO VIDEO CASSETTES

Harold Peters provided some useful tips in his article on servicing VHS cassettes in the January issue. Here are some more, based on my experience.

(1) Spools used by TDK and Maxell/Hitachi are incompatible with JVC shells, though JVC's spools are compatible with TDK and Maxell/Hitachi shells. I've found that TDK and Maxell are in all respects compatible, assuming the format to be the same of course! Note that JVC makes tapes for Ferguson, Baird, Thorn, Akai, ITT and Kodak.

(2) The best method to adopt when removing the leader retaining wedge from the spool is as follows. Turn the spool over (white side up), insert a long ball-point pen tip into the small hole and push the wedge out. Under no circumstances prise the wedge out with a screwdriver blade – the brittle plastic is likely to fracture or break, causing further heartache.

(3) Assuming that the procedures described in the article and above are carried out no problems should arise. It would be far better to discard faulty cassettes, but what about irreplaceable recordings? In serious cases one

would do better to have the recording(s) copied on to a fresh tape before discarding the original – current HQ VCRs are capable of producing excellent copies.

Finally, never use unbranded or unheard-of brands.

In passing, I'd like to sympathise with the man in the battered Marina van. At the ripe old age of twenty two I often wish I'd been this age in the days of faulty valves and open-circuit mains dropper sections. As a toddler in the sixties I recall frequent visits from the NE Co-op engineer who used to attend the family set (a Defiant 9A61U I seem to recall) which frequently gave trouble. Far from screaming, I found the set and its interior fascinating, though the engineer preferred me to be out of the way. But that's another story!

*Brian Renforth,
Newcastle-upon-Tyne.*

BETTER CABINETS WANTED

The things that make servicing more complex are switch-mode power supplies, diode-split line output transformers and CMOS circuitry. Are we paying too high a price for the increased efficiency and power saving that these techniques offer? Personally I wish that manufacturers would revert to more robust cabinets instead of improving the works inside. It's paradoxical that whilst the technology inside TV sets has progressed by leaps and bounds the cabinets, now made of flimsy plastic, have never been worse.

*K. J. Freeby,
Plymouth, Devon.*

STILL PRACTICAL!

Your correspondent "ex-valve set dabbler" is right to point out that *Television* is read more by the trade these days. But take a look at the publications they used to read. The technical ones require fluent hexadecimal and total silence to be understood, while with the trade papers it's difficult to tell where the copy ends and the ads begin.

As for not caring for the enthusiast, I personally in the last year or so have described a method of finding Eutelsat-1 using a milk straw, school protractor and string; a way of videotaping teletext using a single transistor; and how to extend tape life using a pencil, rubber and scissors! F.J. Camm will pause from repairing his celestial two-valver to look down on us benignly for that! Having contributed to the magazine under F. J. Camm, Ray Street, Norman Stevens etc. I personally prefer the current style – the editor uses his blue pencil to add topicality rather than to delete anything with the slightest twinkle of humour in it.

The Western Brothers used to say "there's only a few of us left" (remember?). Les is on his tablets, and so am I to a lesser extent – such is the cut and thrust of fixing today's unfixables. So how about it "ex-valve set dabbler" and others like him? You must have come across something that will be of interest to us all. Simply write it up so that the chap going home on the train after a hard day will enjoy it. I can promise you the sky won't fall in!

*Harold Peters,
Lowestoft.*

NOT DETERRED

I agree with "ex-valve set dabbler" – your magazine is not catering for the DIY man. I don't care what the trade people think, I for one am going to have a go – at anything. It's about time we had a magazine that did

something for us like *Practical Television* used to do, concentrating on a particular set with complete circuit diagram – over two or three issues if need be.

*Geoff Hope, electrician,
Guisborough, Cleveland.*

DABLERS CONDEMNED

It's a good thing "ex-valve set dabbler" didn't sign his name. If I got hold of him I'd be likely to punch him on the nose! How many times have I seen fuses covered with silver paper, soldering like arc welding – even VCR heads cleaned with Germolene. And you can bet that the people who bring these sets in will tell you "it was all right last night". If only my life was centred around an endless supply of replacement panels: maybe I could pack up at dinner time and go home.

After spending three years at technical college (and I'm still not finished) I found that letter an insult. A good technical background and years of experience are needed to do this job properly. That's why some people are dabblers and others experts.

*From a very angry Peter Goodman,
ex-Kettle repairman,
Corby, Northants.*

ENTHUSIAST REPAIRS

I would like to echo the comments made by "ex-valve set dabbler". There has been much talk in your columns recently about service charges, trade-only suppliers and rip-off merchants. Although professionally involved in electronics, as a circuit designer in the computer industry, I repair TV sets for friends simply because I find it a fascinating field, not for any financial benefit. One advantage is that I can mend sets which those in the trade wouldn't consider to be worthwhile. I've spent many hours slaving over a G8 or an A823 that would otherwise end up on the scrap heap. I've even repaired stock faults on sets that respected dealers have said were beyond repair. I'm not kicking the trade, but there are still clearly a lot of hobbyists like myself who repair things purely out of interest and to help others.

A week or so ago I found myself reading some of your issues from the seventies. They were refreshingly interesting, full of practical tips, and there were many more component advertisers. The magazine seems to be trying to cover too wide a field today, the practical TV side being displaced by articles on VCRs (a field that's not really suited to the hobbyist), computers (widely covered elsewhere) and how to run a business. The advertisements also have a strong trade bias – I personally have no use for G11s by the bucketfull.

I suggest you cast your eyes back to what the magazine was saying ten years ago. I agree that times have changed, but would hazard a guess that the number of hobbyists has changed little since then. You should still cater for our needs.

*D.W. Sergeant,
Bracknell, Berks.*

A CLUB FOR DABLERS?

I'd like to meet "ex-valve set dabbler" so that we can get dabbling together. You see I'm an unemployed fault-finding electrician with experience of many types of equipment. My hobbies are amateur radio and electronics.

Last year I managed to get a job for three months, but when they found out I was diabetic I was given a week's notice. Since then I've been unable to get even an interview because of my health and have turned to doing whatever repairs I can for others in a similar impecunious position to my own. Trying to get spare panels etc. when you cannot afford them is a tricky business (has anyone a spare power supply for a G11, the same plus a decoder/signals panel for a G8?).

What I want is to do TV servicing in a workshop. If anyone is interested I'll send my details, c.v. etc. It would be an idea if dabblers and those who are unemployed but have some technical knowledge could get together to form a club. Let's all dabble together!

*Ian Ruddock, G8NCZ, 54 Woodcroft Avenue,
Stanstead Abbots, Ware, Herts SG12 8JQ.*

MODIFICATION WANTED

I wonder if any reader could suggest a modification to the Philips 2023 VCR to override the three-four minute automatic switch off (unless a deck function is in use) so that the machine can be used to remote control a non-remote control TV set without the annoyance of loss of program every few minutes?

*R.W. Silver,
Glasgow.*

SPARE PARTS QUERY

Does anyone know of a spare parts supplier for Silver products? Tech-Semco used to be able to provide spares but is no longer in the spares business. Perhaps one of your readers might be able to help?

*Simon Kelly, JKL Electrix,
Newcastle, Co. Down.*

MMDS AND IRISH CONDITIONS

The MMD system described in the November issue is ideal for short-range links between line-of-site reception points, e.g. for extending a cable system to an adjoining town without the need for costly underground cabling. Here in Eire there's a need to extend multichannel reception of UK signals to smaller urban areas by retransmission from local elevated sites. The problems relate to controlling the spread of reception, achieving adequate financial arrangements and dealing with copyright requirements.

In the case of small, isolated towns and rural areas however MMDS is likely to be a costly business and distribution at 2.5GHz could present many difficulties.

I note with interest reference to Canadian firms in the MMDS article, and recall some previous Canadian efforts at signal distribution in Eire. A decade ago Waterford City Cabling had Canadian experts who chose the wrong reception site and the wrong UK u.h.f. source (from S.W. England instead of S.W. Wales), then spent a couple of years "experimenting" whilst the long-suffering viewers waited for satisfactory signals. To this day some nearby unauthorised rebroadcasters provide reception that's superior to the cable system. In the case of Cork City more Canadian experts "experimented" and chose the wrong mountain range for reception, despite the advice of many Irish experts. Subscribers are of course paying for these past mistakes. I hope that more experiments by Canadians, this time in the MMDS field, are not going to be foisted on Irish viewers.

Personally I'd prefer to see redistribution at u.h.f. with simple encoding. The use of well-tryed u.h.f. technology and local expertise could provide signals at a very reasonable cost – you wouldn't need a multimillion pound organisation to operate such a system. MMDS can be received on a line-of-sight basis only, and linear output amplifiers with outputs in watts would be very expensive. The same power levels at u.h.f. would provide a much more effective TV coverage in Irish rural areas. I can't see the merits of using untried, expensive s.h.f. systems when practical u.h.f. systems would suffice. In the USA and

Canada MMDS operates from high hill sites overlooking wide open expanses of flat terrain – perhaps line-of-sight up to 100 miles. The geographical conditions in rural Ireland are quite different.

Any proposed developments should be given very careful research and experimentation before we see a rush of microwave dishes on our hillsides. Perhaps DBS TV will come to our aid before MMDS. Time will tell.

*Des Walsh,
Carrigaline,
Co. Cork.*

A Low-cost TVRO Installation

Part 1

Roger Bunney

There is very little satellite TV reception at present amongst DX-TV enthusiasts. Several have made their own equipment however while others have invested sums of hard-earned cash in commercial receiving installations – equipment from Connexions seems to be favoured. It's a hard economic fact that even a basic system to traverse the heavens, using an azimuth/elevation mount, is likely to cost you £650 plus. For a motorised system with computer memory and an up-market receiver the figure rises to £1,000 plus. These figures take into account VAT and cables. In addition you might need a line amplifier.

As regular readers will know, I've been involved in terrestrial DX-TV reception and experimentation for many years. Much of my equipment has been home built, and spending large sums of money on equipment goes against the grain. Though so few DXers are active with satellite TV reception I've for some time felt that this subject should be given greater attention. To encourage others I decided to see what could be done. The main aims have been to minimise the cost of the exercise, incorporating home-made innovations where possible, while obtaining results comparable to those provided by a more up-market system. Cost saving has been achieved by accepting a degree of operational inconvenience that would probably put the normal domestic viewer off. It was also felt important that any DIY aspects should be repeatable by others who have little or no knowledge of TVRO installations – though the enthusiasm characteristic of UK TV-DXers has been assumed!

Selection of Equipment

When you look through the advertisements in *Television* and the various video magazines you'll see quite a wide range of TVRO equipment on offer, much of it expensive. What we are seeking is the cheap gear, at the lower end of the market, which means manual receivers, patio mounts and the domestic packages aimed at the DIY or "pub" market. I decided to opt for the cheapest – a 90cm dish with a head unit having a noise figure of 1.8-2dB and a manual receiver. The head unit picks up the signal collected by the dish and converts it from s.h.f. to a lower frequency (the first i.f.) for feeding to the receiver unit itself. It's the convention today to refer to the electronic part of the head unit as an LNB (low-noise block), so we'll use this term from now on. In the patio mount field it's unlikely that you'll find dishes with a diameter of more than about a metre.

With the low-power satellites we're aiming to receive a

90cm dish provides an LNB input that borders on the marginal, so a very low noise system is essential. At under £500 retail typical performance figures are gain of around 55dB with a noise figure of 2dB or lower. If you can go for a 1m dish, so much the better. The latest LNBs use HEMFET technology, with noise figures of less than 1.5dB – but you pay for this enhanced performance! The system I've put together uses a 90cm dish and an Echosphere LNB feeding, via RF125 u.h.f. coaxial cable, an Echosphere SR1000e receiver. Having sounded out the market for possible sources of supply – not an easy task – I decided to purchase the equipment from North East Satellite Systems of Cropton, North Yorkshire. John Standen of North East Satellite Systems is noted for his expertise in the commercial satellite market and I feel that his company's track record gives assurance should any problems arise.

I decided that use of a polarrotor for remote change between vertical and horizontal polarisation was unwise since it introduces a loss approaching 3dB. This is unacceptable with a dish of less than 1m (we're not talking about DBS reception!). It means that the LNB/feedhorn assembly will need to be physically rotated to suit the polarisation of the required transponder downlink. Inconvenient – but a financial saving! I bought an adjustable scalar ring assembly since this allows you to "tune" the head for optimum signal pickup from the dish. Doing this can provide an improvement of 0.5-1dB. The LNB is fed with an input at 10.9-11.7GHz and provides a downconverted i.f. output at 950-1,750MHz.

Having decided to buy the Echosphere units a cheque was sent off. Shortly afterwards two large cardboard boxes arrived . . .

The Patio Mount

A patio mount is basically a fixed dish stand which is bolted down. The dish is elevated by a sliding telescopic pipe arrangement, the lower lip of the dish being hinged to the patio frame beneath. Patio mounts are usually found at pub or bookie shop installations where a specific channel, such as CNN, MTV or Sports Channel, is being received – since only one channel is required the dish can be permanently fixed for reception from one satellite. BT often instal preset dish systems at bookie shops to receive the betting downlink information service.

Having unpacked my patio mount and dish I had the problem of how to adapt the mount to obtain an azimuth swing so that the dish could be swung from east to west through south, giving access to the Clarke Belt where the

various geosynchronous satellites are parked in orbit. Use of a polar mount, which when set up gives accurate tracking across the Clarke Belt, would have been best, but the impoverished TV-DXer following the set up described here must settle for independent adjustment of the azimuth and elevation.

The patio mount is designed to be bolted down on to a concrete base/flat roof. For this purpose several lugs are welded to the hoop that comprises the patio mount frame. The dish is hinged directly to one side of the frame: at the opposite side of the hoop there's a telescopic steel tube assembly that lifts the dish up in elevation – tightening a single bolt maintains the correct angle. A simple but effective arrangement.

Obtaining Azimuth Adjustment

I obtained some sturdy industrial casters (try a tool supplier for these) which for fixing purposes have quarter inch threaded studding. The casters can be bolted to the frame to give movement, using appropriate plated nuts and washers. The only problem is that the casters are free to move and rotate on their own. To overcome this difficulty the vertical spindles around which the casters rotate were carefully drilled and tapped through with steel self-tapping screws (one per caster). When fixed as shown in Fig. 1 and the accompanying photos the dish and mount will now rotate circularly, i.e. turn on the spot. Further precision is needed however.

You will probably be able to scrounge an old industrial tidybin lid from your local refuse depot (find under Environmental Health Services of the local council authority). These are flat, circular lids that fit on top of the wheeled bins you find behind shops etc. The type made by Refuse Systems of Bradford is perfectly flat and round (like a tea tray). It has an access hatch with lip – when used in its intended manner a rubber lid fits over this. I acquired a rusty specimen gratis and cut away the small access lip, leaving a large lid with a hole in it. It's best to paint the lid with rust preventer and then a gloss enamel paint.

The idea is that the dish and its now wheeled patio mount sit inside the upturned lid, rotating within the lid in a disciplined manner. Unfortunately the internal diameter of the dustbin lid was found to be greater than the extreme diameter of the casters. To get round this problem sleeved garden hosepipe was fitted around the inside of the lid's outer lip. The hosepipe was made into a loop and joined with a piece of half inch outside diameter alloy tubing – ex-v.h.f. aerial element tubing. The aim is to achieve a friction fit against the side of the casters so that the assembly can be easily rotated but won't move on its own accord. In my case it was necessary to provide additional packing, using thin plastic strip, to obtain the desired degree of frictional pressure on the sides of the casters. Before the wheeled dish and frame are fitted within the

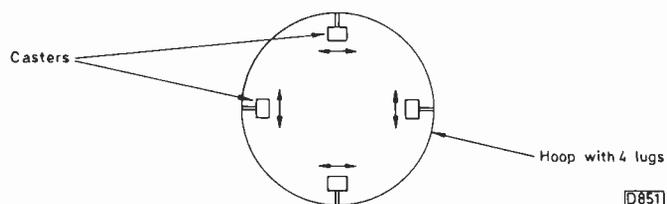


Fig. 1: Fixing the casters to the frame (not to scale). The patio mount casters are fixed at 90° positions on the flanges provided. Lock the caster wheels (see text) to allow movement in one plane only – parallel with the adjacent frame, as shown here.

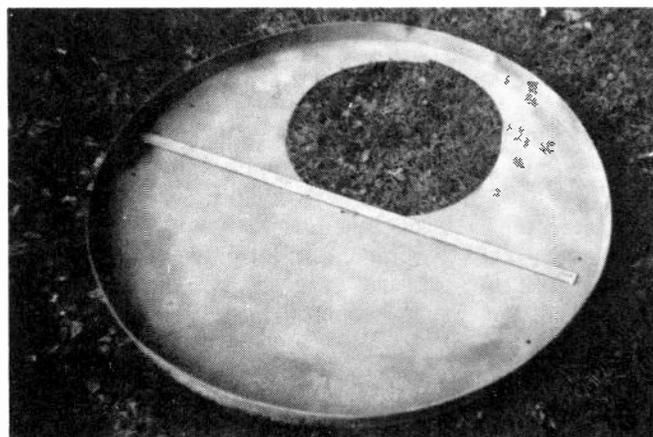


Photo 1: The industrial dustbin lid, with access cut-away, treated with an anti-rusting chemical.

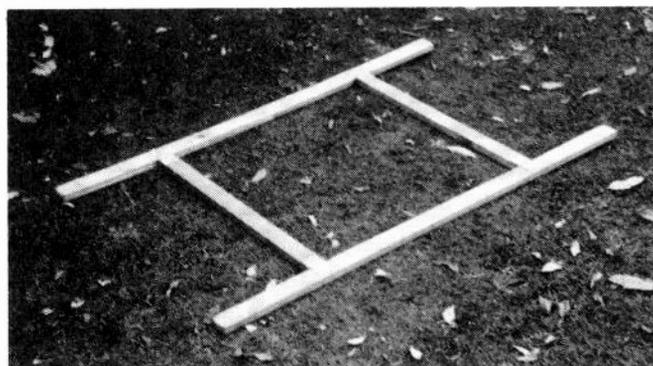


Photo 2: The wooden frame, held together with timber connectors, on which the dustbin lid will rest.



Photo 3: The now painted dustbin lid at rest on the wooden frame. Take care not to cut away the access hole lip too close to the main outside lip.

dustbin lid, paint a horizontal white line to serve as the north/south reference. There are several holes in the surface of the dustbin lid. These were rivet holes for the original steel handles. Use two holes to provide anchorage to the ground to prevent movement of the lid and hence disruption of the N/S reference. Leave the other holes to provide drainage.

Alignment

Make a simple wooden base from creosoted timber, say 2in. x 3/4in., holding it in place with "bang-in" timber connectors. Place the lid on the timber frame in a location that gives a clear view of the southern sky between SE and SW. Carefully align the lid with its white horizontal line on a magnetic north/south path. This reference must be

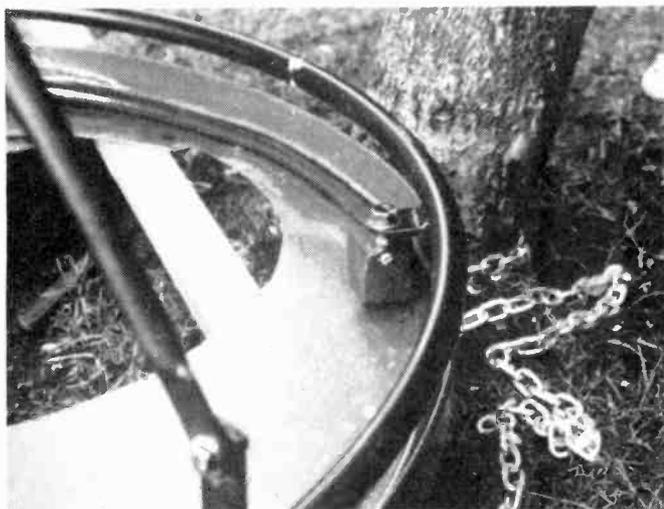


Photo 4: One of the casters bolted to the patio frame hoop. Fix the casters to prevent movement around the vertical spindle. To do this, hold the caster unit in a vice and drill a hole through the side of the caster shroud, then the spindle itself. Fit a self-tapping steel screw of sufficient length to pass through the outside shroud and the spindle, projecting beyond the inner edge of the spindle. The caster will then rotate only parallel to the steel hoop.



Photo 5: The now mobile patio mount sitting inside the dustbin lid. Note the hosepipe packing – this is fixed to the rim of the dustbin lid with Evostick to prevent it moving. The white line is the magnetic north/south reference. The access hole is useful since you can stand in it when adjusting the feedhorn assembly over the top of the dish. Several holes are provided in the dustbin lid to aid drainage and allow two six inch nails to be hammered into the ground to prevent movement of the lid once it has been calibrated with satellite aiming points.

accurate. Avoid using the compass near the lid otherwise the steel will deflect the needle from true. The reason for having the reference line on the lid is so that it can again be aligned when moved elsewhere in the garden and markings for known satellites will remain true.

Make a vertical reference line on the hoop frame, centrally beneath where the dish is hinged, i.e. at the front of the system. When a satellite is located a matching reference line can be painted on the rim of the dustbin lid, with an index or reference number, so that you can always accurately return to the same azimuth.

So we now have a mounting system that provides simple azimuth movement. It cost next to nothing to make (this depends on your sources of scrap metal). Next month we'll give details of the elevation adjustment. If it all sounds a bit

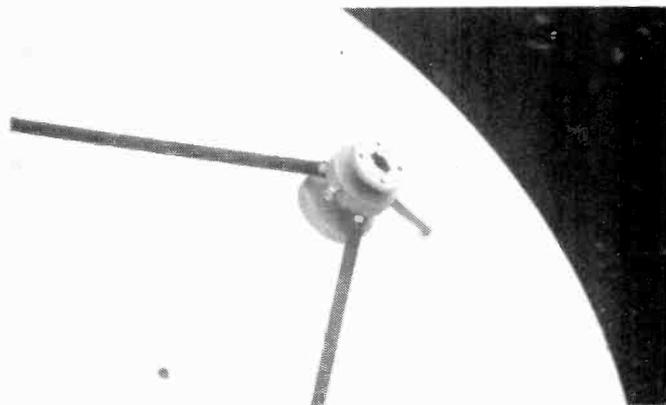


Photo 6: Close-up of the head assembly minus LNB. The support arms with PVC tubing make fixing easy; the protruding screw allows polarisation and focus adjustment. All very simple – you can't go wrong with the equipment I purchased.

