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MARCH 1988

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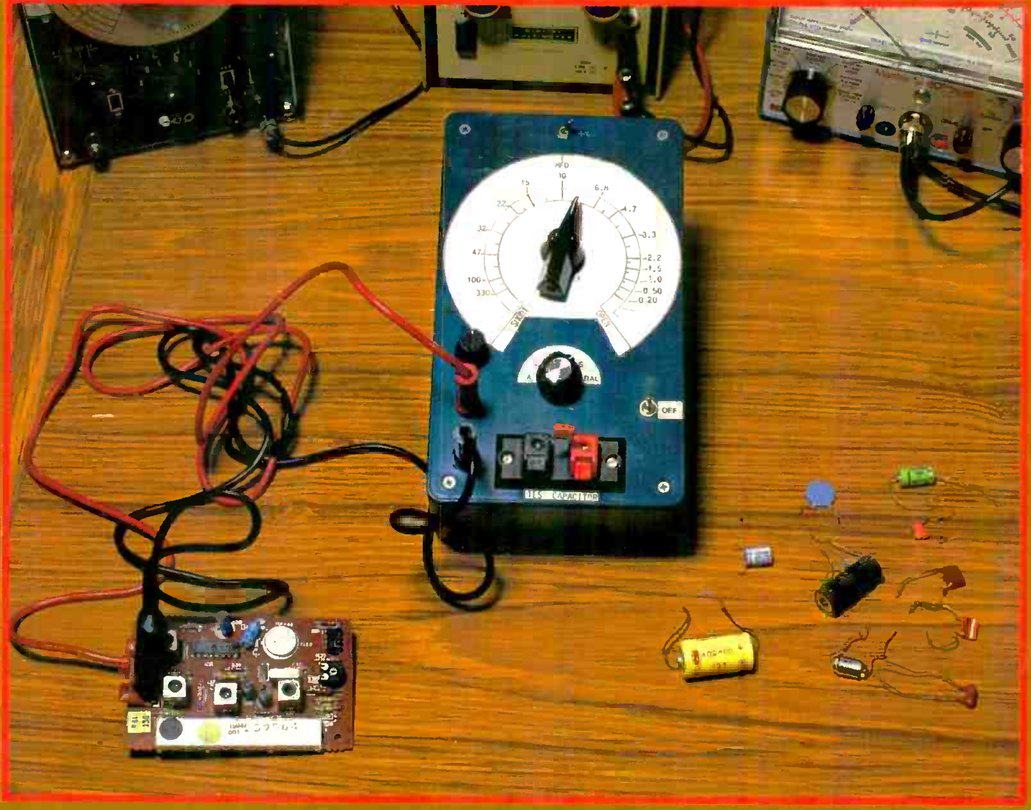
TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS

Free this month
Instrument Screwdriver



Wide-range Capacitance Bridge
A Low-cost TVRO Installation
The Art of Fault Finding
Fast-shutter Video Cameras
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TV Fault Finding • VCR Clinic

TELEVISION

March 1988

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On sale February 17th

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

SUBSCRIPTIONS
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BACK NUMBERS
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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

OUR NEXT ISSUE DATED APRIL WILL BE PUBLISHED ON MARCH 16

P. V. TUBES

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BOOKS AND MANUALS ARE ZERO V.A.T.
Goods are despatched on the day we receive your order. If for any reason we are out of stock we will try to inform you as quickly as possible We try our best to give a speedy, fair and efficient service. V A.T invoice on request Give us a ring – we'll give you service. Please ask if what you need is not listed – we will try to help Prices are subject to change without notice In some cases we may have to supply an equivalent.

SPECTRUM 48K SPARES

ULA6C001	7.80
128K ROM	6.20
RAM 4116-2 (150n)	1.10
CPUZ80	1.70
LM1889	2.00
T14532 use 4164/4564	1.60
OK13732 while stocks last	3.00
ZTX213	0.17
ZTX313	0.27
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Xtal 4.4336 19MHz	0.80
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7805 Voltage Regulator	0.78
74LS00	0.58
74LS32	0.90
74LS157	0.78
Modulator (UM1233)	2.20
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Reset Pot 2.2k	0.15
Trimmer 50pf Max.	0.32
Keyboard Membrane	2.25
Keyboard Template	1.50
Keyboard Conn. 5 Way	0.17
Keyboard Conn. 8 Way	0.35
Double Sided Tape 40cm	0.35
Double Sided Tape Roll	5.75
PSU 1400	0.85
Power Socket	0.32
Power Plug	0.40
Jack Sock. (Ear/Mic)	0.15
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Lower Case	2.00
Feet Each	0.06
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Screw 9.5mm (Qty 4)	0.15
Spectrum Upgrade Kit	23.65
without resets	22.95