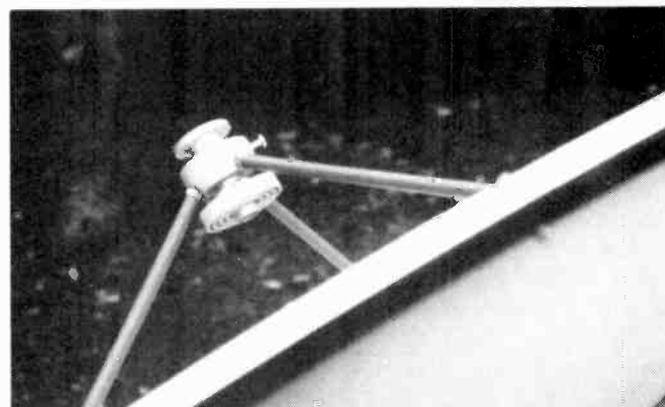


Photo 7: Another view of the scalar ring assembly – its adjustment screw can just be seen. This enables the ring assembly to be slid up and down the feed tube. Careful observation of a weak signal on a TV screen while adjusting the ring will show clearly where it peaks.

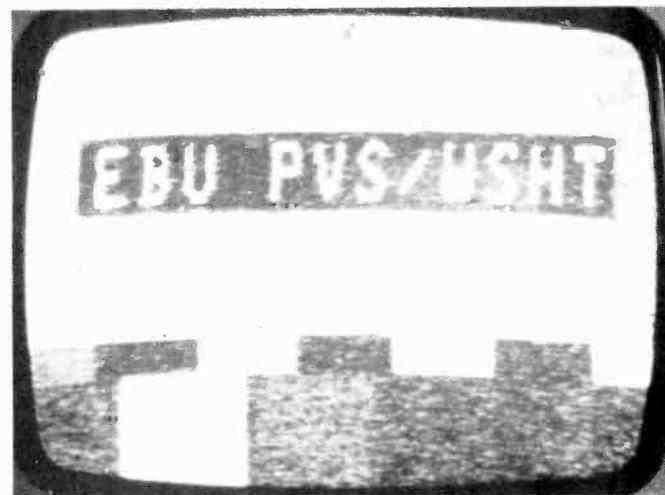


Photo 8: The Intelsat bird at 27.5°W was found within two minutes once the LNB was fixed. Beginner's luck – it took 42 minutes to find the ECS bird at 13°E! Just to prove that the system works, this photo shows the EBU-Washington news preview feed, not too strong a downlink, being a half transponder on the basic full transponder receiver.

complicated, I should add that I can go from say the Intelsat bird at 27.5°W to the Eutelsat bird at 13°E in about twenty seconds (plus a walk to the dish!) and later reset to Intelsat accurately without the need for a signal strength meter or a TV screen display.

TV Fault Finding

Reports from Mick Dutton, John de Rivaz, B.Sc.(Eng.), D.H. Davies, Hugh MacMullen, Joseph Cieszynski, Roger Burchett and Philip Blundell, Eng. Tech.

Ferguson TX90 Chassis

This colour portable suffered from intermittent colour. No amount of heat or freezer would induce the fault. We noticed that the colour was always correct when the set was first switched on. It would then go into bars and finally off. From this it seemed likely that the problem was around the colour decoder reference oscillator. We started to change capacitors and when C155 (47pF) was replaced the colour stayed on. We used a 100pF component as in later production. **M.D.**

ITT CVC800 Chassis

We'd seen this set several times over the past twelve months. The customer always complained that it failed to start properly. He said it made a screeching noise that built up gradually until the set sprang to life. We were never able to pin this down as the set would always work correctly with the back removed and the test equipment hooked up. Recently however the customer came in and reported that the set had gone dead. On removing the back we found that the 110V rail was very low and pulsing. It didn't take long for us to discover that the smoothing capacitor C757 (10 μ F) was open-circuit. **M.D.**

Philips KT3 Chassis

We were fooled by one of these sets which was tripping. By the time a friend called we'd changed just about everything. "What about the mica washer under the line output transistor?" he said. When removed we found it had a pinhole that produced arcing. **M.D.**

Mitsubishi CT180B

This set had suffered its first breakdown from new (some nine years!) The problem was that the picture was severely reduced in size all round. We found that the h.t. line was at only 85V instead of 105V. R909 (220 Ω , 10W) was getting very hot and we discovered that the over-voltage protection transistor Q905 (2SC620) had gone short-circuit. A replacement put matters right. **M.D.**

Rank T20 Chassis

This set came in dead. We soon found that the BU208A line output transistor was short-circuit. A replacement was fitted and the usual dry-joints on the line scan plug were resoldered. The set was given a short soak test then returned to the customer.

It came back a few days later with the same complaint. After fitting several BU208As we eventually found that the scan coil connections at the plug on the coils were burnt and making poor contact. Resoldering the wires directly solved the problem. **M.D.**

Amstrad CTV1600

The complaint with this set was field collapse. Supplies were present at the field output transistors but there was no voltage at the base of the driver transistor. On checking back to the LA7800 timebase generator chip we found that there was no 12V supply to the field section, due to a

dry-joint from the 12V rail to pin 12. It's worth noting that this i.c. has two supplies – one for the field and one for the line section. **M.D.**

Variac Repair

Having been a wally and burnt out the variac I put it on one side and looked up the prices in a surplus catalogue. After recovering from the shock I thought I'd try to repair the faulty one. It can be seen from the circuit (see Fig. 1) that a burn-out usually occurs when current can flow from the mains to an overload through a relatively short section of the winding. Furthermore, it's the output current that's critical. So a 5A cutout was fitted in place of the more usual terminal block (see Figs. 1 and 2). The prongs were removed and replaced with soldering tags: it was then connected in series with the output cable, which ran to a floating 13A socket.

The variac was repaired by first dismantling the unit completely to reveal the central toroid. The burnt section was wound off and a similar diameter enamelled wire was then selected to wind back in its place. Once the section was rewound it was pressed down so that the turns passing under where the brush would move were flat and level. They were then sanded off with a piece of sandpaper so that the brush could make contact.

If I can make it work after a home repair I'm sure most other *Television* readers will be able to do the same should they have a similar unhappy accident. **J.deR.**

Monochrome Portable Problems

Dwektronix "Classic 12": No field scan was traced to D506 (BA233) being faulty. It's connected between the emitter and base of the field output transistor. Note that later versions of the Classic 12 have an i.c. field timebase.

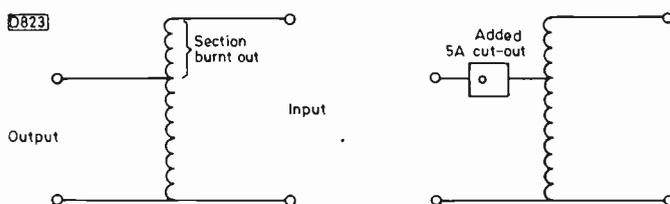


Fig. 1: Variac circuit.

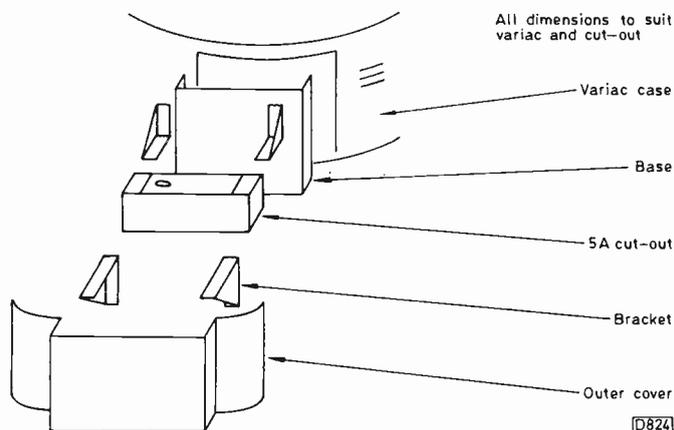


Fig. 2: Variac mechanical details.

Monelectric Minimatic 12in. portable: We've had failure of the ITT mains bridge rectifier in several of these sets. Fitting a 3A RS bridge to the heatsink on the right-hand side cures the fault.

Philips TX chassis: Intermittent loss of the sound and vision signals was traced to dry-joints on the tuner's feedthrough capacitors. Resoldering all joints cured the fault.

Binatone Cavalier Model 19496: Loss of sync was traced to D302 being faulty.

Thorn 1590/1 chassis: The l.t. line was low and couldn't be adjusted. The cause was failure of the line output transistor VT26. **D.H.D.**

GEC 14in. CTV (ITT Pico 1A Chassis)

We've had two of these sets with the same problem. If all the tuning buttons are pushed in they will lock in. To release, open the tuning cover and insert a small plastic probe into the plastic plate behind the buttons. Then lift the plate up and down to release. **D.H.D.**

Fidelity ZX2000 Chassis (CTV14)

The switch-mode power supply would trip when the set had warmed up. The cause was C412 (100pF, 8kV) flashing internally. This capacitor decouples the input to the focus unit. **H.MacM.**

Sanyo CTP3106 (80P Chassis)

This fault took us a time to find because it occurred only when the set was very warm. In this condition there was a considerable increase in the h.t. voltage, from about 115V to 150V. The chopper transistor's input coupling capacitor C314 (47 μ F electrolytic) was found to be slightly leaky. **H.MacM.**

ITT CVC1204 Chassis

The switch-mode power supply seemed to be o.k. but the line output stage wasn't doing anything. R744 (1k Ω) which feeds the line driver stage often burns up to cause this problem but appeared to be perfect visually. It was nevertheless very nearly open-circuit. **H.MacM.**

Hitachi NP6C Chassis

This was a difficult one because the fault occurred only with the back on! The picture would suddenly shrink to about 12in. but remain quite linear and in focus. Eventually we found that TR904 in the regulator circuit was intermittently faulty. The h.t. would then fall to about 95V. **H.MacM.**

Philips K30 Chassis

No video and a very dark raster can be caused by a number of things with these sets, but two faults of particular interest came our way recently.

In the first case there was no luminance output from the TDA2560 chip (earlier two-chip decoder). After some time I tried another decoder panel and proved that the fault was on the mother board. Checks around the flyback blanking transistor T1535, the contrast controls, etc. revealed nothing but I then discovered that pulses were present at the cathode of D1422, which links the line output transformer derived beam-limiting potential to the contrast circuit. This provided the clue since there should be a steady voltage at this point. Inspection of the 68nF smoothing capacitor C1565 revealed a hairline crack at one

end, and when a replacement was fitted a normal picture appeared.

The second set had the same symptoms and initial checks such as unplugging the teletext interface and checking the d.c. voltages showed us only that the tube's cathodes were at 150V, so that the tube was cut off. A scope revealed that colour-difference and luminance signals were present at the decoder panel, but tests around the RGB output panel led us nowhere. At one point we checked the -20V bias supply from the line output stage and found that it was slightly high. Not too surprising perhaps as the supply is unregulated, but we nevertheless found that the relevant reservoir capacitor (C1586, 100 μ F) was open-circuit. We discovered this by scoping the -20V line which turned out to have line-frequency pulses on it. Interesting that when measured with an Avo 8 the voltage was found to be high, something that shouldn't happen when the supply decoupling is open-circuit. We can only surmise that the presence of line pulses with the meter switched to the d.c. range led it to produce an incorrect reading.

Other causes of no picture with these sets are loss of line pulses due to dry-joints, failure of the TDA2560 or TDA3560/1 chip (depending on decoder type), failure of the flyback blanking transistor (T1535) and, on teletext versions, failure of either fuse on the teletext power supply mounted at the base of the cabinet. **J.C.**

Panasonic TC2201

A sad story this. The elderly owner complained that there was intermittent line collapse. No fault could be found during a number of visits and eventually the set failed. Fusible resistor R525 (68 Ω , 0.5W) in the feed to the line driver stage had gone open-circuit. A couple of ordinary 33 Ω resistors in series were fitted temporarily and everything seemed to be all right, but the set failed again a short time after fitting the correct type of resistor. This time the BU208A line output transistor had failed. The set seemed to work normally after replacing this, though the calls complaining about intermittent line collapse were becoming more regular. Finally I saw what the problem was: the set was tripping due to the h.t. rising. I could see the h.t. breathing as I watched it.

On Panasonic's advice I replaced the two zener diodes D809 and D819 which, incidentally, are 5V and 6V respectively, not both 6V as stated in Service Bureau last September (page 773). To be on the safe side I also replaced D815 and the set-h.t. control R813 (1k Ω) which has been known to give trouble.

Unfortunately the focus control had suffered too many blows and was varying intermittently. It's no longer available from Panasonic, so a Thorn 8500 type was pressed into service.

Reverting to the Service Bureau item just mentioned, D815 and R813 should be added to the list of items to be replaced. **R.B.**

Decca 70 Series Chassis

I've had quite a few colour portables in recently fitted with this chassis and with the complaint no colour. The cause of the trouble is often a faulty chroma delay line (DL700). Due perhaps to the sets being dropped? **P.B.**

ITT 80-90° Chassis (Power board CVC820)

If the line output stage is drawing excessive current, pulling down the 120V h.t. supply, before suspecting the shift or line output transformer try disconnecting pin 5 of

the TDA1170S field timebase chip in case it's short-circuit.

If the set changes channel intermittently by itself, try changing the focus spark gap. **P.B.**

ITT CVC30 Chassis

I seem to see a lot of ITT sets: this day all the calls were to the same range. Some of the faults were stock ones, some not.

(1) Dead with the power supply whistling and no 160V h.t. supply. The h.t. rectifier D19 was open-circuit. Someone had fitted an SKE type.

(2) Dead, power supply tripping. The BU208 line output transistor was short-circuit due to a burnt scan coil plug.

(3) Lack of height due to dry-joints on the field module earth.

(4) Intermittent dark picture due to dry-joints on the EW modulator transformer.

(5) Dead set, no 160V supply to the line output transistor due to a dry-joint on the tag to mounting bolt.

(6) Remote control not working when out of set. PCB mounted coil in handset broken off.

(7) Blank raster. R28 (820Ω) open-circuit. This resistor feeds line pulses to the colour decoder panel.

(8) Tripping – stopped when the tripler was disconnected but the fault was still there with a new tripler fitted. C61 on the earthy side of the line output transformer's e.h.t. overwinding was short-circuit.

Didn't need the loan set that day!

P.B.

Teletopics

SONY ADOPTS VHS

Industry watchers have long wondered when Sony would bow to the inevitable and start to supply VHS VCRs. The announcement came on January 11th. Sony is the last VCR manufacturer to join the ranks of VHS equipment producers. The Betamax system is not being abandoned, and Sony will still be pushing the 8mm system which it sees as being the most suitable format for the camcorder market. But for normal domestic use Sony will rely increasingly on marketing VHS machines. Betamax machines will be produced mainly for the replacement market.

Sony's marketing of VHS machines will start in Europe, with bought-in VCRs – understood to be of Hitachi manufacture. Production of VHS machines by Sony is expected to start this summer. Sony VHS machines will then be released in the US and Japanese markets.

The growing use of prerecorded tapes is thought to have been one of the main reasons for Sony's decision. Sony found that of the 10-11 million homes in the UK with VCR users only 22 per cent didn't rent or buy prerecorded tapes – and Betamax prerecorded tapes are not popular with those who run tape libraries. Another factor that could have helped persuade Sony to make up its mind is the prospect of S-VHS machines, which many observers feel will come to dominate the more expensive end of the market.

Sony point out that its VHS machines will be designed to interface with other Sony video and audio products to ensure smooth integration of editing, remote control and interconnections. This should be particularly useful to users of Video 8 camcorders who may wish to edit programmes on to VHS tapes for distribution to relatives or friends.

LAYOFFS AT FIDELITY

Production at Fidelity's N. London plant is being cut back, with an initial loss of 100 out of 450 jobs. The company has decided to cease UK production of 14in. colour portables, which it says is uneconomic in view of the fall in the value of the dollar and the effect this has had on the prices of sets produced in the Far East. Future small-screen Fidelity CTV sets will be imported. Production of large-screen CTV receivers and cordless phones will continue for the time being though Fidelity's parent company Caparo, which has been trying to sell the London plant, is still considering

whether to close it down completely. Elimination of manufacturing losses would enable Fidelity to operate profitably.

Meanwhile Hinari has decided to establish a new plant at Cumbernauld, Scotland for the production of brown goods. Initial products will be hi-fi and compact disc systems.

S-VHS

JVC has announced that the S-VHS specification for Europe has now been finalised. Initial information on S-VHS was given in this magazine last July.

The main change with S-VHS, which requires special tape, is that the f.m. carrier deviation is 5.4-7MHz instead of 3.8-4.8MHz, giving a horizontal resolution of over 400 lines. The chrominance carrier frequency remains the same at 627kHz while the white and dark clip are 210 and 70 per cent respectively. Audio is standard VHS linear or VHS hi-fi. Tapes will be available in a variety of lengths, designated SE180, SE120 etc. – there's so far no provision for a four-hour tape. S-VHS-C tape is the standard thirty minute length (SP mode). European S-VHS equipment is being designed to work with PAL, Secam and other signals including MAC. No launch details have been released.

An International Electrotechnical Commission (IEC) proposal for scart connectors to be used with the new S-VHS system is under consideration. The IEC suggests splitting the separate chroma signal, used with S-VHS to avoid cross-colour effects, into RGB components to feed to the appropriate scart socket pins. This would involve additional circuitry but would have the advantage of compatibility with TV sets equipped with a scart socket.

PRODUCTS GO DIGITAL

Digital seems to be the flavour of the month as Japanese VCR manufacturers add digital machines to their ranges. Models from Panasonic, Toshiba and Sharp have already been mentioned in these pages. Toshiba's latest model, the DV-90W, has digital still and slow plus HQ Pro, which employs all four of the HQ features and additional filtering. It also has an elapsed time counter which uses the control pulses for time calculation. The price is around £480. NEC's latest VCRs, Models DX-1000K and DX-3000K, incorporate a digital video noise reduction system and digital still, slow and picture memory (the off-tape or off-air picture can be frozen). Other features include twin-speed strobe, fast search and HQ circuitry. The DX-1000K has a suggested price of around £450 and the DX-3000K, with hi-fi stereo sound and two-speed operation, a suggested price of around £700.

A digital TV receiver using ITT's chip set has been

introduced by Telefunken. It has a 29in. "Super-Planar" flat-face tube with a new type of gun assembly and a stereo sound capability of 40W music power per channel with four front-facing speakers. The colour decoder is of the multistandard type, handling PAL, Secam and NTSC signals, and the coverage includes v.h.f.

Panasonic has introduced a digital mixer which can mix or wipe any two video signals whether synchronised or not. Special effects can be created by a frame synchroniser. The WJX10 sells at around £1,200.

TV SOUND TUNER

To overcome the problem of poor sound reproduction from the average TV receiver Radio and TV Components (Acton) Ltd. has introduced an independent TV tuner which can be directly connected to a hi-fi system. The unit is mains operated and has full u.h.f. coverage with five preselected tuning controls. It can also be used in conjunction with a VCR. The basic model costs £29.50. A version with a built-in stereo headphone amplifier for the hard of hearing costs £35.90. The tuners are available by mail order (add £2.50 post and packing) from the company's Acton branch at 21 High Street, London W3 6NG. The company has branches in Acton and the Edgware Road.

LOW-NOISE HYBRID AMPLIFIERS

The new OM2000 series of Mullard hybrid amplifiers offers improved performance with MATV, CATV etc. systems – noise figures are about 25 per cent less than with the standard range. There are five devices with type numbers OM2045, OM2050, OM2060, OM2061 and OM2070. Performance ranges from a gain of 12dB with noise figure of 3.6dB for the OM2045 to a gain of 28dB with a noise figure of 4.8dB for the OM2070. The amplifiers are wideband devices covering 40-860MHz with input and output at 75Ω and require a 12V supply. They use thin-film technology and the latest Mullard u.h.f./s.h.f. transistor type BFR92.

IERE RECORDING CONFERENCE

Sessions on laser recording techniques and media will be featured at this year's International Conference on Video, Audio and Data Recording, which is being held at the University of York from March 21-24. The conference is the seventh in the biennial series organised by the Institution of Electronic and Radio Engineers. It will be preceded by a tutorial day wholly devoted to optical recording. Two papers on erasable optical storage, from Philips and Sharp, will be included in the first session of the main conference. For further information and registration forms apply to: The IERE Conference Secretariat, Savoy Hill House, Savoy Hill, London WC2R 0JD (telephone 01-240 1871).

NEW ME TAPE PROCESS

Thorn-EMI has developed a new process for producing metal evaporated (ME) tape, which is used for Video 8 and digital audio cassettes. The process involves enclosing the tape coating plant in a vacuum chamber. A crucible of metal is then heated to boiling point with a high-power electron beam. Finally a wide roll of polyester is wound over the crucible so that the metal atoms condense on the backing to produce an 0.15 micron recording layer. Special shutters ensure that only atoms arriving at an oblique angle

are deposited on the backing. According to Thorn-EMI this results in the columnar crystals leaning against and supporting each other instead of standing upright on the polyester. The magnetic resolution is claimed to be better than 0.3 microns.

FLAT TRADING

Disappointing half year results announced by Dixons have underlined the fact that the radio/video/TV trade has been going through a flat patch, with a poor Christmas. Dixons ordered ten per cent more stocks for the Christmas period but sold twelve per cent less. The present aim is to clear excess stocks by price cutting.

VIDEOPHONE FORMAT AGREEMENT

Agreement of a standard for videotelephones has been reached by Japanese manufacturers and has been given preliminary approval by the Telegraph and Telephone Technology Committee. The standard relates to the transmission of still pictures over conventional telephone lines. Transmission of a picture takes five-six seconds, during which time conversation is not possible. Mitsubishi, Matsushita, NEC and Sony plan to start selling still picture phones this spring. There had been disagreement earlier between Mitsubishi and Sony, both of whom have been selling videophones in the USA. Mitsubishi's system was quicker and had a slightly larger screen, but sold for \$1,000 compared to about \$375 for the Sony equipment. The systems basically use fax principles with a camera and microchips for image processing.

NEW APPROACH TO 3-D VIDEO

A small, London-based technology company, Aspex, has developed a new approach to 3-D applicable to all forms of recorded visual images including TV, video and film. The system uses a special lens – there's no need for two separate images – and is said to improve the sharpness and colour saturation of images. When special glasses are worn a depth effect is created.

TELECOM STILL PICTURE TRANSMITTER

Canon has developed a portable transmitter, type RT611, for use with its still video communications system. The transmitter enables images held on an SV floppy disc to be easily transmitted via an ordinary telephone to anywhere in the world. It can be connected to the line directly by means of adaptor LC-RT or coupled to the telephone mouthpiece by means of acoustic coupler AS-RT. The RT611 has a built-in 1.5in. screen for display of the image. At the receiver end a conventional wire phototransceiver can be used for monochrome or a Canon SV transceiver type RT971 for colour or monochrome. Colour transmission takes only three minutes.

The transmitter was exhibited at the recent Geneva Telecom Show alongside two units currently under development, the Canon image processor and a video input adaptor for use with the Canon digital colour laser copier. The latter was launched in the UK last year. The image processor will process video images in a variety of ways – capabilities include manipulation of form, colour and image size, and combining multiple images to form a composite image. The unit is computer controlled and incorporates a frame store: to alter the image as required a pressure pen is used with a colour monitor.

Long-distance Television

Roger Bunney

Apart from an uplift from Geminids/Ursids meteor shower activity December is traditionally a quiet month. This time it was somewhat different. There were no fewer than three tropospheric openings that produced quite excellent reception, particularly in central/southern England, during the period.

The first spell occurred on December 6th, when a prevailing high-pressure system produced high-level Band III/u.h.f. signals from near/central Europe. Typically Belgium, Holland, France, West/East Germany and Denmark were received in the Midlands.

The second spell occurred around the 14th, with a virtual repeat of the conditions on the 6th though Band III ducting was more noticeable – many enthusiasts received CST (Czechoslovakia) ch. R10 (Plzen) for the first time. The opening continued through the 15th, with reception extending as far as Poland. Another first for several vigilant DXers was TVP (Poland) ch. R38 Wroclaw. One comment had it that this transmitter came in “like a local”. Reception of CST ch. R35 was also widely reported.

The third and perhaps most dramatic opening occurred on the 23rd, though it was trailed and tailed on the 22nd and 24th. A fast-moving lift produced rapidly changing and selective reception, with ducting. Towards the latter part of the event signals were received from Scandinavia. Several logs received resemble a West European transmitter list, covering from RTE (Ireland) in the west to Denmark in the east and NRK (Norway) to the north. France was well received, with David Moller in Birmingham logging TV5 on chs. E29 and E35. Several DXers had their first sighting of the new NOS-3 (Holland) ch. E34 Roermond transmitter on test pattern. Many West German Band III and u.h.f. stations were logged, and as with the earlier openings Band III was most rewarding, with TVP-1 ch. R8, SR (Sweden) ch. E8 and u.h.f., NRK chs. E5, 8 and 9 (but no reports of the new u.h.f. relays!), RTL (Luxembourg) ch. E7 and, for those near the east coast, Dutch ATV amateurs (PE1HLR, PE1DWA) in the 435MHz band. An interesting reception for three DXers was the ch. E2 100W BRT (Belgium) relay in Antwerp, with vertical polarisation – even Simon Hamer in distant North Wales logged this one!

Three doses of tropospheric reception during December constituted a good Christmas present for many TV-DXers. It's unfortunate that 435MHz ATV activity seems to be on the decline. Though they do look, few DXers now report having seen any ATV transmissions during good conditions. Perhaps there's been a mass migration to 1.3GHz f.m.!

There was some Sporadic E reception during the month. The collated log is as follows:

7/12/87 TVP (Poland) ch. R1; DR (Denmark) ch. E3.
8/12/87 TVE (Spain) E3.
9/12/87 RTP (Portugal) E3; ORF (Austria) E2a.
13/12/87 TVE E2; MTV (Hungary) R1.
15/12/87 RAI (Italy) 1A; NRK (Norway) E3.
16/12/87 NRK E3, 4.
17/12/87 RAI 1A; TVE E3.

23/12/87 TVE E2.
25/12/87 TVE E2, 3; NRK E4.
26/12/87 TVE E3.
27/12/87 RAI 1A; NRK E3.

A very slight tropospheric lift was noted on the 27th, with mainly signals from TDF (France).

Auroral activity was very quiet. Iain Menzies (Aberdeen) noted slight disturbances on the 12th, 14th and 19th.

The tropospheric activity turned interest away from MS reception – the Geminids and Ursids showers seem to have produced minimal activity this year. The January Quadrants around the 4th produced an increase in the normal diurnal activity, with Band I favoured – no reports of Band III reception at all.

An excellent month for December then, ending the year with a flourish!

My thanks to the following for their reception reports: Iain Menzies (Aberdeen), Simon Hamer (Powys), David Oliver (Birmingham), Gareth Foster (Twickenham), Cyril Willis (Norfolk) and Roger Fussell (Torpoint).

George Gaskin (Gibraltar) reports that TVE is now operating for 24 hours a day at weekends and that private stations will be starting up over the next two years, also a third channel in the Andalusian region. So we should be noting more Spanish reception. For optimists, GBC-TV (Gibraltar) has started its “infotel” service, a continuous series of advertisements outside broadcast hours, generally on a 24-hour basis.

During the past month I've been assembling a flexible TVRO system using a 90cm dish with patio mount and 11GHz satellite package. The results are chronicled elsewhere in this issue. The aim was to gain experience in this new field (following earlier experiments at 4GHz and with the 860MHz ATS satellite) and to encourage others. It can be an expensive move to make, so I opted for the cheapest solution possible which has meant operational limitations. On the day this was written, January 7th, I noted a new downlink on the ECS bird at 10°E. The 11.65GHz (horizontal) signal consisted of colour bars with the identification E8T-5-MI and conversation in Italian. There are signals apart from Super Channel and the domestic/cable downlinks about.

News Items

UK: New scope for TV-DXing in the UK is in prospect with the efforts being made to find space for fifth and sixth networks. Many new transmitters could be accommodated in chs. 35-38, the problem being that parts of these channels are at present used for airport radar and radio astronomy. Another possibility being considered is distribution at 2.5GHz (see article in the November issue). For this latter application North East Satellite Systems has already made prototype receiver-converters with six inch dishes, aiming for a price at around £50. The signals would be down converted to u.h.f./a.m. at the head. Using current technology, systems could be in operation within eighteen months. A microwave band that's likely to be allocated to truly local terrestrial TV within the next five years is at 29GHz.

Devices called videosenders are currently available at various glossy high street hi-fi stores. They are illegal to use but not to buy! Their purpose is to enable the user to transmit the output from his VCR around the house – and it seems around the immediate neighbourhood as well. Garry Smith (Derby) recently tested one and found that it

produced excellent quality radiation even without fitting an aerial. Ranges claimed are up to 165ft, at around ch. 21. Gareth Foster has taken the use of these devices to the Advertising Standards Authority, since they are being advertised in video magazines with in some cases no warning about the illegality of their use. Interference to IBA ch. 21 transmissions has already been investigated.

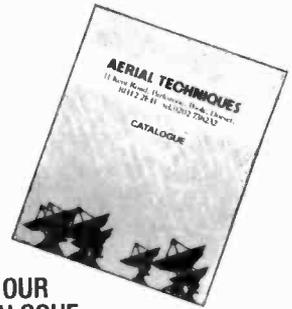
Belgium: A new TV service in Flanders, Vlaamse Televisie Maatschappij, is due to start this autumn. It will carry advertisements. Operators have yet to be appointed.

Australia: The first Aboriginal TV service, Imparja Television, has been brought into operation by the Central Australian Aboriginal Media Association of Alice Springs. The transmissions are uplinked to the Aussat satellite, picked up on downlink by a number of ground stations and then retransmitted locally. Local stations can opt out of the network Imparja programme.

The Minister for Communications has announced a timetable for the clearance of TV from Band II (chs. 3, 4, 5 and 5a). Services will be moved to other frequencies, including u.h.f. Most stations are to be moved by 1993 though a few relays will continue in operation until 1/1/96. The aim is to allow more rapid development of the Band II f.m. radio services. Australian readers can obtain the "Television Station Draft Clearance Timetable", media release no. 98/86, from the Department of Communications (062 64 3235).

West Germany: The opening up of u.h.f. channels E61-68 for TV use is progressing well and it's hoped that the new spectrum will be in use by private TV starting this autumn. Low powers will be used initially, with higher power stations later. There's more DXing potential with transmitters in the Schleswig-Holstein area transmitting the SAT-1

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- Wide 85° coverage.
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This advanced new intrusion detector operates by detecting the body heat of an intruder moving within the detection field. The use of a dual element pyroelectric sensor means that changes in ambient temperatures are ignored, thus providing a stable and reliable performance. Easily installed in a room or hallway, the unit will provide effective detection of any intrusion. Operating from a 12V supply and consuming only 15mA, it is ideal for use with the CA 1382, CA 1250 or any equivalent high quality control unit. Supplied with full instructions, its performance compares with detectors costing more than twice the price.

CA 1382 ADVANCED CONTROL UNIT that's simple to install and operate.



- Fully automatic siren re-set.
- Audible entry/exit warning.
- Alarm Sounded memory.
- 2 separate loop inputs + 24hr circuits.
- Built-in electronic siren.
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• 3 levels of discrimination against false alarms • Crystal control for greater stability • Adjustable range up to 25ft

- Built-in delays • 12V operation.

This advanced module uses digital signal processing to provide the highest level of sensitivity whilst discriminating against potential false alarm conditions.

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programme (Garding ch. E25 at 6kW e.r.p., Schleswig ch. E42 at 330W and Eckernforde ch. E37 at 120W) and RTL Plus (Garding ch. E58 at 6kW, Suderlugum ch. E56 at 5kW, Schleswig ch. E52 at 500W and Eckernforde ch. E60 at 120W).

Denmark: Two additional TV2 stations are likely to come on-air this summer (TV2 officially starts in October). These are TV-Fyn and either TV/nord (Aarhus transmitter) or a unit in Copenhagen.

Radio Amateurs: Dutch amateurs have been allocated the 50-50.45MHz spectrum for c.w. (morse) at up to 30W output from March 1st to January 1st 1994, with an annual review by the authorities to consider any interference problems – we understand that many cable systems now use ch. E2.

Computer interference: Interference from the BBC computer can be reduced significantly. An article in the December issue of the RSGB magazine *Radio Communication* contains a thorough discussion of the problem and practical suppression details that allow reception at 50MHz with the receiver some ten feet from the computer!

Satellite TV: As mentioned in Teletopics last month the West German TV-Sat 1 DBS satellite has been written off. The loss also affects the start of the French DBS service and, we understand, later stages of the Aussat programme.

The UK film channel Premiere is now using SAVE-SAT scrambling.

Signal Strength Meter Postscript

I reviewed the Planet SSMU signal strength meter, a budget priced instrument distributed by HRS Components, in the March 1987 issue. The review seems to have had an effect since the two shortcomings noted have been dealt with in the new SSMU-2 version. Aerial Techniques have sent me an instruction folder which shows that an increased audio level is now available via a two-position switch (for normal or boost level) and that a 3.5mm jack socket has been fitted for external headphone use outdoors – inserting a 3.5mm plug cuts out the internal sound via the case-mounted transducer.

Studies on Additional TV Services

A press release from the DTI, dated December 17th, brings good news. The current studies into the feasibility of

additional TV networks for the UK are to be extended to include Bands I and III as well as u.h.f. and MMDS at s.h.f. (2.5GHz). The DTI seems to prefer the term MVDS (multipoint video distribution system) to MMDS (multichannel microwave distribution service). At v.h.f. the study will consider the possible effect on recent mobile radio allocations.

From our Correspondents . . .

Keith Watkins (Redruth) has written to us on some interference problems. A friend lent him an RTTY/CW decoder unit which wipes out Band I, while his Christmas present, a Philips CD160 compact disc player, similarly removes any chance of Band I reception. Has anyone any solutions for this latter problem?

Fred Robins (Stubbington) spent a period in Japan recently. During his visit he took a series of excellent off-screen photographs of local TV test patterns etc. We'll be featuring some of these over the next few months. Thanks Fred.

Jean Louis Dubler, who has written to us previously from South Korea, has now moved to Montreux, Switzerland. A recent letter describes local TV conditions there. He has four Swiss and four French channels, two of which (Canal Plus and Telecine) are scrambled. The situation is about to change, with Canal Plus taking over the Swiss Telecine transmitters. The two-year-old Telecine has always operated at a loss, but Canal Plus has sufficient subscribers to make a profit. Canal Plus will have to use a different scrambling system in Switzerland since pirate Italian decoders are available there cheaply. It has opted to use the Telecine system. The situation is further complicated since Canal Plus uses yet a third system in the Swiss/French border area. Canal Plus operations are eventually to be extended to Belgium and Morocco.

A pirate station near Geneva transmits on ch. E52 using the SECAM-L system and intends to introduce repeaters, assisted by the NRJ f.m. radio network. There's been a proliferation of pirate transmitters in the French/Swiss border area, some like Radio Thollon at 93MHz, 4kW operating with high output powers. Many stations on the French side of Lake Geneva aim at a Swiss audience.

The Montreux cable network has fifteen channels, including the English-language Sky and Super services and the French LA5 and M6 services.

A Professional Institution for TV Technicians

Ian Channing

There have been professional bodies in the consumer electronics industry since the early days of broadcasting. In the 1920s the Institute of Wireless Technology was formed: it eventually became the Institution of Electronic and Radio Engineers. The Institution of Practical Radio Engineers was founded in the 1930s: this became the Incorporated Practitioners in Radio and Electronics. The Guild of Radio Service Engineers appeared in the 1940s, only to disappear in the 1950s. The Society of Electronic and Radio Technicians (SERT) was founded in 1965, to look after the interests of what are now known as Engineering Technicians and Technician Engineers. In every case the aim of founding such bodies was to establish a standard which employers would recognise and use. It would keep out the "cowboys". The problems are that (a) there will always be cowboys around and (b) the industry

needs a means of identifying competent staff.

Over the past twenty years the pattern of qualifications has changed. The majority of technical staff in the servicing field now qualify through the City and Guilds Course 224, Electronic Servicing, which however does not meet the current requirements of the Engineering Council for Technician registration. Realising this, SERT sought a means of providing a professional service for servicing staff who, though qualified, were not eligible to join the Society.

The opportunity to do this occurred in 1982 when SERT was asked to take over the Incorporated Practitioners in Radio and Electronics (IPRE). This body had been in existence since 1935 but had been going through a period of considerable decline. When the existing members of the old IPRE were absorbed into SERT a new division was set up, using the same title – the IPRE Division. The Society's

IPRE Division provides a complete professional service for qualified staff engaged in the maintenance, test and installation field in all branches of electronics. It has an autonomous Board Management which runs its own affairs and has representation on the main Council of SERT.

There are two corporate grades within the Division – Member and Associate Member. Members of both grades are entitled to use the appropriate designatory letters – MIPRE or AMIPRE. There is also a Student grade for those still receiving technical education.

All the Division's members enjoy the same learned society benefits as members of SERT. These include the monthly journal *Electronic Technology*, which contains feature articles, industry news and new product information across the whole range of electronic engineering. The Division organises special one-day seminars on matters of current technical interest, such as compact discs and satellite broadcasting. All IPRE members are entitled to attend these at a reduced members' rate. They are also entitled to attend seminars and residential conferences organised by the Society of Electronic and Radio Technicians.

IPRE members are able to participate in SERT Local Section activities, and most section committees include at least one IPRE member. These activities include technical lectures, visits and social events.

The main qualification for membership of the IPRE Division is the Part II Certificate of Course 224, Electronic Servicing, but certain service and company qualifications are accepted on an individual assessment basis. The minimum age of admission to the grade of Member is 26: applicants must be exercising some degree of responsibility such as being a senior engineer or service manager. Associate Member applicants must be at least 20 years of age and have had one year's appropriate experience.

Membership at present costs £18 a year for Members and £16 a year for Associate Members. There's a £5 entrance fee for both grades. Student members pay £7 a year and there is no entrance fee.

The aim is to maintain standards and in so doing enhance the status of appropriately qualified personnel. Membership enquiries are welcome. Full details and application forms are available from the Secretary, IPRE, 57-61 Newington Causeway, London SE1 6BL.

Fast-shutter Video Cameras

Eugene Trundle

For conventional applications the pick-up device used in a video camera, whether of the broadcast or consumer type, integrates the received image over an entire field period. During this period each picture element (pixel) at the rear of the pick-up device's faceplate charges or discharges – depending on whether the image sensor is a solid-state type or a vidicon-type tube. With a vidicon the scanning electron beam charges the photosensitive surface once per field: between scans, the surface discharges depending on the intensity of the light falling upon it. With a solid-state image sensor the photosensitive surface charges, the signal being read out by charge transfer at field rate. Whichever way it's done, the important thing is that there's a storage effect during each TV field.

As with conventional still photography, this long exposure time gives good sensitivity. Unfortunately however it means that fast-moving objects are blurred. If anything in the picture moves appreciably during the 20msec field period it will be reproduced as a blur, no matter how good the still-frame arrangements employed by a VCR used to play back the picture. The problem is that the video signal at each pixel represents the integration of all that's visible during the whole field period, not just the brief moment when a pixel is being scanned or read out.

With a vidicon type tube little can be done about this. Either a very special target layer would have to be used or a fast-scan system with some form of external field storage. Neither is practical for an inexpensive camera with the requirement to revert at will to conventional image sensing. With a CCD (charge-coupled device) type of solid-state image sensor however the scanning and storage functions are easy to separate. This opens the way to the use of fast-shutter techniques which give clear reproduction of fast-moving objects.

The idea is that each sensor pixel is blinkered during most of the duration of the field period, taking a very brief "peep" at the scene at 20msec intervals. Again as with conventional still photography there's a penalty to be paid:

light sensitivity is inversely proportional to shutter speed, so that a camera operated in the fast mode will produce good pictures only when the light conditions are good.

CCD Operating Principles

Behind the faceplate of a CCD image sensor there's an array of capacitive photodiodes arranged in rows and columns. These correspond with the lines and pixels that make up the TV image. With suitable biasing each photodiode acquires a charge that corresponds to the light level it sees. The imaging surface of the CCD consists of hundreds of thousands of mutually isolated photodiodes. The output from each photodiode is connected to a MOSFET transistor that acts as a switch – see Fig. 1. When a pulse is applied to the gates of these transistors the

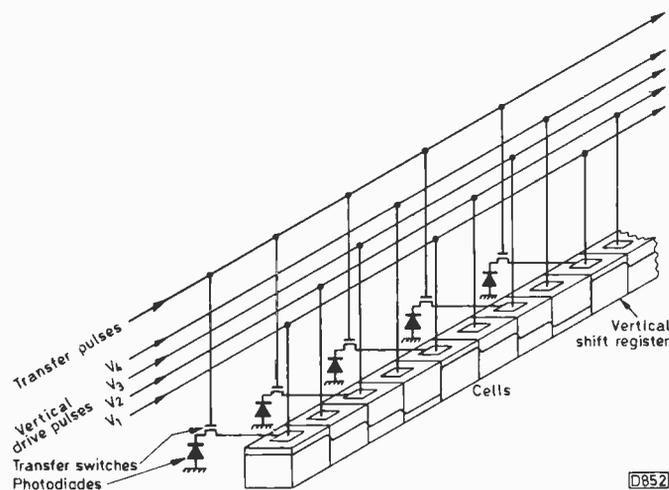


Fig. 1: Photodiode charge transfer. The diodes on the left represent one column of image sensors: the "progressive bucket" effect of the transfer charge voltage applied to each cell of the register on the right is represented by the depth lines on their sides.

charges on the photodiodes are transferred to a shift register. Unlike a digital shift register, the type used in this application can handle an analogue signal that consists of charges, or "packets" of electrons. This type of shift register is commonly referred to as a bucket-brigade device (BBD).

Shifting the charge packets along the register is achieved by sequentially altering the potentials applied to the BBD's cells. The electron packets have a tendency to fall into an adjacent "potential well": by creating successively deeper depletion layers in adjacent cells the electron packets can be stepped along the shift register/BBD by using clock pulses in a four-phase sequence.

As shown in Fig. 2, each column of photodiodes has an associated, separate vertical shift register. During each field blanking period a transfer pulse is applied to the gate of each FET. As a result the charges developed by the photodiodes are transferred to the associated vertical shift registers. All the FETs are switched on at the same time, so that once per TV field a complete set of pixel charges is stored.

On the first change of V-clock pulse the charges in all the vertical shift registers move up one. At the top there's a horizontal shift register which thus receives the first line of the picture. This is another BBD, whose contents are now rapidly transferred leftwards by a second and much faster four-phase clock pulse system. The charge packets fall off at the end of this shift register as it were, forming a sequence of pulses of varying height – the analogue video signal. The clock pulses have to be filtered out before the signal can be used.

During the line blanking interval the vertical registers are again pulsed, so that successive complete TV lines are fed into the horizontal shift register. These charges are clocked leftwards along the horizontal shift register during the following line scan period. We thus get at the output a serial information stream that corresponds to the target output from a conventional vidicon tube. At the end of a field the charges from all the photodiodes have been read out, the vertical and horizontal registers are empty, and the

whole sequence is repeated. The CCD clock and drive pulses are provided by a timing/divider chip which is governed by the camera's master subcarrier and sync generator (SSG) section. This is in turn controlled by a precision crystal.

Timing

Each photodiode or pixel sensor is briefly addressed once per field. Between times it sits there building up a charge depending on the light input – see Fig. 3. The pulse train at the top of this diagram represents the field blanking intervals. At time t1 we are approaching the end of a field period and charges will have been built up on the photodiodes which have for some time been isolated from the vertical shift registers. The video information from the previous field – A – has been moving along the vertical shift registers as shown in the lower half of the diagram. At time t2 the transfer pulse occurs, during the field blanking period. The next field, B, is then fed into the vertical shift registers, ready to be clocked through. The photodiodes are now discharged and start to charge once more to produce the next field C.

Fast-shutter Mode

Fig. 4 shows the sequence of events when the CCD control chip is switched to the fast-shutter mode. Again at time t1 we are towards the end of one field period and each photodiode has had some time to charge. This stored image will contain blur, and must therefore be discarded. At about line 623 a transfer pulse t2 dumps the charges into the vertical shift registers. Soon afterwards a high-speed charge-shifting pulse train is applied to the shift registers to flush them clean – see Fig. 5. The effect of this is not seen – it occurs during the field blanking period, when the video is muted.

Meanwhile the photodiodes have again been charging. They are allowed to do so for 19 TV lines (nos. 623 to 17), as Fig. 5 shows. On line 19, at time t3 in Fig. 4, a second

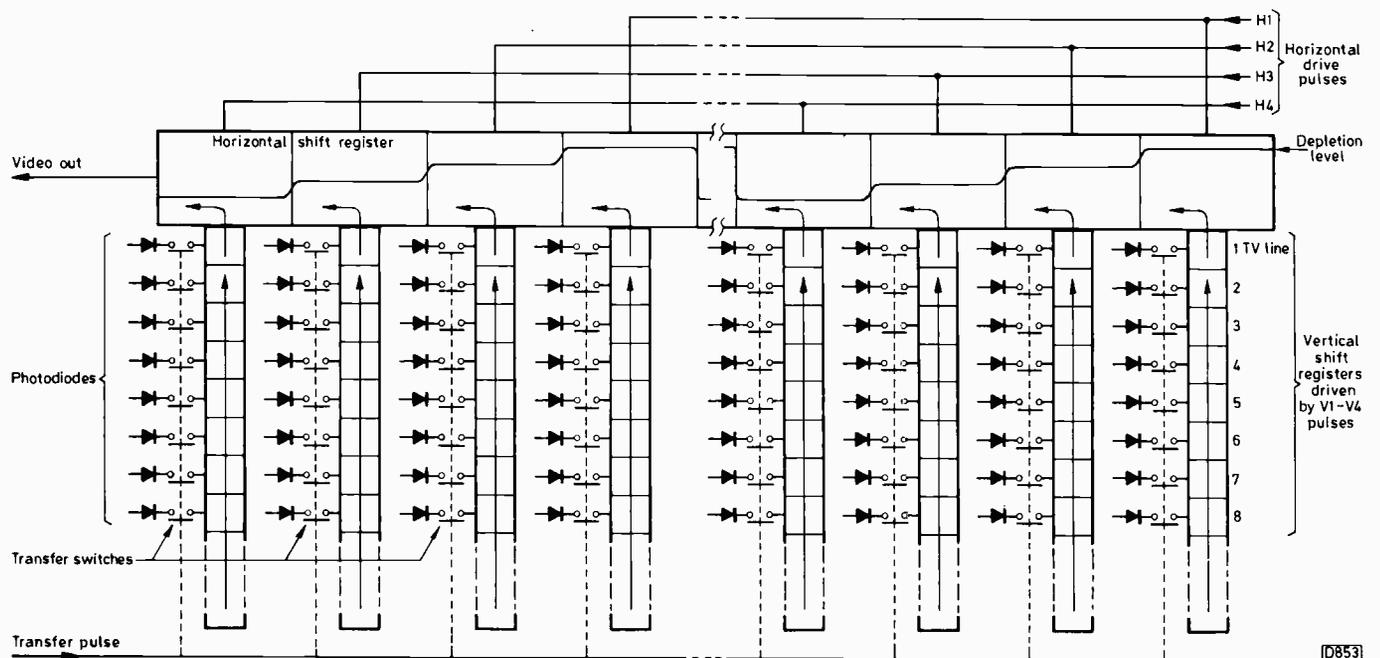
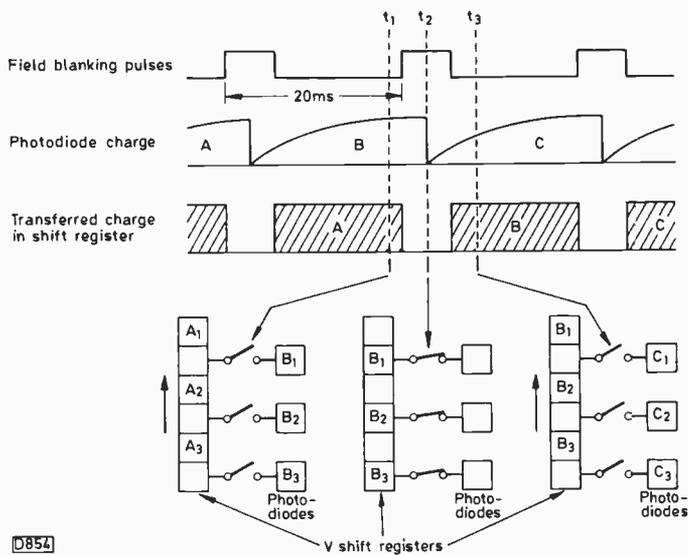
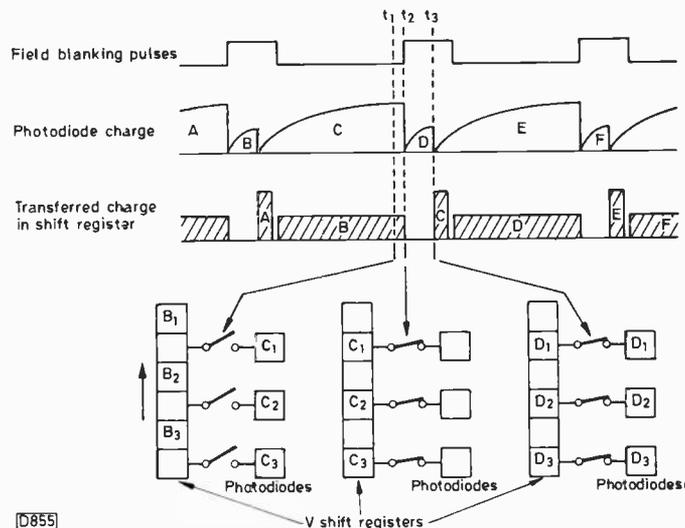


Fig. 2: Representation of a complete CCD image sensor, simplified to show 64 sensors in an eight-by-eight matrix. Typical practical arrays for consumer cameras would have about 250,000 elements arranged in a 579 x 422 matrix. The switched charges progress upwards along the vertical shift registers then along the horizontal shift register, under the control of four-phase clock pulses.



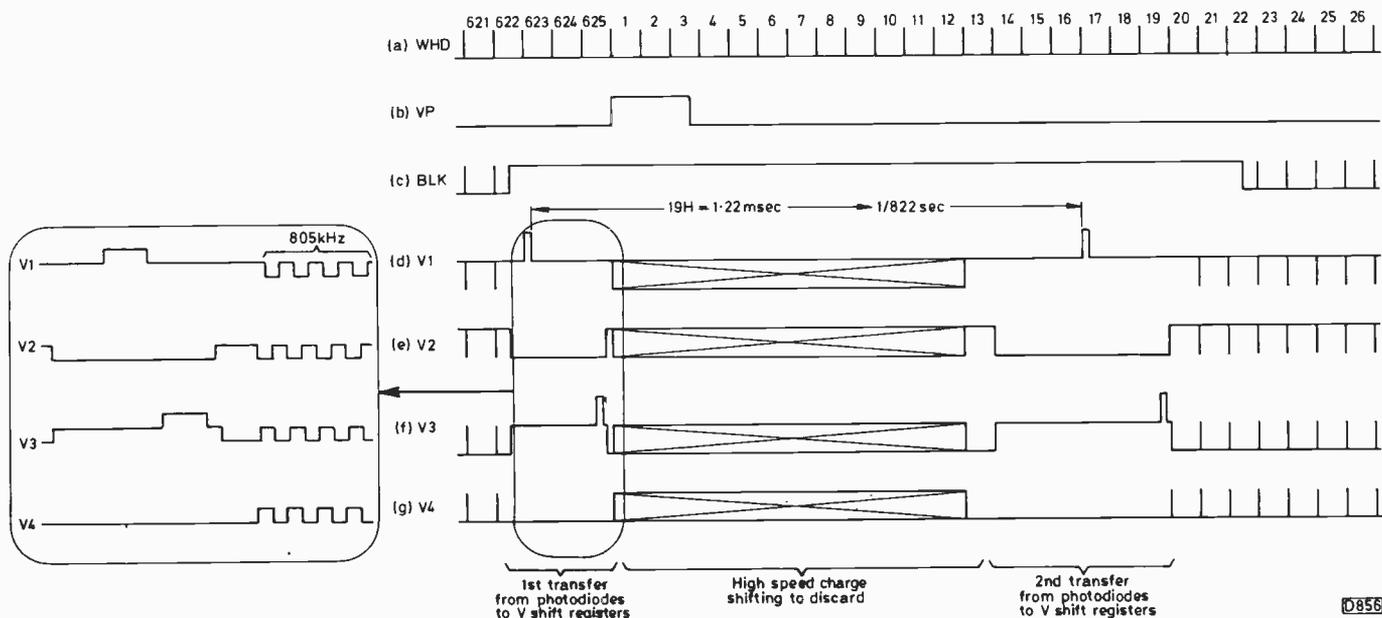
0854

Fig. 3: Photodiode charging and transfer switching at the normal (20msec) shutter speed. Three successive fields, identified as A, B and C, are shown.



0855

Fig 4: Photodiode charging (two-cycle) and transfer switching in the high-speed shutter mode. Between t_2 and t_3 a fast discard clocking pulse train sweeps all the C information out of the vertical shift registers.



0858

Fig. 5: Time-related waveforms for the high-speed shutter mode, (a) line sync pulses, (b) field sync pulse, (c) composite blanking, (d-g) three-level vertical drive pulses in the image sensor section – the highest levels V1 and V3 trigger photodiode charge transfer. The 805kHz pulse trains in the waveforms on the left rapidly empty the vertical shift registers during the first half of the field blanking period.

transfer pulse is applied to once more fill the vertical shift registers. This time the information contains no blur, since the "shutter" has been "opened" for only a 19-line period. Nineteen lines is 1.216msec or 1/822 sec. The brightness information obtained during this short period is stepped along the registers in the normal way to form the video output signal. This is continuous because of the storage effect introduced by the cells in the BBD shift registers, but at a lower level, as Fig. 4 shows.

There are other methods of carrying out fast-shutter operation. The one described, used by Panasonic, doesn't require special facilities on the sensor array itself. A range of shutter speeds can be provided to trade off sensitivity against image blurring. You can't however see how well you've done until you get home and use the VCR to freeze the image, so that any shutter speed control is best done automatically with reference to the available light. No doubt the next generation of fast-shutter cameras will have automatic movement speed detectors and light meters

hooked to a microcomputer to govern the exposure time. With auto-focus, auto-iris and auto-white balance they may, by 1990, have disappeared up their own exhaust pipes: we can then all go back to box Brownies.

Use

The fast-shutter facility should be used only when it's known that freeze-frame reproduction with a suitable VCR will be required. This avoids not only the penalty of a twenty-fold decrease in light sensitivity but also the loss of some "smoothness" in the picture when it's viewed in the normal playback mode.

Fast-shutter operation is really successful only in sunlight: artificial lighting from an a.c. source (i.e. the domestic mains supply) gives rise to a heavy flicker effect. This is most noticeable with fluorescent lighting which has short-persistence phosphor. Fluorescent lighting makes camera colour balancing difficult anyway.

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15/80H	3.30	2SA940	1.32	2SC535	0.79	AF180	0.55	BA656	1.00	BC560C	0.14	BDX63A	1.96	BFY52	0.27	BYX71-350	0.72
15/85R	3.30	2SA940-2	2.14	2SC536	0.45	AF181	0.53	BA7100	11.35	BC635	0.36	BDY20	1.21	BFY79	0.49	BYX94	0.16
16039	0.79	2SA950	0.72	2SC537	0.54	AF186	0.53	BA841A	28.98	BC636	0.28	BDY81	1.05	BFY90	0.61	BYX95	1.20
16181	1.04	2SA951	1.75	2SC605L	1.16	AF239	0.43	BA843	3.96	BC637	0.24	BF115	0.40	BLY49	2.20	BZ793C30	1.86
16182	1.04	2SA966-Y	1.16	2SC620	0.95	AF279	0.88	BA854	5.76	BC639	0.20	BF117	0.60	BR100	0.29	BZ788 RANGE	0.10
16334	0.98	2SA999	1.36	2SC643A	1.54	AL113	1.36	BAV18	0.21	BC640	0.24	BF118	0.60	BR101	0.65	BZ616 RANGE	0.18
16335	0.94	2SB774	1.15	2SC668	0.67	AN115	3.98	BAV19	0.49	BC879	0.21	BF121	0.25	BR103	0.55	BZ779 RANGE	0.10
16446	0.98	2SB185	1.13	2SC681	4.40	AN155	1.89	BAV20	0.35	BC880	0.31	BF123	0.21	BR303	1.15	C106D	0.46
16600	1.38	2SB375	3.87	2SC682	1.88	AN206	2.58	BAV21	0.18	BCX34	0.18	BF127	0.13	BR316	0.67	C106M	0.76
16802	1.27	2SB400	0.40	2SC684	1.65	AN208	3.55	BAW62	0.11	BCY70	0.30	BF137	0.29	BR330	2.01	C1129	0.58
17052	5.61	2SB405	1.03	2SC693	0.63	AN210	2.28	BAX12	0.48	BCY71	0.21	BF153	0.58	BR330	0.77	CA3046	1.55
17053	5.61	2SB449B	6.98	2SC710	0.69	AN211	3.25	BAX16	0.11	BCY72	0.20	BF154	0.26	BR330	0.77	CA3046	1.55
17074	9.30	2SB511	2.50	2SC711A	0.50	AN214Q	2.40	BC107	0.11	BD116	0.70	BF158	0.18	BR330	1.08	CA3090AQ	3.25
17089	3.45	2SB54	1.39	2SC717	1.28	AN234	5.92	BC107A	0.13	BD124	1.31	BF159	0.18	BR330	2.19	CA3094	2.20
17127	2.50	2SB546	0.56	2SC734	1.43	AN236	3.78	BC107B	0.18	BD124P+KIT	0.69	BF160	0.31	BR330	2.08	CA3131EM	2.95
17376	1.58	2SB56	2.80	2SC761-Y	0.95	AN239	4.68	BC108	0.08	BD131	0.57	BF167	0.38	BR330	2.60	CBF16848N-071	1.56
1N4001	0.04	2SB618A	2.22	2SC783	3.98	AN240P	1.25	BC108B	0.15	BD132	0.20	BF173	0.35	BR330	0.67	CD4001	0.34
1N4002	0.06	2SB631	1.45	2SC790Y	1.85	AN241	1.71	BC109	0.12	BD133	0.53	BF177	0.34	BR330	0.69	CD4002	0.27
1N4003	0.06	2SB643	0.80	2SC828	0.28	AN245	4.49	BC109B	0.15	BD135	0.36	BF178	0.40	BR330	0.87	CD4008	1.35
1N4004	0.05	2SB669	3.67	2SC867A	3.84	AN253	1.80	BC109C	0.12	BD136	0.26	BF179	0.36	BR330	0.87	CD4011	0.29
1N4005	0.05	2SB681	3.96	2SC876	0.96	AN253	1.80	BC113	0.14	BD137	0.26	BF180	0.36	BR330	0.87	CD4012	0.29
1N4006	0.08	2SB695	1.98	2SC930	0.54	AN260	3.85	BC119	0.36	BD138	0.33	BF181	0.32	BR330	6.25	CD4013	0.33
1N4007	0.07	2SB75	1.04	2SC935	4.13	AN262	1.20	BC126	0.23	BD139	0.28	BF182	0.39	BR330	7.25	CD4016	0.46
1N4148	0.03	2SB819	1.13	2SC940	4.68	AN295	5.52	BC132	0.14	BD140	0.29	BF183	0.39	BR330	3.07	CD4017	0.82
1N4448	0.05	2SC1034	6.75	2SD1128	2.90	AN301	2.45	BC135	0.18	BD144	1.70	BF184	0.43	BR330	2.85	CD4020	1.23
1N5401	0.14	2SC1050	5.06	2SD1138	0.94	AN302	3.99	BC137	0.18	BD150	1.25	BF185	0.39	BR330	3.49	CD4021	0.39
1N5402	0.15	2SC1096	1.16	2SD1138	1.56	AN303	4.39	BC138	0.38	BD157	1.67	BF194	0.14	BR330	0.60	CD4023	0.28
1N5403	0.16	2SC1104	3.98	2SD1453	1.40	AN305	8.95	BC139	0.24	BD160	1.60	BF195	0.14	BR330	1.29	CD4025	0.64
1N5404	0.15	2SC1106	4.54	2SD152K	2.64	AN305	2.46	BC140	0.45	BD163	0.71	BF196	0.17	BR330	0.30	CD4028	0.84
1N5408	0.35	2SC1114	3.25	2SD198	4.20	AN316	5.53	BC141	0.62	BD165	0.62	BF197	0.18	BR330	0.50	CD4040B	0.85
1N914	0.04	2SC1116	4.95	2SD234	0.49	AN318	5.25	BC142	0.23	BD166	0.42	BF198	0.17	BR330	0.51	CD4047	1.06
IR3403	5.00	2SC1124	1.28	2SD235	0.60	AN320	5.47	BC143	0.19	BD168	0.73	BF199	0.17	BR330	1.61	CD4049	0.24
1S1555	0.31	2SC1129	1.65	2SD241	2.29	AN321	2.25	BC147	0.08	BD175	0.20	BF200	0.37	BR330	1.45	CD4052	0.75
1S44	0.10	2SC1131	0.64	2SD257	1.98	AN322	5.85	BC148	0.13	BD181	0.99	BF224	0.17	BR330	2.17	CD4069	0.29
1S5012A	0.81	2SC1158	3.33	2SD292	2.59	AN331	5.11	BC148C	0.11	BD182	0.99	BF237	0.65	BR330	2.48	CD4070	0.66
1S921	0.10	2SC1162	0.55	2SD313	2.59	AN337	5.37	BC149	0.11	BD183	0.99	BF240	0.15	BR330	1.98	CD4081	0.35
2N1303	0.38	2SC1172	2.22	2SD325D	2.26	AN340P	1.17	BC149B	0.13	BD184	1.21	BF241	0.15	BR330	0.89	CD4093	0.72
2N2219A	0.33	2SC1195	3.26	2SD348	16.13	AN355	5.98	BC153	0.14	BD187	0.53	BF245	0.50	BR330	4.42	CD4511	1.10
2N2222	0.38	2SC1213	0.89	2SD353	7.50	AN370	3.95	BC154	0.14	BD189	0.69	BF245A	0.52	BR330	2.89	CD4528	2.04
2N2646	0.80	2SC1226	1.46	2SD389	2.41	AN5010	5.70	BC159	0.36	BD190	0.72	BF245B	0.49	BR330	2.48	CD4556	1.47
2N2904	0.36	2SC1253	0.90	2SD401	1.40	AN5111	2.52	BC160	0.40	BD201	0.65	BF246A	2.52	BR330	1.08	CR02AM-8	1.70
2N2905	0.59	2SC1306	1.98	2SD414	1.98	AN5120N	4.50	BC161	0.28	BD202	0.60	BF255	0.20	BR330	2.65	CV12E	4.09
2N2906	0.38	2SC1316	10.25	2SD471	2.13	AN5132	5.39	BC168	0.36	BD203	0.50	BF256	0.38	BR330	5.69	CO95D	3.14
2N2926	0.15	2SC1317	0.50	2SD560	2.95	AN5132	5.39	BC169C	0.16	BD204	0.41	BF256LB	0.42	BR330	4.16	CX104	9.64
2N3053	0.35	2SC1364	0.49	2SD588A	2.36	AN5435	2.25	BC170	0.16	BD207	1.79	BF256LC	0.82	BR330	4.26	CX108	12.48
2N3054	0.99	2SC1383	1.20	2SD600	2.98	AN5610	5.50	BC171	0.11	BD208	0.34	BF257	0.34	BR330	1.45	CX109	7.86
2N3055	0.61	2SC1391	2.45	2SD601R	1.03	AN5612	4.68	BC172B	0.17	BD222	0.50	BF258	0.36	BR330	6.53	CX130	8.76
2N3442	1.56	2SC1413A	3.05	2SD621	12.85	AN5630	4.68	BC172B	0.17	BD225	0.49	BF259	0.34	BR330	1.35	CX134	12.32
2N3702	0.14	2SC1446	1.25	2SD636	0.55	AN5701N	4.63	BC173	0.27	BD228	0.63	BF262	0.28	BR330	1.27	CX136	11.49
2N3703	0.18	2SC1447	2.07	2SD639-R	0.72	AN6250	3.95	BC174B	0.37	BD229	1.05	BF263	0.37	BR330	1.65	CX139	11.83
2N3705	0.16	2SC1475	0.60	2SD655	0.98	AN6300	4.40	BC177	0.26	BD232	0.50	BF271	0.54	BR330	1.20	CX157	5.52
2N3706	0.14	2SC1505	1.00	2SD657	3.50	AN6310	2.95	BC178	0.26	BD234	0.42	BF273	0.20	BR330	1.92	CX158	5.52
2N3707	0.16	2SC1514	1.69	2SD661A	0.80	AN6320N	4.28	BC179	0.05	BD237	0.47	BF274	0.20	BR330	1.17	CX177	6.46
2N3711	0.13	2SC1573Q	1.25	2SD731	1.05	AN6340	8.74	BC182	0.05	BD238	0.39	BF324	0.35	BR330	1.95	CX187	6.84
2N3717	0.70	2SC1578	8.74	2SD773	0.60	AN6341	4.28	BC182L	0.10	BD239	0.45	BF336	0.33	BR330	2.08	CX185	12.95
2N3772	1.61	2SC1583	0.50	2SD811	3.30	AN6342	10.14	BC182LB	0.07	BD240	0.57	BF337	0.45	BR330	2.45	CX85A	6.85
2N3773	1.75	2SC1617	3.89	2SD823	1.98	AN6343	2.98	BC183L	0.11	BD241	0.39	BF338	0.33	BR330	2.00	DEC1	2.20
2N3819	0.54	2SC675	1.41	2SD837	1.56	AN6344	2.77	BC183LB	0.16	BD242	0.39	BF335	0.49	BR330	2.20	DEC2	2.20
2N3823	1.17	2SC1678	1.98	2SD841	1.56	AN6363	10.66	BC184	0.23	BD243A	0.35	BF362	0.62	BR330	2.20	DS3486N	4.33
2N3904	0.62	2SC1741	1.25	2SD856	1.00	AN6531	9.24	BC184L	0.14	BD243C	0.29	BF363	0.50	BR330	1.49	DS3487N	4.95
2N3908	0.62	2SC1810	1.70	2SD857Q	1.84	AN6551	10.66	BC184LB	0.26	BD244	0.45	BF371	0.50	BR330	1.79	E1222	0.40
2N4101	1.73	2SC1815	0.45	2SD882	1.15	AN6552	1.95	BC186	0.27	BD244C	0.79	BF391	0.25	BR330	0.82	E5024	0.28
2N4240	3.30	2SC1826	0.67	2SD894	1.75	AN6610	1.35	BC187	0.28	BD245C	0.99	BF417	0.84	BR330	0.99	E5386	0.25
2N4444	0.99	2SC1829	2.22	2SD898	1.85	AN6677	0.68	BC204	0.16	BD246C	0.77	BF418	1.87	BR330	5.29	E9003	0.46
2N5293	0.50	2SC1875	4.50	2SK105H	2.15	AN7111	2.40	BC207	1.05	BD253	1.05	BF422	0.29	BR330	1.13	E9005	0.50
2N5294	0.50	2SC1881K	2.98	2SK152	3.59	AN7114E	10.45	BC212	0.11	BD278A	0.60	BF423	0.52	BR330	1.45	FND500	5.78
2N5296	0.49	2SC1893	3.02	2SK34	0.76	AN7115	1.25	BC212B	0.26	BD317	2.60	BF450	0.35	BR330	1.25	GC374	1.65
2N5297	0.50	2SC1906	0.98	2SK41	1.07	AN7120	8.54	BC213L	0.10	BD318	2.00	BF451	0.29	BR330	1.65	GD243	4.34
2N5298	0.61	2SC1921	1.37	2SK79	2.98	AN7145	3.38	BC213LB	0.15	BD375	0.42	BF457	0.41	BR330	1.80	GF58	0.84
2N5771	1.18	2SC1923	0.30	40408	0.50	AN7146	4.65	BC214	0.10	BD380	0.76	BF458	0.33	BR330	2.95	GH3F	1.82
2N6109	1.58	2SC1929	2.25	40594	1.53	AN7151	2.30	BC214B	0.26	BD410	0.52	BF459	0.52	BR			

PO BOX 15, WOLVERHAMPTON, WV2 4AZ ☎ TEL 0902 712083

HA1374	4.80	LR3419	9.37	NE565N	1.33	SKE4F2/08	0.80	STK3042	4.95	TA7312P	2.45	TD62105P	2.50	TDA3560	5.25	TUA2000	8.98
HA1377	1.75	LR3471	9.27	NE645BN	3.35	SKE4F2/06	0.44	STK3044	5.75	TA7313AP	1.36	TD62104P	2.50	TDA3571Q	2.83	TV106	2.37
HA1389R	2.05	LU1141	7.37	NP1106	7.25	SKE4F2/10	1.24	STK4019	4.50	TA7314	5.94	TD62706P	4.50	TDA3576	7.48	TY6010B	2.97
HA1389	2.30	LU52012	5.95	QA202	0.11	SKE4G2/02	0.96	STK430	10.55	TA7323P	3.15	TDA1001B	2.31	TDA3590	5.79	U05G	1.14
HA1392	2.49	LU52011	14.95	QA47	0.16	SKE5F3/10	1.60	STK433	6.25	TA7325P	1.15	TDA1003A	2.25	TDA3591	6.45	ULN2204	8.50
HA1394	2.95	LU03112	12.37	QA91	0.08	SKS1/10	2.15	STK4332	8.25	TA7339P	1.85	TDA1005A	2.38	TDA3650	6.95	UPA53C	4.94
HA1397	3.76	M193	6.83	QA95	0.13	SL1310	3.14	STK435	5.94	TA7340P	5.95	TDA1006A	2.11	TDA3652	2.60	UPC1003	5.95
HA1398	2.95	M21C	1.13	QC28	2.95	SL1430T	0.89	STK4352	1.95	TA7607AP	3.10	TDA1010AF	4.25	TDA3651AQ	5.95	UPC1009C	8.95
HA1406	1.30	M23C	1.98	QC29	2.15	SL414	3.69	STK436	4.70	TA7609	3.91	TDA1011	1.95	TDA3651A	1.75	UPC1025H	3.00
HA1452	0.85	M293	6.95	QC36	1.28	SL432A	3.44	STK437	9.65	TA7611AP	2.32	TDA1010	0.28	TDA3651A	1.80	UPC1026C	1.24
HBFA4030AF	2.48	M51102L	4.95	QC44	0.35	SL439	2.48	STK4372	11.15	TA7616P	5.25	TDA1011A	1.03	TDA3950	1.75	UPC1028H	2.00
HD14538	2.07	M5115P	5.24	QC45	0.18	SL471	2.50	STK4379	7.25	TA7622AP	8.94	TDA1028	2.45	TDA4050B	3.95	UPC1032H	2.77
HD38702-A2	7.95	M51203L	3.15	QC72	0.44	SL480	3.98	STK441	8.75	TA7628P	2.50	TDA1034B	2.42	TDA4280	5.95	UPC1020H	0.62
HD38750A53	10.44	M51231P	0.95	QC75	0.44	SL490	2.58	STK443	10.29	TA7629P	7.50	TDA1035S	2.95	TDA4290	4.47	UPC1042C	8.95
HD38750A-7	7.25	M5134-93A1	4.13	QN236	1.06	SL901B	9.95	STK457	13.45	TA7630P	0.95	TDA1035T	1.85	TDA4420	2.55	UPC1052H	1.45
HD38800A50	14.09	M51353P	5.25	ON782	1.98	SL918A	6.97	STK460	7.02	TA7640AP	2.29	TDA1037	1.95	TDA4422	3.65	UPC1158	5.84
HD44801A05	19.98	M51381P	5.45	OT121	1.45	SN16861A0N	1.65	STK461	9.68	TA7672P	2.55	TDA1037D	2.05	TDA4423	9.00	UPC1168	4.96
HEF4001BP	0.67	M51393AP	9.35	PT6042	2.45	SN16862AN	2.98	STK463	11.53	TA7676P	2.81	TDA1044	1.95	TDA4427S	9.00	UPC1182H	1.22
HIS11010	8.59	M5142P	6.85	PT8504	4.98	SN16866N	10.25	STK466	11.77	TA7676P	12.50	TDA1047	3.25	TDA4431	2.27	UPC1186H	1.05
HIS1004	6.00	M5144P	2.97	R1039	2.19	SN29717N	7.19	STK4833	10.95	TAA320A	1.27	TDA1059B	0.98	TDA4440	3.26	UPC1181H	1.35
HIS1002	9.50	M51513L	2.06	R2008B	1.33	SN29715N	3.64	STK501	6.32	TAA350A	6.45	TDA1059M	1.35	TDA4442	4.15	UPC1181H	1.60
HM6231	9.81	M51515BL	2.75	R2009	1.98	SN29722	11.95	STK502	7.25	TAA570	1.85	TDA1060	2.60	TDA4500	4.75	UPC1188	7.40
HM6232	10.65	M51517L	2.90	R2010B	1.33	SN29723AN	8.77	STK514	12.32	TAA621AX1	4.85	TDA1082	2.95	TDA4500-2	2.10	UPC1212C	1.72
HM6251	6.51	M5192	2.20	R2029	1.33	SN29764AN	1.65	STK5730	2.99	TAA621A12	2.14	TDA1151	1.22	TDA4610	1.79	UPC1225H	3.25
HM7103	4.85	M5194AP	5.74	R2030	1.33	SN29767	4.90	STK7216	14.50	TAA661B	2.62	TDA1170S	1.85	TDA4620	4.78	UPC1230H	1.78
HM9032	9.98	M5231L	1.95	R2257	3.71	SN29770BN	1.95	STK7172	6.95	TAA691	8.58	TDA1190	2.11	TDA4620	6.20	UPC1238	2.00
HM9012	3.22	M53274P	1.33	R2265	1.49	SN29772BN	4.91	STR1096	5.45	TAA700	2.37	TDA1190Z	3.96	TDA4620	2.75	UPC1263	4.09
HM9015	3.24	M54532P	1.71	R2305	1.18	SN29771BN	1.65	STR4090	10.55	TAA930	4.87	TDA1200	1.51	TDA4620	2.25	UPC1277H	4.95
HT4207	17.16	M58478P	8.77	R2323	0.76	SN29798N	5.56	STR440	4.78	TAA970	2.83	TDA1235	3.88	TDA4620	1.99	UPC1351C	1.81
HT4208	20.65	M58485P	14.25	R2354A	2.01	SN2709	0.44	STR451	5.96	TAA110	2.52	TDA1236	4.30	TDA4620	1.95	UPC1350C	1.40
IN5401	0.11	MA06	1.07	R2354B	2.01	SN7400N	0.34	STR453	8.16	TAG232-600	0.79	TDA1270	1.55	TDA4620	3.15	UPC1353	7.85
IR2403	1.45	MA8001	0.82	R2443	0.88	SN7401N	0.36	STR454	4.95	TAG262-600	1.20	TDA1327A	3.33	TDA4620	1.49	UPC1355C	2.13
IR2C05	4.25	MA8003	1.16	R2461	1.91	SN7402N	0.65	STR6020	4.95	TBA120AS	0.69	TDA1412	1.05	TDA4620	2.30	UPC1363	4.20
IR3P06	2.25	MB3705	1.98	R2540	1.50	SN7404N	0.52	TG029V	5.75	TBA120SB	1.05	TDA1420	2.55	TDA4620	1.50	UPC1366	6.98
IR3P08	4.95	MB3712	1.85	R2540X	3.30	SN7408N	0.27	TG035V	0.73	TBA120T	0.97	TDA1440	3.45	TDA4620	2.50	UPC1368C	4.51
IR94558	6.25	MB3713	1.69	R2615	0.67	SN7410N	0.27	TG036	0.67	TBA120U	0.62	TDA1470	2.80	TEA1020SP	8.21	UPC1370H	1.25
IS751	2.85	MB3730	2.94	RCA16029	2.01	SN74121	1.60	TG037	2.11	TBA120A	1.05	TDA1470P	4.25	TIC106C	0.61	UPC141C	4.95
ITT425	0.18	MC13002	3.59	RCA16600	1.38	SN7413N	0.74	TG044V	0.97	TBA1440	0.78	TDA1506	7.85	TIC106M	0.77	UPC1458	3.34
I20003GE	5.37	MC1310P	2.25	RCA16802	1.08	SN74141N	2.65	TG045	1.25	TBA1441	1.62	TDA1510	4.60	TIC106C	0.61	UPC1458	3.34
I20020GE	5.93	MC1327P	1.33	RCA17074	6.60	SN74151AN	1.51	TG049	1.45	TBA240A	2.65	TDA1512	3.69	TIC44	0.72	UPC151C	2.95
K174YP	3.46	MC1330P	1.45	RCA17376	1.58	SN7415AN	1.27	TG052V	0.87	TBA395	1.10	TDA1515	2.60	TIC45	0.50	UPC2002	1.48
KA2101	2.92	MC1350P	1.61	RCA17524	0.83	SN74190	1.35	TG058	3.08	TBA395Q	1.10	TDA1559	3.15	TIC47	0.35	UPC300C	2.51
KC581C	6.32	MC1351P	3.96	RCA17523	0.83	SN7420N	0.55	TG059	1.27	TBA396	1.20	TDA1559	3.15	TIC47	0.35	UPC324C	4.17
KC582C	3.97	MC1352P	2.50	RCA2060	2.00	SN7430	0.49	TG063V	1.25	TBA400	2.39	TDA1670	4.48	TIP120	1.06	UPC32C	5.25
KC583C	6.63	MC1357P	2.15	RGP01-15	1.65	SN7440N	0.27	TG065V	2.38	TBA400C	2.34	TDA1670	4.48	TIP110	1.06	UPC32C	5.25
L200CV	1.69	MC1358P	1.35	RGP10	0.30	SN7472	1.54	TG911V	1.40	TBA4800	1.30	TDA1905	6.85	TIP112	0.54	UPC339C	4.35
LA1201	1.02	MC14001	2.40	RGP30M	0.28	SN7474N	0.44	TG913V	4.95	TBA510	2.11	TDA1908	2.98	TIP112	0.54	UPC41C	2.10
LA1210	1.56	MC14013	0.41	RT402	1.58	SN7490AN	0.93	TG914V	2.42	TBA520	2.15	TDA1940	1.95	TIP126	0.73	UPC4558C	4.15
LA1230	2.20	MC14493P	5.95	RT905A	2.38	SN74LS26N	1.45	TG916	1.92	TBA520Q	1.68	TDA1950	2.95	TIP132	0.99	UPC47A	5.11
LA1320	2.87	MC14494P	2.15	SI1299	5.34	SN76001N	1.65	TG919V	1.98	TBA530	1.30	TDA2005	1.45	TIP137	1.50	UPC554C	1.85
LA1352	1.65	MC14497	3.15	SI75	31.48	SN76013ND	2.50	TG934V	1.45	TBA530	1.30	TDA2006	1.55	TIP29	0.84	UPC566H	2.95
LA1357N	11.07	MC14510BAL	3.75	SD262D	0.95	SN76022N	3.75	TG935V	1.95	TBA540	1.15	TDA2004	1.48	TIP295	0.95	UPC575C2	2.40
LA1363	1.05	MC14511BCP	1.10	SD800D	5.54	SN76023ND	3.96	TG935V	1.95	TBA540	1.15	TDA2002	0.90	TIP295	0.84	UPC576H	2.50
LA1364	3.02	MC14528BCP	2.15	SD802	0.47	SN76033N	1.33	TG954V	0.70	TBA560C	1.40	TDA2003	1.75	TIP295	0.84	UPC576H	2.50
LA1365J	0.95	MC1712	3.88	SD818	3.85	SN76110N	1.15	TG957V	0.70	TBA560CQ	1.60	TDA2010	1.68	TIP295	0.84	UPC576H	2.50
LA1385	1.53	MC5192	19.50	S3702S	1.65	SN76115AN	1.11	TG962V	0.49	TBA570C	1.35	TDA2020	1.95	TIP295	0.84	UPC576H	2.50
LA1387	5.95	MC7724CP	3.49	S40W	18.54	SN76131	1.92	TG964	3.64	TBA570A	1.71	TDA2030	1.45	TIP305	0.75	UPC577C	1.34
LA3155	1.25	MC7818C	2.18	SD680B	8.80	SN76227N	0.25	TG960	4.35	TBA641A12	3.03	TDA2140	1.68	TIP305	0.75	UPC577C	1.34
LA3301	1.41	MCR100/7	1.00	SA8063	5.17	SN76228ND	0.95	TG960	4.35	TBA641B72	3.03	TDA2150	6.20	TIP30A	0.41	UPC595	2.95
LA3350	1.43	MCR106-5/6	0.95	SA11006	1.85	SN76228N	3.27	TG970	1.74	TBA651	0.87	TDA2151	2.07	TIP30C	0.16	UPC595	2.95
LA3361	1.60	MCR220/7	2.28	SA11020	4.76	SN76242	8.95	TG972	1.74	TBA673	2.05	TDA2160	4.10	TIP30C	0.16	UPC595	2.95
LA3365	3.98	ME0402	0.17	SA11025	4.40	SN76243	8.95	TG974	2.55	TBA700	1.85	TDA2161	1.85	TIP31A	0.34	UPD1514C	4.76
LA3390	5.52	ME0404/2	0.47	SA11024	2.81	SN76296	2.30	TG976AP	0.71	TBA720	3.50	TDA2170	2.88	TIP31B	0.38	UPD2819C	4.96
LA4030P	3.16	ME0411	0.28	SA11075	6.25	SN76533N	2.45	TG976AP	1.27	TBA730	3.55	TDA2270	2.25	TIP31C	0.50	UPD4013B	4.95
LA4031P	3.20	ME6002	0.26	SA11121	7.44	SN76532N	0.97	TG976	3.13	TBA750D	2.90	TDA2520	2.37	TIP32A	0.35	UPD4066B	4.95
LA4032P	2.35	ME6102	0.28	SA11124	3.30	SN76545	1.95	TG9770P	1.83	TBA760	0.71	TDA2522	3.46	TIP32B	0.69	UPD553-164	19.50
LA4100	1.25	ME8001	0.34	SA11130	4.99	SN76546N	3.47	TG9770P	2.57	TBA800	1.92	TDA2524	4.50	TIP32C	0.40	UPD8049C-1	11.52
LA4101	1.30	ME0411	0.75</														

The Art of Servicing

B.A. Berry

As an old hand at this radio and television servicing business it saddens me that fault finding is becoming a lost art. The growing use of chips is doubtless responsible for much of this lack of finesse, and as ever more advanced techniques are coming into use the situation is getting worse. There's still room for the art of fault finding however, even if it's only in fault location to panel level. Nowadays, on being handed a piece of faulty equipment to repair, too many youngsters charge straight in without thinking. Even when they do think they invariably assume that the fault is the most complicated one they can imagine. The next time you're handed a piece of equipment for repair – stop right there and *think!* Nearly all faults can be isolated to a particular area without bringing even a test meter into use.

Customer Interrogation

Before you let the customer out of the shop it's imperative that you give him a real third degree on just what's gone wrong and how it happened. Write this down, because the moment he's gone you'll forget the most important point. It's also extremely important that you ask whether he attempted to do anything about the fault himself. Most people will cheerfully leave say a camera repair job to a specialist but will quite happily take a screwdriver to their video recorder or TV set, then expect you to be able to diagnose and repair a fault when the equipment has been misaligned. It's happened to me all too frequently.

So take careful notes before the customer leaves. The sorts of things you should ask are: At what time and where did the fault occur? Was the customer in the room at the time? For how long had the equipment been working satisfactorily? What are the symptoms, and was there any smoke or peculiar noises? What action did the customer take when the fault occurred, and did the equipment get hot? If so, ask him to point out the exact spot on the external case. Had the customer been doing anything to the equipment at the time? You'd be surprised for example how many people attempt to join up a speaker extension lead while the equipment is working!

The final thing before the customer leaves is to ask him tactfully whether or not he's attempted any repair action himself. Point out that this question is merely to save him money in the long run. If any trimmers or preset controls have been turned, find out now. Such information could cut down the servicing time considerably. Much as you would like to read the riot act at this stage, don't. To do so would only result in the customer denying that he'd even thought of touching anything.

Preliminary Assessment

Having got the equipment on the bench you may feel that you are now justified in removing the outside case. Not so! If you are unfamiliar with it, get the service manual out – if you have one – and check on the system and circuit configuration. In a great many cases, especially with the more sophisticated types of equipment that are being increasingly brought in for attention, the cause of the trouble can simply be a matter of misadjustment, e.g. a

TV/aux switch in the wrong position. It's so easy for even an experienced engineer to miss the obvious when questioning a customer in a perhaps crowded shop. So unless the reported fault obviously requires a look inside, don't unbox the equipment. Instead, apply power and commence your own investigation by checking all external control settings and indicator lamps. Don't neglect input fuses, even when the customer has told you that he changed the fuse. Some 3A and 13A mains fuses are notoriously unreliable. I always make a habit of putting the meter across a new one just in case.

As you go through the various controls, note exactly what they do or don't do. Take your time over this, because this is the stage at which you will be forming your own opinions as to the likely cause of the fault. I always remember the advice given to me by an old engineer who taught me the trade: eyes first, ears next, fingers last of all! It's stood me in good stead over the years.

Initial Checks Inside

By now you will have formed a preliminary idea of what the problem is and where the cause lies. So power off and unbox. At this stage the most useful tool may well be a large magnifying glass. A thorough and concentrated look at the board and the components on it may well reward you with an easy repair. Cracks, solder bridges, overheated components and dry-joints are easy to see under a lens.

With equipment that's been operating satisfactorily for at least six months component failure is only rarely the cause of a fault – unless the component has been subjected to outside influences! Modern components are very reliable. Remember the bathtub curve which clearly shows that most component failures in solid-state equipment occur in the first few months. Failures then fall to a very low level for the normal life span of the equipment, rising again as the equipment reaches the end of its expected life span. During the long period between the initial burn in and old age most faults are due to the causes previously listed, with dry-joints leading the list of possible culprits. In the main they can be found quite easily with a lens.

Test Equipment Next

Component failures do of course occur from time to time in otherwise healthy equipment. It's then that you need the meter or scope. I can't emphasise too much the wisdom of measuring supply voltages and currents. They can give a very good clue to the cause of a fault – especially if you've been clever enough to measure these voltages and currents in a similar piece of equipment that's working. Yes, I know that the readings are given on circuit diagrams – but not always, and not always the particular ones you want. It pays to make your own measurements and keep a note of them. A rise in supply current will lead you to look for a short-circuit, while a reduction should lead you to a burnt out or open-circuit component.

After checking the supply voltages make voltage checks around the transistors in the suspect area. The fastest way to check a transistor in an amplifier circuit is to measure its base-emitter bias – with a normal silicon transistor the reading should be around 0.7V. A quick front-to-back

resistance check on any diodes in the fault area comes next. If a diode reads o.k. but you're still suspicious, change it. I've met some really nasty diodes in my time – ones that check out fine but prove, on replacement, to have been the cause of the equipment failing to work correctly.

If everything else seems to be in order it's time to suspect the i.c.s on the board. Undoubtedly the fastest method of checking is by substitution, particularly with some of the special devices that are around today. If you haven't got a replacement to hand you might find that there's a second chip of the same type on the board. This can be swapped over with the suspect to see whether a different fault appears. If so, you've found your culprit.

I've found that the little RS logic testers that can be clipped over a chip are very handy, though somewhat expensive: LEDs give an instantaneous indication of the logic state at each pin, making the job much easier. Don't neglect the old-fashioned signal tracer with audio equipment. A quick probe around with one of these can locate the source of a fault in a matter of minutes.

DC Amplifiers

About the worst type of fault I've met in audio equipment, at least of the older type, is where there are several d.c. coupled amplifier/driver/output transistors. When one of the output transistors goes short-circuit normally one or more of the other transistors fails with it. If you try to work out what's wrong by taking voltage readings in a logical manner you can find yourself running round and round in circles. The best approach is to start with the first transistor involved. Remove and check it – the ordinary Avo tests will do nicely. If necessary, replace it. But don't switch on again until you are sure that all the transistors and diodes in the circuit are o.k. The amount of distress this procedure will save makes the time taken well worthwhile.

Don't Twiddle Coils

Perhaps the best advice I can give the up and coming engineer on TV repairs is not to assume that any coils are misaligned. The occasions when this is the case are rare indeed – unless the customer has been at it! I can well recall the grief I caused myself in my earlier years by assuming that a twitch here and there would provide a cure – only to discover that it didn't, and eventually that the cause of the trouble was a dry-joint, leaving me with an unnecessary realignment job – it was this, by the way, that led my boss to give the little lecture referred to earlier! I'm well aware that there are those of you out there who consider yourselves to be perfectly able to align a TV set by eye and ear. The next time you try it, have a look at the 3.5MHz bars in a test pattern – they won't be a pretty sight!

Electromechanical Equipment

With any equipment that employs both mechanical and electronic techniques the cause of trouble is much more likely to lie in the mechanical side. Where an electronic component is subject to wear, this will probably be the cause of its failure – video and audio heads provide clear examples of this. And we all know the problems that the tape path can cause with VCRs. It's worth emphasising again that with this sort of trouble it's your eyes that will be of most use to you: study the problem until you are quite sure of what is causing the fault, and only then start stripping the equipment down.

next month in

TELEVISION

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VCR Clinic

Reports from Steve Beeching, T. Eng., Alfred Damp, Khalied Kwimry, R.S. Narwan, Eugene Trundle and Christopher Holland

Amstrad 4600

The capstan servo lost lock when the machine had warmed up. A slight problem was that the main servo chip IC303 (BA718) responded to freezer but the fault was still there after it had been replaced – not to mention the hassle of getting one . . . The culprit turned out to be the operational amplifier chip IC302 which drives IC303 and is next to it. This device had obviously caught some of the freezer. S.B.

Grundig VS380

The problem with this machine was no clock display. The clock and calendar counter, with serial clock and data outputs to the main microcomputer, is IC2080. All voltages seemed to be o.k. but the 32kHz quartz crystal was very quiet. So the crystal and IC2080 were replaced – to no effect. After much deliberation it was realised that the 5V reading at pin 15 (VSS1) was incorrect due to the serial ni-cad cell being short-circuit. The correct voltage is 3.8V. Replacing the cell restored the clock operation. All other functions had to be reset using the service/pause function to preload the RAM. S.B.

Toshiba V5470

The playback picture looked as though the TV set's field oscillator was running fast – locked at twice field frequency with two partially superimposed pictures. The oscilloscope showed that part of the video signal was missing, but only on alternate fields. As the f.m. playback signal was full and correct it wasn't head or mechanical alignment trouble.

Attention was turned to the muting circuits on the servo/logic panel where C608 was found, by substitution, to be low in value. It's in the muting hold-off circuit and prevents muting as long as the control track pulses are present. In this case the capacitor's changed value meant that the time-constant wasn't long enough. S.B.

Amstrad 5200

There was no operation with this machine. Q651 in the 18V power supply was open-circuit and the supply had a short to chassis across it. This was traced to the BA718 chip IC307 which was short-circuit. Replacing the chip and the transistor restored full operation. S.B.

Panasonic NV370

There was no playback colour – the a.p.c. loop was not locking as the reference frequency was way off. The PCB module component was replaced. S.B.

Panasonic NV100

Quite an old machine, this one. It had two faults, no playback audio and no playback colour. Lack of audio was due to a leaky capacitor, C4016 – I knew it was leaky because the voltage at pin 1 of IC4001 was low at about 2V instead of 4.3V. The absence of colour was more of a problem – IC8001, a hybrid device, had been changed. It took quite a long time to measure all the frequencies and set up the a.f.c. and a.p.c. circuits. The result of all this effort was no colour for the first few seconds, the exact time depending on how long the machine had been switched off. After an overnight rest it was two-three minutes whereas after a half-hour off period the colour stayed away for only

thirty seconds. It did make fault-finding tiresomely long, but the customer wanted it done. Anyway, the a.f.c. loop was found to be locked during the monochrome period so this was cleared of suspicion, leaving the a.p.c. loop. In fact the ident output at pin 41 of the relevant chip was highly active, confirming the diagnosis. None of the frequencies were off and I was getting down to change the i.c. when I spotted C8009. Replacing this cured the problem. S.B.

Grundig VS180

If you find that one of the reel motors is running continuously check C301 or C305 in the motor drive circuit for being leaky. S.B.

National Panasonic M5 Camcorder

If the complaint with one of these machines is noisy audio on playback of its own recordings, before spending a lot of time searching for some obscure fault in the microphone/audio record section first try checking the d.c. lead to the drum motor. I've found that the ribbon cable supplying the d.c. presses against the lower drum motor, causing audio pickup of a clicking noise which is transferred to the microphone. K.K.

Fisher FVHP530

The fault report was no channel operation – you couldn't get any test signal on the monitor either. All l.t. outputs from the power supply were checked. A 3.15A fuse was found to be open-circuit as a result of Q907 (B698) being short-circuit. After checking transistor data a BD234 was fitted as a replacement. This along with a new fuse solved the problem. R.S.N.

JVC HRD120/Ferguson 3V35

A good rule of thumb with microcomputer based mechacon and syscon circuits is that the main microcomputer chips themselves seldom fail. Before replacing them check the relevant d.c. lines, the clock pulses, etc., and remember that the various buffer chips are more prone to failure than the microcomputer chips.

We've recently had two HRD120s that proved to be exceptions to the rule. In the first the machine operated normally for about ten minutes before jumping into the timer mode, after which the machine became totally non-functional. Liberal squirts of freezer didn't have any effect. We found that in the fault condition the input to the CPU chip from the timer switch at pin 35 wasn't activated: the conditions at the rest of the CPU's pins appeared to be correct, with the trains of pulses on data line pins 27, 28, 29 and 30 showing some activity on the scope. After removing half a tube of Japanese Evostick from the chip's 52 pins and fitting a replacement the machine worked normally.

The second machine couldn't be switched on by the operate switch. Again the conditions at the CPU's pins all appeared to be correct, with the level at pin 36 changing when the operate switch was selected, but this time there was a distinct lack of activity on the four data lines that connect to the input/output expander IC202. A new CPU chip was again the answer.

As an aside, we've found that the capstan motors in quite a number of these machines have become noisy. This normally has no effect on the quality of the picture and sound, and when the owner is confronted with the price of a replacement motor he's usually prepared to live with the noise. If a particularly bad motor is run in the play mode for a few hours however check that it still has sufficient torque to perform tape unloading properly – a loop of tape can be left outside the cassette and this will be damaged when the cassette is ejected. C.H.

Ferguson 3V20 Camera

The electronic viewfinder took a long time to display an image and when the c.r.t did light up there was lack of width with foldover on the right-hand side of the screen. The cause of the fault was traced to the line output transistor's 10 μ F/16V base drive coupling capacitor. Inspection revealed that it had a corroded leg. A similar type and value electrolytic is used in the viewfinder's field timebase circuit: this was also corroded, though there was no field fault. Both electrolytics were replaced. A.D.

Ferguson 3V35 and variants

Intermittent cassette loading with these machines is usually due to the insert detect switches. These switches can also cause the following symptoms: excessive force has to be used to insert a cassette, or the cassette is taken in half way then ejected. To prove whether the switches are faulty, check at pin 6 of CN27. This pin should go low while the cassette is being taken in. If the pin goes high the switches are faulty. Needless to say both should be replaced.

To operate these machines with the cassette housing unplugged and removed from the machine, switch off at the front, connect pin 5 of CN27 to chassis, then switch on. The microcomputer now thinks that the cassette housing is lowered: all functions with the exception of record can be selected and the shorting link removed. For record, connect pin 7 to chassis and select play and record as usual.

The capstan motor can be a source of rumbles which can usually be cleared with a drop of oil. To prove that the capstan motor is the source of the noise, play a tape and then select pause. If the noise stops the capstan motor is at fault. It should have no play on its shaft at all. If, by holding the motor, the pulley can be moved back and forth there's wear in the bearing. Another check worth making is to look for metal filings on the ASM board. Their presence indicates considerable wear in the bearing. Replace the motor if these checks indicate that the bearing is worn.

The video heads in these machines seem to be prone to early failure. The refurbished heads available work well. In setting up the Q you might find that the trimmers are noisy. A.D.

Mitsubishi HS318

Not a very old machine this one – still under guarantee in fact. It would accept a cassette quietly, but when it was asked to play or record its efforts to load the tape were accompanied by a mechanical bang-bang-click effect as the loading arms jumped about violently. Moving from stop to fast forward or rewind was also a noisy business.

Inspection showed that plastic gear 1 (part no. 641D71001) had several teeth broken off it. Phasing up the mechanics after fitting a replacement can be difficult! The key to success is to align the scribe marks on the two sliders at the front (underside) of the deck, and closely follow the manual's instructions for refitting the mode

switch. Both must be done with the mechanics in the stop (not eject) position. E.T.

Panasonic NV8600

These oldies were built well! Some look set to go clunking and twanging into the nineties. One we had in for repair wouldn't play or record because the pinch roller solenoid wouldn't pull in. The solenoid would hold in when operated by hand and we found that the pull-in transistor Q622 was open-circuit. A BD139 transistor turned out to be a successful replacement, but we also checked the damping diode (D624) as a precaution. E.T.

JVC HRD150

The owner of this machine must have had super-sensitive hearing – or a shelf or trolley that acted as a sounding board! He complained of a barely perceptible clonking noise in the record and playback modes. In a very quiet part of the workshop we could hear it: the noise was coming from the area of the supply spool turntable. We found that the supply reel clutch pinion was very slightly eccentric. This was proved by watching and listening while we spun the supply reel by hand with the back-tension band slackened. A replacement clutch assembly eliminated the trouble. E.T.

Panasonic NVM5B Camcorder

This was the first camcorder we've serviced without removing its case – the trouble was in the viewfinder, which clips on and plugs in. Its little screen was brilliantly lit up, with not a vestige of a picture. The diddy little monochrome c.r.t. is grid modulated by a single transistor video amplifier which is supplied by a negative line derived from pin 5 of the tiny line output transformer. The negative supply was missing because the rectifier diode was open-circuit. It's encapsulated within the transformer, so the entire unit had to be replaced – fortunately under guarantee. The replacement came in a tiny parcel . . . E.T.

Panasonic WVP200E Camera

We and our customer almost came to blows over this old camera! He said it sometimes lost sound. We ran it for days on end with complete sound continuity. He finally convinced us by bringing in a tape recorded by the camera. There were long periods of silence, often triggered by movement of the camera. When the sound went the action of the audio a.g.c. circuit brought up the background noise, so we decided that the trouble was not far from the microphone.

And so it was! The signal from the camera-mounted microphone passes through a switch on the jack socket for the left (mono) external microphone. The socket's connecting pins were dry-jointed to their mini-PCB. E.T.

Mitsubishi HSC20/JVC GRC7 Camcorder

The symptom with this camcorder was no threading. It would try to do so, then shut down with various function lights flashing. While dismantling it we noticed that one of the four cassette lid screws was missing. When we'd got it completely to bits we discovered that the missing screw was lodged in the loading mechanism – this was the cause of the trouble. We were much miffed to note that a good shake and rattle session would have dislodged the screw without the need to take the machine apart . . . E.T.

Dual-channel TV Sound Systems

Part 3

Geoff Lewis, B.A., M.Sc.

Last month we looked at some of the basic techniques used in digital sound systems. In this concluding instalment we'll consider some of the systems in use or proposed for use in dual-channel TV sound applications.

Dolby ADM System

The Dolby adaptive delta modulation (ADM) system is a variant of delta modulation using one bit per sample to indicate whether the analogue audio signal has increased or decreased in amplitude. It's a most effective bit rate reduction technique, allowing the use of a considerably higher sampling frequency. This in turn leads to a simpler decoder filter arrangement, without the risk of aliasing. Unlike pulse-code modulation, a single bit error has the same effect wherever it occurs. When an error bit is detected in a delta modulation system, introducing an opposite polarity bit will reduce the audible effect to almost zero. The only major disadvantage is that an overload can arise when the signal amplitude changes by an amount greater than the quantizing step size. The ADM system devised by Dolby Laboratories Inc. and adopted for use with the Australian DBS service, which uses the B-MAC transmission standard, employs both a variable step size and variable pre-emphasis to produce very high quality audio.

A pre-emphasis circuit at the encoder continuously monitors the signal frequency spectrum to determine the optimum pre-emphasis characteristic. After pre-emphasis the signal passes through a step sizing circuit which continuously evaluates the signal slope to select the best value. The pre-emphasis and step-size information is then coded as two low bit rate control signals. The audio signal is delayed by 10msec relative to the control signals: this ensures that the control signals reach the decoder in time to enable it to decode the received audio signal in a complementary manner.

For transmission the digital signal is formatted into blocks, with provision made for synchronisation. There are two types of format, one for signals that occur in bursts, such as sound-in-syncs and B-MAC, and the other for continuous signal channels.

The basic operation of the decoder can be outlined with

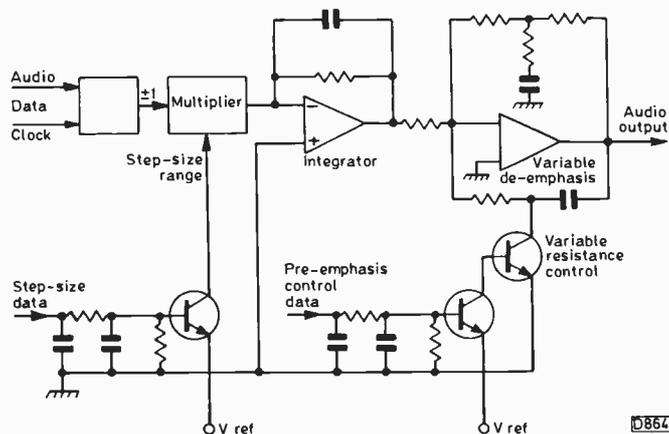


Fig. 1: Dolby ADM decoder.

reference to Fig. 1. After demodulation the signal components, which consist of audio data for each channel at a typical bit rate of 200-300kb/sec and the control data at the half line rate of 7.8kb/sec, are separated out using suitable filters. The audio data is clocked into a multiplier stage as a bipolar signal: the step-size data acts as the multiplying constant. The audio data is then converted to analogue form using a leaky integrator. De-emphasis control works in a similar way, but instead of using the control signal to vary the gain the amplifier stage involved operates as a variable, single-pole frequency de-emphasis network. The decoder is available in i.c. form (the Signetics NE5240), is simple and is relatively insensitive to component tolerances.

MAC/Packet Systems

The overall frame structure for the C-MAC and D-MAC systems, with packet sound channels, is shown in Fig. 2. The only significant difference between the two systems lies in the carrier modulation method employed. C-MAC/ Packet uses 2-4 phase shift keying (a form of QPSK) modulation of the common sound and vision carrier while D-MAC/ Packet uses duo-binary coding which can be amplitude or frequency modulated on to a separate sound carrier.

Each 64µsec line period contains 1,296 sampling points, which is equivalent to a sampling frequency of 20.25MHz. The audio channels are sampled at 32kHz, quantized into 14 bits per sample, and then coded in twos-complement form. For stereo the left and right channels are sampled simultaneously, coded separately and transmitted alternately. The sound and data bits are organised into 164 packets, each of 751 bits, in two sub-frames. We thus have a total of 123,164 bits which have to be transmitted in 40msec, equivalent to a bit rate of 3.0791Mb/sec. This total capacity can be subdivided in many ways. Depending on the methods of coding and level of error protection employed, some of the possibilities include: three linear stereo sound channels with basic error protection; four companded stereo sound channels with basic error protection; two linear stereo sound channels with extended error protection; three companded stereo sound channels with extended error protection; or the equivalent in mono or dual-language channels.

The error protection systems used are as follows: (1) Linear mode, first level. One even parity bit is added to the eleven most significant bits of each sample. (2) Linear mode, second level. An extended Hamming code (16,11) is applied to the eleven most significant bits. This is capable of correcting single-bit errors. (3) Companded mode, first level. One even parity bit is added to the first six most significant bits. (4) Companded mode, second level. An extended Hamming code (11,6) is added to each sample. This will correct most single-bit errors.

The companding system is similar to that employed with NICAM-3 (see later), which is used for processing digital sound in studios etc. After sampling, the sound plus data burst is organised into blocks of 32 14-bit samples. These are then compressed to ten bits each, using a scaling factor determined by the magnitude of the largest sample in the

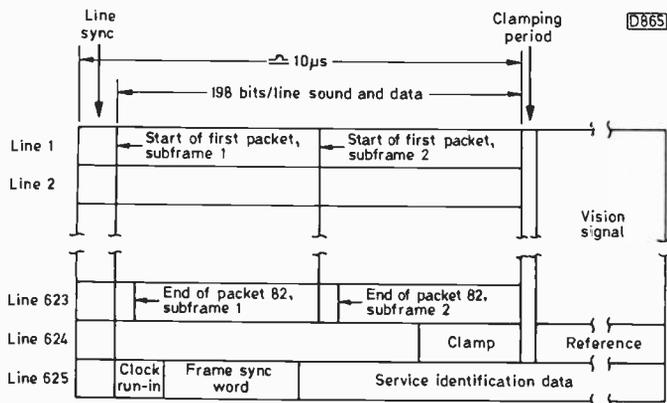


Fig. 2: Frame multiplex structure used for C-MAC and D-MAC Packet systems (not to scale).

block. The scaling factor is encoded into the parity bits for each block to indicate the degree of compression. This scaling factor is extracted at the receiver using majority-decision logic which also restores the original parity. The decoded scaling factor is then used to expand all the samples in the relevant block.

To minimise the effects of burst errors the 751 bits in each packet are interleaved. An energy dispersal or spectrum shaping technique is applied after interleaving, to randomise the data stream. This is done to all except the first seven bits in each line and the data in lines 624 and 625. The process consists of adding the output of a PRBS generator with a period of $2^{15} - 1 = 32,767$ bits to the data stream by means of exclusive-or logic. The PRBS generator runs at 20.25MHz and is initialised at the start of every frame so that the first addition always applies to bit eight of line one.

C-MAC Modulation/demodulation

With the 2-4 PSK modulation system logic one is represented by a $+90^\circ$ phase shift while logic zero is represented by a -90° phase shift. There are three basic ways of demodulating such signals. If the carrier/noise ratio is high, typically greater than 16dB, it's possible to use the vision f.m. discriminator to recover the audio/data signal as well. More commonly however either a coherent or a differential demodulator is used. A coherent demodulator detects the incoming signal and compares it with a highly stable reference signal: any instability leads to bit errors. Since the received signal is in the form of DPSK, differential demodulation can give better results: with the received data in the form of phase differences in successive intervals, these differences can easily be detected by comparing the received signal with itself after a delay of one bit period.

D-MAC Modulation/demodulation

The bipolar duo-binary sound and data signal is in analogue form, with a bandwidth of only 10.125MHz, for a channel bit rate of 20.25Mb/sec. After demodulation the sound signal can be recovered by full-wave rectification followed by slicing at the half amplitude level.

D2-MAC Sound Channel

The D2-MAC/Packet sound channel has the same format as D-MAC/Packet except that provision is made for only one sound and data sub-frame in the same approximately $10\mu\text{sec}$ period. The reduced bit rate of 10.125Mb/

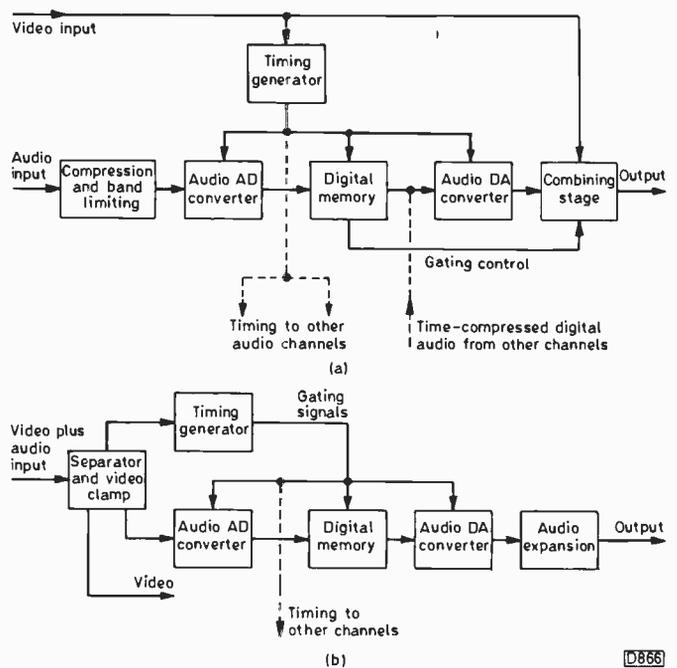


Fig. 3: The VIMCA system. (a) Block diagram of the encoding arrangement. (b) Decoder block diagram.

sec allows for one high-quality stereo channel plus a lower grade audio channel and a limited data service. The total bandwidth of the sound and vision channels is just under 13.5MHz, allowing transmission over current cable networks.

Compatibility of MAC Systems

In all the MAC variants described above the demodulated digital signal is processed in a manner complementary to the sequence used for encoding. That is, the signal is first descrambled to remove the PRBS energy dispersal component, de-interleaved, expanded from 10 to 14 bits and finally checked for errors. This common arrangement, plus the similarities in the sound and data frame multiplexes, means that universal chip sets that will automatically recognise and decode whatever system is in use are likely to be made available to setmakers.

VIMCA System

An important point that has to be considered when planning to add stereo sound to an established mono TV network is the cost of modifying all the transmitters.

The Australian organisation IRT Ltd. has developed a bolt-on system that provides a neat solution. It's known by the initials VIMCAS (vertical interval multiple channel audio system) and can also be used with VCRs, again without modification being required. Basically, the system incorporates time-compressed and companded audio signals in spare line periods during the field blanking interval. Each line can accommodate an audio base bandwidth of approximately 4.7kHz, so that six lines will provide a pair of stereo channels 14kHz wide. Multiple lines can alternatively be used for dual-language or data transmissions.

Fig. 3 shows the general principles involved, (a) for encoding and (b) for decoding. We'll consider encoding first. The analogue audio signal in each channel is first band limited and compressed, then sampled, quantized and loaded into a digital memory. During the appropriate video line it's read out of the memory at a very much higher rate, thus achieving time compression. The signal is then

converted back to analogue form and is gated into the video signal. The bandwidth of the time-compressed audio signal is about 2.5MHz, which is well within the capacity of the video channel. Decoding is done in a complementary manner, as shown in Fig. 3(b). Any additional channels require their own AD converters and digital memories but can share the DA converter.

When several contiguous lines are used for wideband audio there's signal duplication at the end and beginning of successive lines. The signal at the beginning of a line, where corruption by interference or distortion is most likely, can thus be discarded.

The system has been found to be very flexible in operation – it's possible to mix wide and narrow band signals without cross-talk. Scrambling can be provided while the signal is in digital form or simply by alternating the line sequences. When the system is used with a video tape recorder the signals are not affected by the head switching and, due to the method of synchronism, wow and flutter are said to be negligible.

NICAM 728

The UK standard for terrestrially transmitted digital stereo TV sound channels is NICAM 728. Let's briefly look at the history. The West German dual-carrier system was extensively tested in the UK, with the PAL system I standard. It was found to be almost impossible to include a second sound carrier between 6 and 8MHz without causing unacceptable interference to either the vision or the primary sound carrier. With systems B and G, used elsewhere in Europe, the primary sound carrier is at 5.5MHz with respect to the vision carrier, leaving enough spectrum space to avoid the interference problems found in the UK. Over the years BBC and IBA engineers have developed considerable expertise in digital processing of the TV sound channel – from the sound-in-syncs system used since the late sixties for sound links between studios and transmitters to the more recent work on MAC systems. Starting with this background BBC engineers developed the system that has come to be known as NICAM 728 – NICAM relates to the companding system employed (near-instantaneous companded audio multiplex) while 728 indicates the digital data rate used.

NICAM 728 has a second subcarrier at a level of -20dB relative to the peak vision carrier and spaced 6.552MHz above it ($6.552\text{MHz} = 9 \times 728\text{kHz}$). This carrier is differentially modulated by the digitally encoded signals for both channels of the stereo pair. The present 6MHz f.m. sound channel is retained in the interests of compatibility with current mono receivers.

The digital subcarrier is quadrature (four phase) PSK modulated: each resting carrier phase represents two bits of data, thus halving the bandwidth required. Because of the differential encoding (DQPSK) only the phase changes have to be detected at the receiver, the bits to phase change relationships being as follows: 00 = -0° phase change; 01 = -90° phase change; 10 = -270° phase change; 11 = -180° phase change.

Pre- and de-emphasis to CCITT recommendation J17 – 6.5dB boost or cut at 800Hz – is applied either while the sound signal is in analogue form or by means of digital filters while it's in digital form. The left and right channels are simultaneously sampled at 32kHz, then coded and quantized separately to 14-bit resolution and transmitted alternately at a frame rate of 728 bits per millisecond (728kb/sec).

The NICAM compander processes the 14-bit samples in

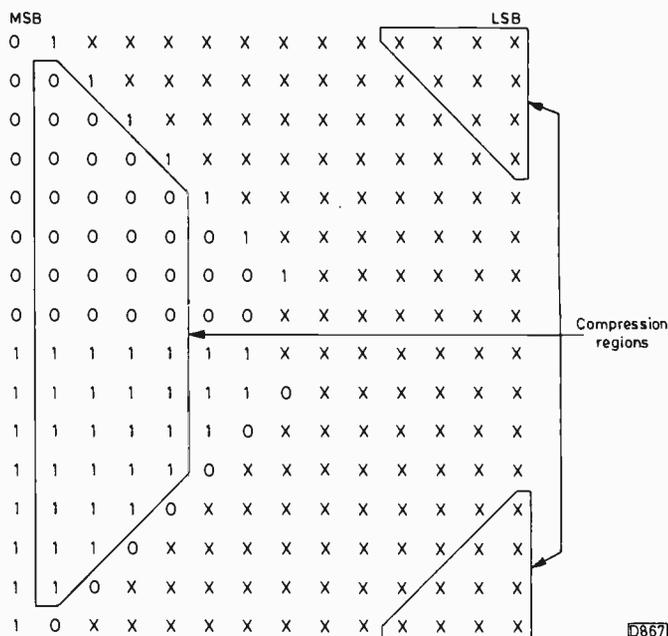


Fig. 4: Coding scheme for NICAM 728 companding.

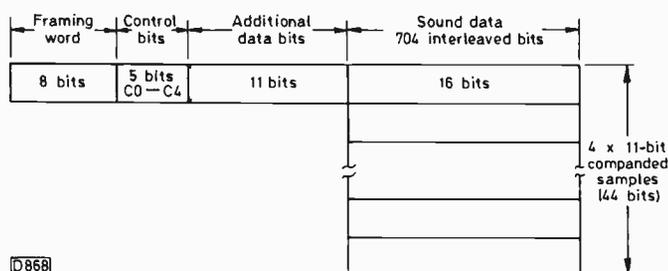


Fig. 5: NICAM 728 frame multiplex.

the manner shown in Fig. 4. The rule for disregarding bits can be summarised as follows: the most significant bit (MSB) is retained and the four following bits are deleted when they are of the same consecutive state as the MSB; if this leaves a word of more than ten bits the excess bits are deleted from the region of the least significant bit (LSB). A single even parity bit is added to check the six most significant bits in each word. The data stream is then organised into blocks of 32 11-bit words in two complement form.

The magnitude of the largest sample in each block is then used to determine a 3-bit scaling factor, which is encoded into the parity bits for that block. A majority decision logic circuit is used in the receiver to extract the scale factor – this process also restores the original parity pattern.

Two blocks of data are then interleaved in a 16×44 (704 bits) matrix to minimise the effects of burst errors. Adjacent bits in the original data stream are now 16 bits apart.

A transmission frame multiplex of the form shown in Fig. 5 is then organised. Additional bits are used as follows: eight bits form a frame sync word (framing word); five control bits select the mode of operation (C0-C4); eleven additional data bits are reserved for future developments. The modes are as follows: stereo signals consisting of alternate channel A and B samples; two independent mono signals transmitted in alternate frames; one mono signal plus one 352kb/sec data channel on alternate frames; one 704kb/sec data channel; other ideas not so far defined.

After the interleaving of the 704 sound data bits (64×11 -bit samples) the complete frame, except for the framing word, is scrambled to provide energy dispersal. This is

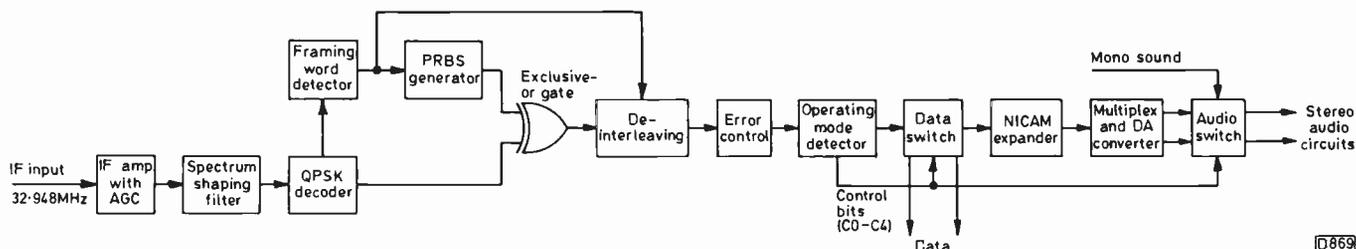


Fig. 6: Decoding the NICAM 728 stereo signal.

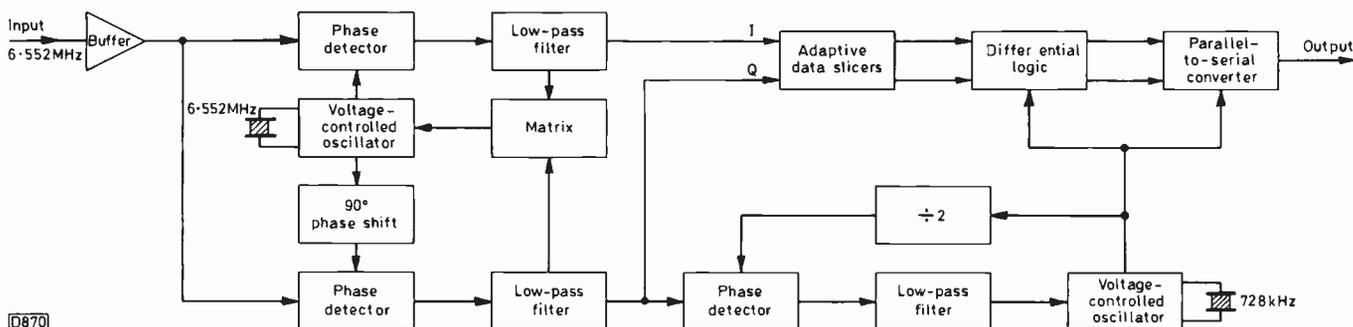


Fig. 7: DQPSK signal decoding.

done by adding via exclusive-or logic a PRBS of length $2^n - 1$. The PRBS generator is reset on receipt of the framing word.

To limit the bandwidth the data stream is passed through a spectrum shaping filter that removes much of the harmonic content of the data pulses. This, combined with the action of a similar filter in the receiver, produces an overall response that's described as having a full or 100 per cent cosine roll-off.

The data stream is finally divided into bit pairs to drive the 6.552MHz subcarrier's DQPSK modulator.

Decoding NICAM 728

NICAM 728 decoding is shown in block diagram form in Fig. 6. The secondary sound channel's subcarrier appears at either 32.948MHz or 6.552MHz depending on the arrangements used in the receiver's i.f. strip.

The spectrum shaping filter forms part of the system's overall pulse shaping and has an important effect on noise immunity. Overall filtering ensures that most of the pulse energy lies below a frequency of 364kHz (half bit rate).

The QPSK decoder recovers the data stream which is scanned by the framing word detector so that the start of each frame is located in order to reset the PRBS generator. The PRBS sequence is then added to the data via the exclusive-or gate to provide descrambling (energy dispersal signal removal). De-interleaving is also synchronised by the arrival of the framing word. Standard procedures are used for error control, which is carried out within an i.c. The operating mode detector searches for the control bits C0-C4 to set up the data and audio stage switches automatically, the data outputs being those for the 352 or 704kb/sec data channel options. The expansion circuit functions in a complementary manner to the compressor, but uses the scaling factor to expand the 10-bit data words into 14-bit samples. The data stream is finally converted back into analogue form for feeding to the audio amplifier stages. These should be designed to a very high standard – the audio quality provided by NICAM 728 approaches that of the compact disc.

The DQPSK decoder is a particularly complex item

that's fortunately available in i.c. form – the block diagram shown in Fig. 7 is very much simplified. The two main sections are concerned with recovery of the carrier and the bit-rate clock. The first section employs a voltage-controlled crystal oscillator running at 6.552MHz and two phase detectors to regenerate the parallel bit pairs, which are referred to as the I and Q signals (in-phase and quadrature). A second similar circuit, locked to the bit rate of 728kHz, is used to synchronise and recover the data stream. Parallel adaptive data slicers square up the data pulses and the DQPSK signals are then decoded by differential logic. The bit pairs are finally converted to serial form.

A practical decoder incorporates a further phase detector circuit driven from the Q chain. This is used as an amplitude detector which generates a muting signal if the 6.552MHz subcarrier is absent or fails. The audio system is then switched over to 6MHz f.m. mono sound.

Current Status of NICAM 728

Both the BBC and the IBA are currently involved in a transmitter replacement programme and plan to add NICAM 728. The BBC has announced that a regular service with NICAM 728 is unlikely to start before 1991, but the IBA has hinted that its services could start earlier. In the meantime, the Swedish and Hong Kong broadcast services have taken up the system and expect to be operational some time this year. As a result of the similarities with the MAC/Packet systems it's expected that chip sets for decoding will soon be available at a reasonable cost. Texas Instruments and Toshiba have both stated that they could have chips available at very short notice, while JVC has announced that it already has a TV receiver and VCR with digital stereo capability ready for launch as soon as the services come into operation.

Correction

Finally, a correction to Part 2 last month. $2^n - 1$ in the first line of the second column, page 271, should have read $2^n - 1$. As printed there would be only four PRBS states instead of the seven listed in Table 2.

Service Bureau

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GRUNDIG CUC220 CHASSIS

After the set has been running for about twenty minutes the chopper transformer starts to buzz. This increases, with increased contrast or brightness. Eventually the set will go to standby intermittently. All the secondary supplies seem to be in order.

Replace R632 (100k Ω), C631 (100 μ F) and R631 (0.68 Ω). If the problem remains the TDA4600 chopper control chip IC631 is suspect.

FERGUSON 3V23

The picture is stable but there's very bad flutter on sound. This fault got worse over a period of six months and is now so bad that listening is unpleasant, especially with tapes recorded by the machine. Changing the main capstan drive belt has had no effect. I've bought a second machine to use while the first is put right and find that the same fault is beginning to occur with this one.

First check that the back-tension is correct and not varying – watch the back-tension lever in operation. If this is all right listen to the sound carefully. If the problem is amplitude variation (loud/soft) try zenith adjustment of the audio head – tilt its top slightly outwards. If the problem is frequency variation (wow) concentrate on the operation of the capstan. Clean the capstan and pinch roller – replace the latter if it's eccentric or binding. The capstan speed could be varying due to a faulty motor, but check the capstan servo circuit first, setting up as outlined in the manual – an oscilloscope is almost essential for this.

ITT CVC9 CHASSIS

There are horizontal black lines at the top of the picture, in bands, decreasing in intensity from the top of the screen. Very occasionally these lines are not present. Various items in the line/field blanking circuits and the line output stage have been checked.

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TELEVISION MARCH 1988

A common cause of this problem is ringing in the scan yoke (field section) or the pincushion distortion correction transducer. Check the following: R364, R362 (pincushion amplitude), L125 and R354 (vertical shift). A dry-joint on the transducer L121-4 or one of the above components is quite common.

PHILIPS CTX-E CHASSIS WITH TELETEXT

There's a great disparity in the brightness levels between teletext and programme displays. When the brightness is set for a normal picture the teletext is blindingly bright. Are most sets sold like this? I gather there's no means of adjustment.

The amplitude of the teletext display is set by a small potentiometer which is situated between the SAA5050 character generator chip and plug V5. There are two potentiometers in this area on the teletext decoder board. The one nearest the edge adjusts for minimum judder in the mixed mode, the one that's farther in setting the brightness. These adjustments are not present on later boards. With these the teletext and picture brightness can be set separately by means of the remote control handset.

FERGUSON 3V22

Considering its age this machine records and plays back quite well. The problem is that with prerecorded tapes the colour smears to the left. Adjusting the tracking control alters the condition for a second or so, then the colour returns to its original position.

This problem can be caused either by incorrect tape path alignment, which is common with later versions of the 3V22, or by incorrect or varying drum or capstan speed. By adjusting the tracking control you are momentarily altering the drum speed so that the position of the heads with respect to the information on the tape alters, hence the fault clears momentarily. The action required to restore correct operation is to replace the belts, pinch roller and take-up clutch, then go through the full alignment procedure for the audio/servo board, taking particular care with the drum and capstan adjustments. If the problem persists, use a scope to check the pulses from the control and pickup heads. Finally, it may be necessary to carry out complete realignment of the tape path.

ITT CVC1203 CHASSIS

When this set first came in we found that the mains bridge rectifier's reservoir capacitor C658 was leaky. Prior to this the set was reported to have "gone off" on a few occasions. No fault was noticed during a three day soak test, so as a precaution the chopper and line output transistors were replaced and the h.t. was checked. The set is now going off again, the first symptom being loss of station before the set reverts to the standby mode.

We suggest that you start by replacing R716 (150k Ω) in the power supply and C614 (100 μ F) in the line generator circuit: these components are troublesome in this chassis. If necessary then suspect the 12V regulator chip IC751 (type 7812) – after checking for dry-joints around the chopper and line output transformers.

NEC PVC470E

After replacing the video heads the picture obtained is excellent. Record and playback of tapes recorded since the head change is normal but with tapes recorded before the head change there's a tracking problem which is usually confined to the lower part of the picture. The problem can be described as bright white blips with small tails. Moving

the tracking control either way from centre makes the problem worse, i.e. more blips with horizontal white lines. I suspect that the drum entry guide needs adjustment.

You are almost certainly right in suspecting that a tape path problem is present. Since the mistracking is mainly confined to the bottom of the picture however it's more likely that the problem lies with the exit guide. Before carrying out adjustment (consult the manual) clean the guide, head drum assembly etc. thoroughly and ensure that the head screws are tightened evenly.

TEST CASE

303

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

This month's test case concerns an Hitachi VT8500 VCR, though the symptom and cure would apply equally to any VCR, whether of the VHS or Betamax format. It was a puzzler indeed. Since solving it however we've come across similar symptoms in other machines – and in every case the cause of the problem has been the same.

The fault was confined to the recording process: playback of a known good tape was perfect every time. When a tape recorded by the machine was played back the picture tended to roll and judder vertically – whether played back on the machine itself or another one. Vertical stability of the monitor's picture depends on the field sync pulses of course, so our first step was to hook an oscilloscope to the playback head amplifier.

The display on the scope's screen is shown at the top in Fig. 1. An unusual sight: the leading edge of every other r.f. envelope from the heads had a hole in it, wide enough to knock out some of the field sync pulse – which is almost the first thing to be recorded during each head sweep across the tape. The edges of the holes were quite steep and sharply defined, quite unlike the bottle-neck effect produced by a misaligned tape entry guide. Guide problems seemed unlikely anyway since the r.f. output envelope from one head was perfectly square and normal. Surely any

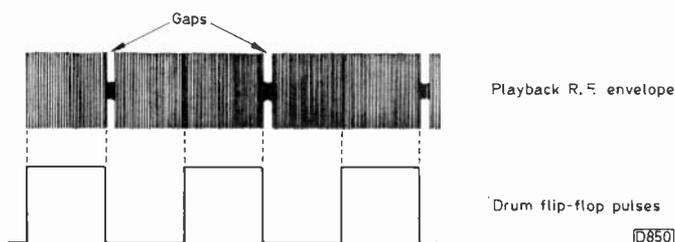


Fig. 1: Top, the waveform at the faulty machine's playback head amplifier. Bottom, the correctly timed 25Hz drum flip-flop waveform.

mechanical problems would effect both heads equally? We couldn't imagine any tape path or head faults that would give rise to this strange effect. So it seemed to be some sort of electrical fault.

When we monitored the luminance writing current during record we found that it was continuous and of the correct amplitude. Next we closely examined the 25Hz drum flip-flop pulse waveform during record and playback. It was straight-sided, symmetrical and correctly timed, as shown at the bottom in Fig. 1. In desperation we phoned the owner and quizzed him closely on how and when the fault had developed. It seemed that the machine had been perfectly all right until it had been taken to a repair shop (not ours) with the complaint "woolly sound". Since being returned with a hefty bill the sound had been better but the picture had bounced and rolled like a ball. Our morale sank. The "fault" may have been the result of hamfisted twiddling, modification or bodgery . . .

In an attempt to analyse the fault symptom in greater detail we played back the tape on another, good machine and watched the playback r.f. envelope. The results were just the same. As soon as the section of tape recorded by the Hitachi machine changed to the machine's own recording the shape of the envelope returned to normal. We noticed a strange effect however, and this was the key to correct diagnosis. Two or three seconds before the end of each playback of a test recording session on the Hitachi machine the shape of the r.f. envelope returned to normal – the hole had disappeared! This happened regardless of the machine used for playback. Suddenly we knew the answer! What was it? See next month.

ANSWER TO TEST CASE 302 – page 291 last month –

The situation outlined last month arose from inexperience on the part of the technician sent to deal with the problem in the field. The very bright raster displayed by the 16in. ITT set couldn't have been caused by an increase in the c.r.t.'s cathode voltages – indeed the increase was a result of the technician's reaction and that of the beam-current limiter circuit to the high brightness fault, the technician backing off the manual brightness control while the beam-limiter circuit pulled down the contrast level, both in ineffectual attempts to restore a normal display.

As Sage quickly twigged, the key to the problem lay in the fact that adjustment of the tube's first anode voltage had no effect on the brightness of the raster. It should have done! His conclusion was that the first anode voltage was excessively high and was unaffected by the first anode potentiometer's setting. At no time had the field technician checked the voltage at pin 10 of the tube! The cause of the trouble lay in R46A of course: this resistor links the earthy side of the potentiometer to chassis, forming part of the potential divider chain. Its body had cracked.

The value of R46A is 750k Ω , which is not normally carried as a spare – it's not a preferred value. Since the technician didn't have two 1.5M Ω resistors to connect in parallel he fitted an 820k Ω resistor and readjusted R47A to obtain the correct black level.

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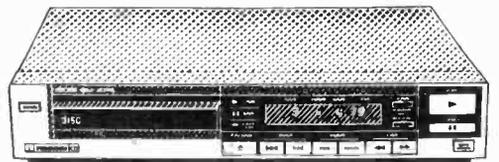
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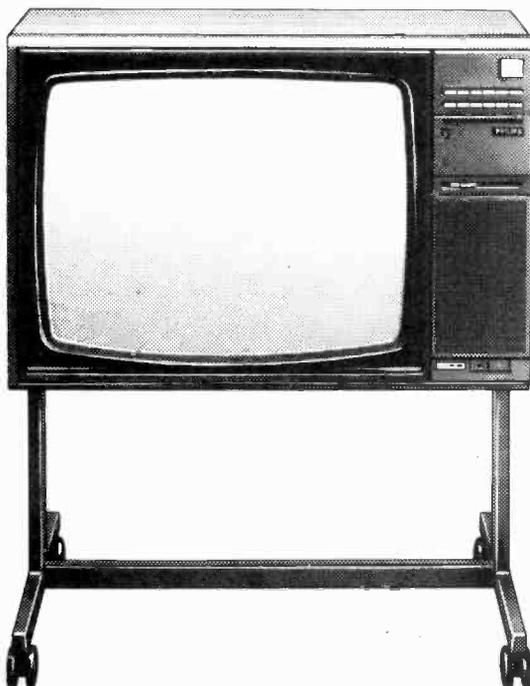
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3V32.....	£66.95
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Sharp	
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VC8300.....	£66.40
VC9300, VC9500, VC9700.....	£61.10
VC381, VC383, VC386.....	£61.10
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VT8500, VT8700.....	£34.50
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VT11E, VT14E.....	£34.50
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Philips	
VR6460.....	£44.00
VR6462.....	£44.50

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NV688.....	£6.50
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NV870, NV810.....	£2.80
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SLC6.....	£7.50
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VC8300.....	£6.50
VC9100, VC9300, VC9500.....	£6.50
VC381, VC383, VC386.....	£6.50
Hitachi	
VT5000, VT5500.....	£6.50
VT8000, VT8300, VT8500.....	£2.90
VT9300, VT9500, VT9700.....	£3.30
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VT33E.....	£6.50
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3V23.....	£2.90
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3V35, 3V36, 3V38, 3V39.....	£2.90
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VTC5300, VTC5400.....	£2.50
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VC8300.....	£3.90
VC9100, VC9300, VC9500.....	£3.90
VC381, VC383, VC386.....	£3.90
Hitachi	
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VT9300, VT9500, VT9700.....	£1.50
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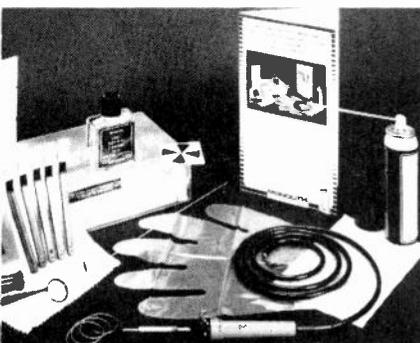
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AN211A	£2.30	AN6811	£1.60	BA5204	£2.75	HA11786	£4.50	LA4505	£2.50	TA7073AP	£2.75	TA3341	£3.60
AN217B	£2.20	AN6873	£4.50	BA5402A	£2.75	HA11788	£4.50	LA4505	£2.50	TA7074P	£1.95	TA3360	£4.50
AN228WB	£2.50	AN6875	£3.50	BA5406	£3.20	HA11816	£6.50	LA4507	£4.25	TA7122AP	£0.90	TA3361A	£4.95
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AN241P	£1.50	AN7106K	£1.50	BA6208	£2.95	HA12002	£2.95	LA4570	£3.75	TA7145P	£2.50	TA33652	£3.30
AN259	£2.75	AN7110	£1.50	BA6209	£3.75	HA12035	£9.50	LA5112	£1.85	TA7193P	£4.00	TA4420	£3.75
AN260P	£2.20	AN7111	£1.50	BA6304	£2.20	HA12038	£6.75	LA5527	£1.95	TA7205AP	£1.00	TA4450	£3.95
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AN274	£2.50	AN7115E	£1.60	HA1124DS	£1.50	HA12413	£2.75	LA6490	£1.20	TA7214P	£2.60	TA4720	£2.20
AN277A	£2.75	AN7120	£1.50	HA1125	£1.50	HA13007	£4.95	LA7016	£2.75	TA7215P	£3.20	UPC575C	£1.00
AN277	£2.50	AN7130	£1.75	HA1137W	£1.75	HA13402	£4.95	LA7032	£4.50	TA7217AF	£1.60	UPC1001H	£2.00
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AN301	£3.50	AN7140	£2.20	HA1151	£2.50	LA1111	£0.95	LA7224	£2.95	TA7222AF	£4.95	UPC1025H	£1.30
AN302	£3.30	AN7143	£2.95	HA1156W	£1.20	LA1130	£2.75	LA7505	£2.95	TA7223P	£4.75	UPC1031H	£1.95
AN303	£2.75	AN7145M	£2.80	HA1167	£3.75	LA1140	£2.20	LA7507	£2.95	TA7227P	£6.25	UPC1032H	£3.00
AN305	£3.50	AN7146M	£2.80	HA1186	£1.75	LA1222	£1.00	LA7520	£3.25	TA7229P	£6.50	UPC1181H	£1.10
AN313U	£2.95	AN7149N	£2.95	HA1197	£3.70	LA1230	£1.50	LA7521	£4.50	TA7230P	£7.00	UPC1182H	£1.10
AN315	£2.30	AN7154	£1.90	HA1199	£1.85	LA1231	£2.00	LA7571	£4.75	TA7232P	£9.50	UPC1185H	£2.50
AN316	£3.75	AN7156N	£2.50	HA1319	£2.50	LA1240	£1.95	LA7575	£3.20	TA7233P	£7.75	UPC1188H	£2.75
AN318	£4.95	AN7158N	£3.25	HA1365W	£1.80	LA1260	£2.95	LA7800	£1.95	TA7237P	£7.95	UPC1225H	£2.75
AN337	£5.25	AN7160	£3.75	HA1366WR	£1.85	LA1265	£2.50	LA7801	£2.95	TA7241AP	£7.50	UPC1230H	£2.50
AN340P	£1.50	AN7161	£3.75	HA1367	£1.85	LA1265	£2.50	LA7806	£2.75	TA7269P	£5.50	UPC1263C	£2.50
AN360	£1.30	AN7166	£2.95	HA1368	£1.90	LA1368	£2.50	LA7808	£2.95	TA7270P	£5.75	UPC1277H	£2.75
AN362L	£1.60	AN7178	£2.95	HA1368R	£1.95	LA1368	£1.95	LA7808	£2.95	TA7271P	£9.50	UPC1278H	£2.75
AN363N	£3.50	AN7178	£2.95	HA1370	£3.70	LA1387	£3.60	LA7910	£2.20	TA7272P	£6.75	UPC1363C	£2.75
AN366P	£2.20	AN7213	£1.75	HA1372	£3.50	LA1460	£2.50	LA7920	£1.75	TA7273P	£6.75	UPC1364C	£4.75
AN374P	£2.20	AN7218	£1.75	HA1374	£2.50	LA1464	£3.20	LA1405	£2.20	TA7274P	£6.50	UPC1384C	£3.50
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AN5010	£1.75	AN7310	£1.20	HA1392	£2.50	LA3220	£2.95	LA1735	£3.75	TA7288P	£8.75	UPC2002	£0.80
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AN5265	£3.20	AN7410	£3.00	HA1396	£3.75	LA3301	£1.30	LA1740	£3.95	TA7317P	£7.75	BC639	£0.22
AN5410	£5.50	AN7415	£2.95	HA1397	£2.75	LA3310	£2.75	LA1743	£3.95	TA7328P	£2.20	BC640	£0.22
AN5411	£2.50	AN7420	£3.25	HA1398	£2.75	LA3350	£1.30	MS134P	£3.25	TA7343AP	£2.95	BRF90	£1.50
AN5430	£2.95	BA301	£0.80	HA1457W	£2.75	LA3361	£1.20	MS155P	£1.85	TA7358P	£2.80	BRF91	£1.20
AN5510	£2.75	BA311	£0.95	HA1215W	£4.35	LA3370	£2.80	MS1102L	£3.95	TA7607AP	£7.50	BRF90	£1.50
AN5512	£2.75	BA312	£1.20	HA11219	£2.75	LA3370	£2.80	MS104L	£3.75	TA7608CP	£5.75	BR303	£1.50
AN5612	£2.75	BA314	£2.20	HA11221	£2.75	LA4031P	£1.95	MS1514	£1.80	TA7609P	£6.50	BR500	£1.80
AN5620X	£3.50	BA318	£1.50	HA11223W	£1.90	LA4032P	£1.90	MS1515BL	£2.50	TA7613AP	£7.50	BR506	£1.20
AN5701	£1.80	BA328	£2.50	HA11225	£3.85	LA4100	£1.20	MS1516BL	£2.80	TA7628P	£8.50	BU208A	£1.20
AN5722	£1.60	BA333	£3.50	HA11226	£4.50	LA4101	£1.40	MS1517L	£2.80	TA7640AP	£8.95	BU208D	£1.80
AN5730	£1.85	BA335	£3.60	HA11235	£2.30	LA4102	£1.81	MS1518L	£2.20	TA7658P	£8.75	BU326A	£1.95
AN5732	£1.85	BA340	£2.80	HA11251	£2.75	LA4110	£1.75	MS1521L	£1.90	TA7668P	£4.95	BU500	£1.80
AN5750	£3.75	BA343	£2.75	HA11401	£2.80	LA4112	£1.75	MS1531	£1.80	TA7669P	£6.75	BU508A	£1.80
AN5753	£1.95	BA402	£0.95	HA11423	£4.40	LA4120	£2.95	MB3705	£1.80	TA7678P	£6.75	BU508B	£1.80
AN6250	£3.30	BA403	£1.95	HA11440	£3.95	LA4125	£2.20	MB3712	£1.60	TA7682P	£6.75	BU508C	£1.50
AN6326N	£2.70	BA511A	£1.85	HA11701	£3.50	LA4126	£2.60	MB3714	£2.95	TA7683AP	£6.50	BU508D	£1.50
AN6327	£4.75	BA514	£1.90	HA11703	£4.50	LA4137	£1.95	MB3722	£3.50	TA7688P	£6.75	BU508E	£1.50
AN6328	£4.20	BA516	£1.90	HA11704	£4.00	LA4140	£0.90	MB3730	£2.50	TA7690CP	£6.50	BU508F	£1.50
AN6330	£2.95	BA521	£2.20	HA11705	£6.95	LA4145	£1.70	MB3731	£3.50	TA7692P	£6.80	BU508G	£1.50
AN6340	£7.85	BA524	£2.75	HA11706	£4.75	LA4160	£2.40	MB3756	£2.60	TA7693P	£4.25	BU508H	£1.50
AN6341N	£4.00	BA526	£3.50	HA11710	£3.75	LA4170	£3.50	MB3759	£2.30	TA7698P	£6.50	BU508I	£1.50
AN6342N	£2.50	BA527	£1.75	HA11711	£9.50	LA4178	£2.50	MB8719	£3.85	TA7700P	£6.50	BU508J	£1.50
AN6344	£4.75	BA532	£1.60	HA11713	£6.50	LA4182	£2.20	STK011	£3.95	TA7701P	£6.50	BU508K	£1.50
AN6350	£7.50	BA536	£2.50	HA11714	£5.95	LA4193	£2.95	STK014	£7.25	TA7702P	£6.50	BU508L	£1.50
AN6356N	£2.85	BA546	£2.20	HA11716	£4.75	LA4192	£1.95	STK015	£5.20	TA7703P	£6.50	BU508M	£1.50
AN6357N	£4.95	BA547	£2.50	HA11717	£5.75	LA4201	£1.60	STK016	£6.25	TA7704P	£6.50	BU508N	£1.50
AN6360	£4.50	BA612	£1.80	HA11718	£4.75	LA4220	£1.50	STK020	£5.75	TA7705P	£6.50	BU508O	£1.50
AN6362	£5.50	BA631A	£5.75	HA11724	£9.25	LA4230	£2.25	STK025	£7.50	TA7706P	£6.50	BU508P	£1.50
AN6363	£4.25	BA656	£4.50	HA11727	£9.50	LA4420	£1.75	STK043	£19.50	TA7707P	£6.50	BU508Q	£1.50
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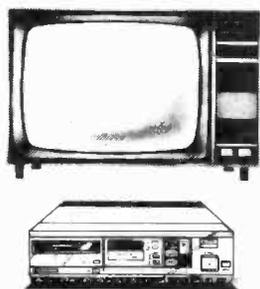
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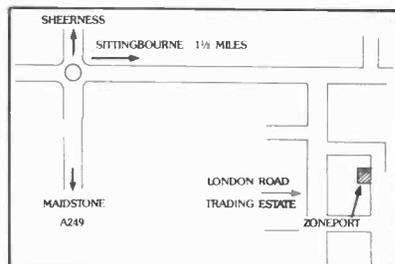
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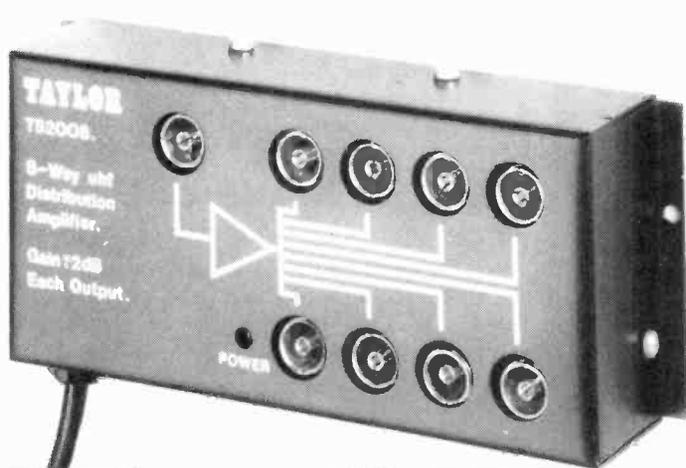
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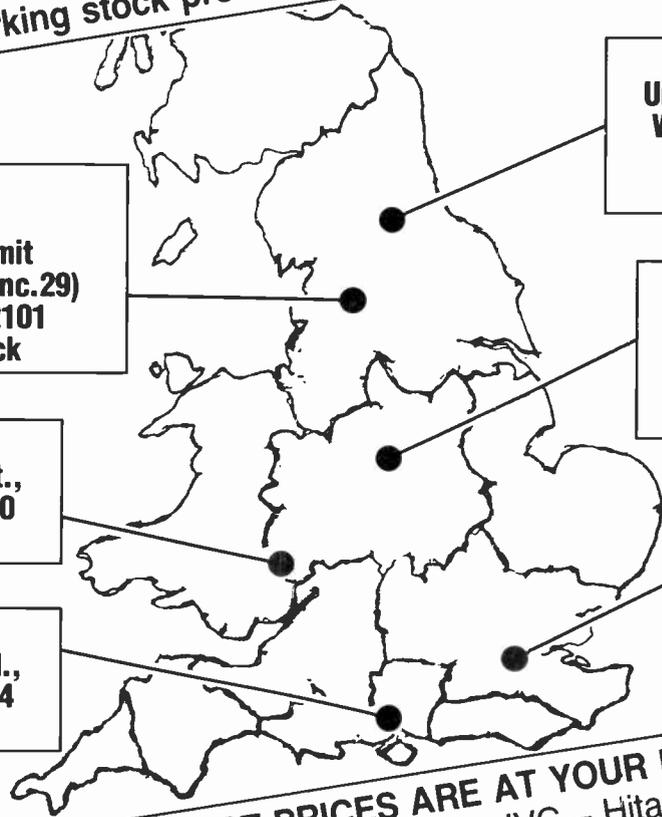
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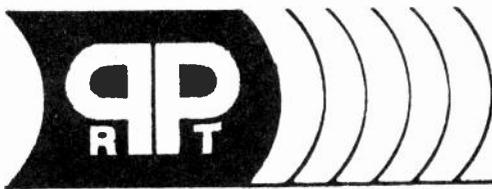
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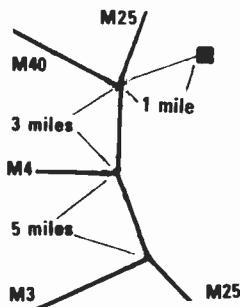
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25A-1104	£2.05	25C-733	£0.25	25C-1815	£0.15	25D-426	£1.50	AN-5738	£1.00	HA-1374	£1.99	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2061	£0.36	
25A-1106	£1.50	25C-738	£0.25	25C-1819	£0.71	25D-428	£1.50	AN-5900	£1.50	HA-1374	£1.99	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2062	£0.36	
25A-1110	£0.45	25C-741	£1.95	25C-1845	£0.15	25D-438	£0.30	AN-6248	£1.20	HA-1377	£2.00	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2063	£0.36	
25A-1142	£2.90	25C-783	£1.10	25C-1875	£2.40	25D-468	£0.25	AN-6249	£1.20	HA-11225	£1.70	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2064	£0.36	
25A-1145	£0.20	25C-789	£0.35	25C-1890	£0.20	25D-476	£0.45	AN-6250	£0.40	HA-11225	£1.70	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2065	£0.36	
25A-1147	£1.90	25C-790	£0.90	25C-1906	£0.25	25D-478	£0.90	AN-6320	£2.00	HA-11235	£1.70	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2066	£0.36	
25A-1156	£0.60	25C-828	£0.15	25C-1913	£0.90	25D-525	£0.75	AN-6338	£5.00	HA-11244	£1.65	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2067	£0.36	
25A-1180	£1.80	25C-829	£0.15	25C-1914	£0.15	25D-526	£0.75	AN-6341	£2.80	HA-11251	£0.80	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2068	£0.36	
25A-1220	£0.45	25C-839	£0.25	25C-1922	£2.50	25D-600	£0.90	AN-6342	£1.50	HA-11423	£2.10	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2069	£0.36	
25A-1232	£1.80	25C-929	£0.15	25C-1941	£0.40	25D-612	£0.40	AN-6360	£2.80	HA-12002	£1.70	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2070	£0.36	
25A-1262	£1.55	25C-930	£0.15	25C-1942	£2.70	25D-613	£0.65	AN-6551	£1.00	HA-12413	£1.30	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2071	£0.36	
25A-1265	£1.30	25C-941	£0.25	25C-1986	£0.45	25D-669	£0.45	AN-6651	£0.45	HA-12413	£1.30	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2072	£0.36	
25A-1303	£1.50	25C-945	£0.15	25C-2003	£0.25	25D-716	£0.85	AN-6884	£0.90	HA-12411	£1.60	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2073	£0.36	
25B-324	£0.45	25C-959	£0.60	25C-2022	£0.38	25D-718	£1.25	AN-6912	£1.25	LA-1207	£1.25	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2074	£0.36	
25B-337	£1.50	25C-998	£0.60	25C-2073	£0.75	25D-733	£2.30	AN-7060	£1.25	LA-1207	£1.25	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2075	£0.36	
25B-407	£1.30	25C-1012	£0.80	25C-2120	£0.06	25D-745	£2.40	AN-7105	£1.60	LA-1385	£1.20	TIP-31C	£0.22	TIP-31C	£0.22	V-8600	£1.45	RC-2076	£0.36	
25B-492	£0.30	25C-1018	£0.75	25C-2229	£0.25	25D-748	£1.50	AN-7110	£1.20	LA-										

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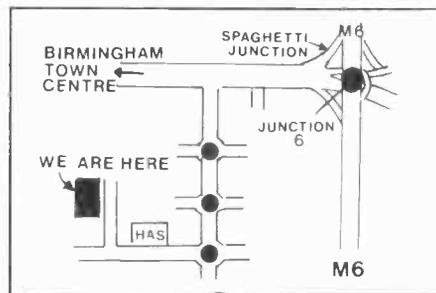
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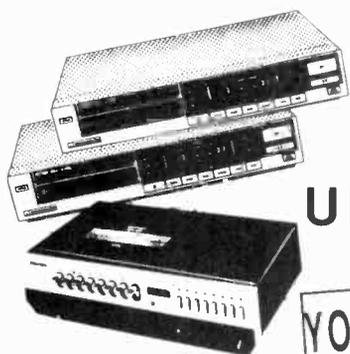
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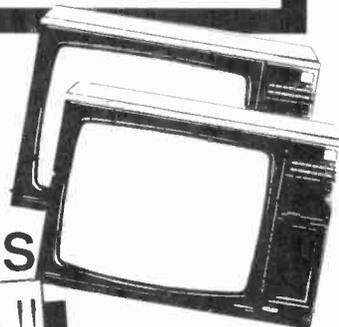
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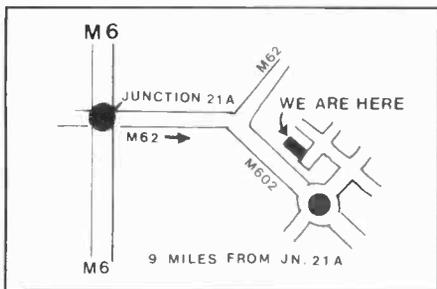


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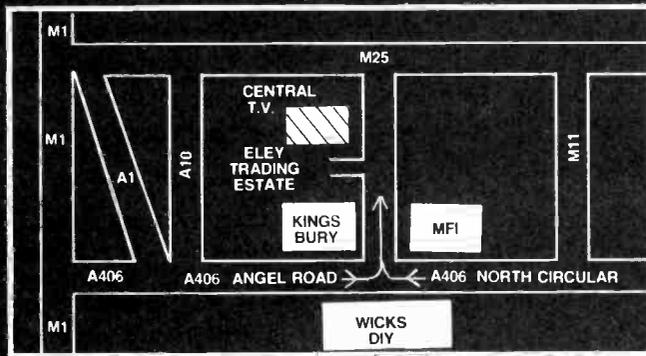
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WORKING TV & VIDEO

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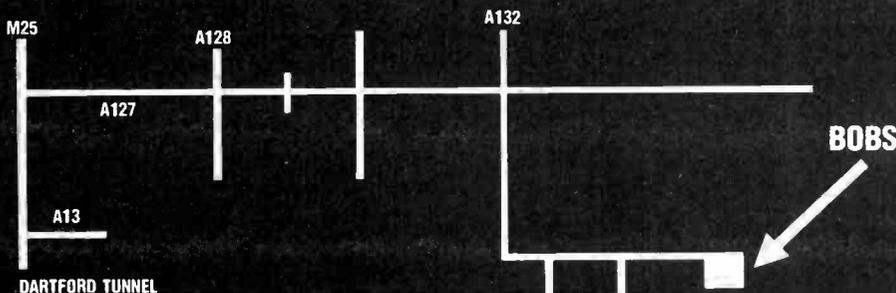
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THORN-3V23
3V29
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AT ROCK BOTTOM PRICES

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Make Thorn, Decca, GEC, etc.

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T26	X	5	16	20	17	X
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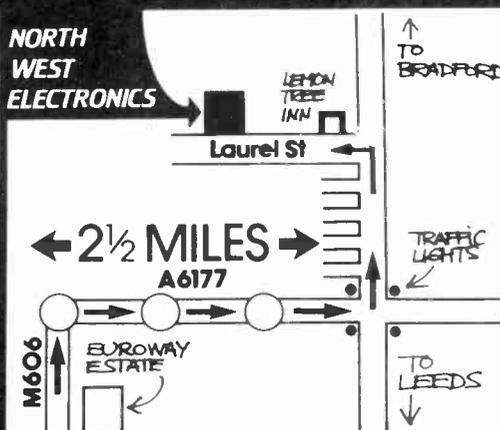
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 BASIC FROM £
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SONY — SANYO — TOSHIBA

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 and Video's
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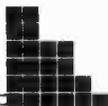
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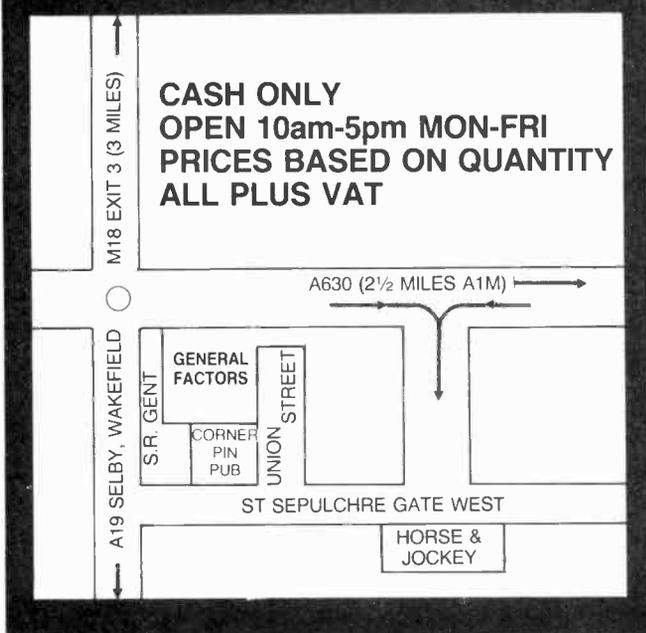
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Sylvania UHF F-4720B	£6.00
Sylvania VHF 900	£6.00
Small Tuner DX 175-220MHz	£5.00
Auto Changeover	£5.00
9000 Thorn Tuner on Panel	£7.00
THORN 1400 4P B. Mech. Tuner	£7.00
THORN 1500 4P B. Mech. Tuner	£7.00
THORN 1500 4P B. Mech. Tuner	£7.00
THORN 3500 4P B. Mech. Tuner	£7.00
All new & boxed	£4.00 each
TDK T9006A	50p
Delay Lines	£1.00
KT 31 Lumence	75p
Lumence Delay Line (CVC 45)	15p
Co-Ax Joint	12p
Co-Ax Belling Lee Plug	12p
Co-Ax Splitter	£1.00
UHF Modulator CCR	£3.00
Infra Red Emitting Diode	20p
NE2261 Small Neon Lamps GEC & Philips	5p
Mullard 5 Watt Amps. LP1162 New	75p

T.V. Tubes		S.W. Filters	
5" NE-C140ANB31	£9	SW2013	50p
12" 90P	£10	SW453	50p
12" 110P (No Post)	£10	SW153A	75p
12" 1410 (30/50 with coils)	£10	SW154	50p
12" A31/300 Hitachi	Post £2.50 £5	SW173	50p
		F1035B	50p

BD646	50p	BD646	50p
BD676A	30p	BD676A	30p
BD807	20p	BD807	20p
BD826	50p	BD826	50p
BD930	30p	BD930	30p
BD948	30p	BD948	30p
BD131A	50p	BD131A	50p
BDX75	20p	BDX75	20p
BDX64B	50p	BDX64B	50p
BDU65	50p	BDU65	50p
BF 761	30p	BF 761	30p
BF 769	30p	BF 769	30p
BF 788	30p	BF 788	30p
BF 819A	30p	BF 819A	30p
BF 888	30p	BF 888	30p
BF 871	30p	BF 871	30p
BF R39	15p	BF R39	15p
BF R53	7p	BF R53	7p
BF R79	15p	BF R79	15p
BF R81	15p	BF R81	15p
BF R87	10p	BF R87	10p
BF S60	10p	BF S60	10p
BF T42	20p	BF T42	20p
BF T47	20p	BF T47	20p
BF W11	30p	BF W11	30p
BSD215	50p	BSD215	50p
MRI366	20p	MRI366	20p
BRC-ME200	40p	BRC-ME200	40p
BRC-NE300	50p	BRC-NE300	50p
BRG 1693	£1.00	BRG 1693	£1.00
BRG 3064	£1.00	BRG 3064	£1.00
BT1822	£1.00	BT1822	£1.00
BT16016	£1.20	BT16016	£1.20
BT16018 MI 237B	£1.50	BT16018 MI 237B	£1.50
BT16218	£1.50	BT16218	£1.50
BT18124	£1.00	BT18124	£1.00
BT18224	£1.00	BT18224	£1.00
BU122A	£1.00	BU122A	£1.00
CA270AF	50p	CA270AF	50p
CA270CW	50p	CA270CW	50p
CA270CF	50p	CA270CF	50p
CA270AF	£1.00	CA270AF	£1.00
CA3140	50p	CA3140	50p
CA 3046	50p	CA 3046	50p
CA 3065Q	50p	CA 3065Q	50p
CA 3094AF	50p	CA 3094AF	50p
CA 3123	40p	CA 3123	40p
CA 3146	40p	CA 3146	40p
CA 3189	40p	CA 3189	40p
CB116848	50p	CB116848	50p
CD4510	30p	CD4510	30p
CD4555H1	30p	CD4555H1	30p
CM7192	40p	CM7192	40p
EA1106	50p	EA1106	50p
EA1370	£2.00	EA1370	£2.00
EA1423	40p	EA1423	40p
EA11440	50p	EA11440	50p
EA11484	£4.00	EA11484	£4.00
EA14758	50p	EA14758	50p
EA14801	50p	EA14801	50p
EA14811A	10p	EA14811A	10p
EA14811B	10p	EA14811B	10p
EA14811C	10p	EA14811C	10p
EA14811D	10p	EA14811D	10p
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EA14811F	10p	EA14811F	10p
EA14811G	10p	EA14811G	10p
EA14811H	10p	EA14811H	10p
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EA14811J	10p	EA14811J	10p
EA14811K	10p	EA14811K	10p
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EA14811M	10p	EA14811M	10p
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EA14811CH	10p	EA14811CH	10p
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EA14811DF	10p	EA14811DF	10p
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EA14811DI	10p		