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74LS04	0.58
ZX8401 = PCF 1306	4.50
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Clamp Long	0.15
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Spring (Each)	0.15
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ZX81 SPARES

ULA 2C210E	3.95
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RAM 2114	2.31
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Resistor Pack 5×10K	0.27
Resistor Pack 8×10K	0.27
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Screw 2.2mm × 9.5mm (4Pk)	0.15
Feet (Each)	0.06

COMMODORE ICs

6510 CPU	5.66
6526 CIA Keyboard Int.	5.11
6561	7.74
6569 Col Vid. Cont	20.77
6581 Sound Gen	7.79
901225 Char ROM	3.37
901226 Basic ROM	6.45
901227 Kernel ROM	3.52
906114 PLA	4.51
4164 RAM	1.60
Timer 555	46
8501	3.50
8701 Clock Chip	5.46

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2764	3.20
27128	4.95
27256	5.90
4116	1.10
4164	1.60
6264	2.75
6522	4.00
Z80A CPU	1.70
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ZTX213	17
ZTX313	27
ZTX650/1	35
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AN6341N	8.97
AN6344	7.85
AN6360	6.81
BA521	1.50
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CA555	46
CA556	84
CA741	25
CA748	45
CA1532	4.20
CA3065	1.80
DIC141WF	30
CV12E	3.07
GH3F	1.82
HA1137	3.20
HA1151	3.89
HA1342	5.58
HA1306N	2.60
HA1366WR	1.50
HA1377	3.65
HA11219	4.21
HA11244	4.04
HA11741	23.22
IS1555	43
LA3350	95
LA4031P	3.21
LA4032P	1.30
LA4102	1.10
LA4112	3.25
LA4422	1.20
LA7801	2.20
LC7130	5.93
LC7120	5.87
LC7137	5.50
LM1011	3.25
LM8361 = MM5387ANN	4.15
M293	7.10
M50790SP	6.98
M54544L	3.80
MC13002	4.98
MC14493	8.97
MN1219	11.43
MB3712	2.60
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MC1327	1.70
MC1330P	1.84
MC1351P	2.93
MC1349	1.99
MC1350	1.50
MC1352	1.75
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ML231 ETTR6016	2.20
ML232	2.20
ML237	2.50
ML238	6.00
ML922	3.29
ML923	2.90
MSM5807	7.87
MS1513L	2.80
MS1515L	3.28
SAA1025	8.50
SAA1124	5.34
SAA1250	4.99
SAA5000	6.15
SAA5010	6.30
SAA5012	6.50
SAA5020	5.90
SAA5030	8.25
SAA5050	8.50
SAF1032	6.30
SAF1039	7.77
SAS560S	2.07
SAS570S	2.07
SAS660	3.25
SAS670	3.25
SAS580	2.90
SAS590	2.90
SG-264A	5.12
SG629	8.05
SG-6533	13.20
SL901B	7.00
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SL1310	1.80
SL1327Q	1.20
SL1430	1.58
SL1432	3.36
SL76544	2.05
SL490	1.89
SN76709	8.00
SN76115N	2.27
SN76131N	2.00
SN76226DN	2.72
SN76533N	1.70
SN76033N	2.49
SN76544N	2.35
SN76660N	80
SN76666N	1.52
SN76530A	1.47
STK015	7.36
STK435	9.06
STK436	6.50
STK437	6.00
STK439	8.40
STK459	9.50
STK441	11.57
STK461	12.60
STK465	12.60
STK463	14.30
STK2129	17.27
STK4352	6.00
STR441	6.50
STR454	4.73
STR451	6.50
STR6020	5.80
SW153	3.90
TA7050P	95
TA7051P	95
TA7063P	2.20
TA7074P	3.46
TA7108P	3.43
TA7120P	2.43
TA7129AP	3.76
TA7130P	1.93
TA7146P	4.67
TA7193P	5.67
TA7171P	8.90
TA7172P	8.90
TA7173P	8.90
TA7176P	2.00
TA7202P	4.27
TA7204P	1.35
TA7205AP	3.72
TA7208P	1.44
TA7210P	6.60
TA7222	1.20
TA7223P	3.74
TA7227P	5.98
TA7228P	5.98
TA7310P	2.78
TA7609P	4.39
TA7611AP	2.70
TAA570	3.98
TAA310	2.83
TAA320	2.00
TAA550	55
TAA630	3.90
TBA120SA	1.49
TBA120B	1.30
TBA120SB	1.37
TBA120T	1.47
TBA120U	1.49
TBA1440G	2.50
TBA395	50
TBA396	67
TBA440N (TBA1441)	2.75
TBA440P (TBA1440G)	2.50
TBA480Q	1.82
TBA510	3.00
TBA520(Q)	1.10
TBA530(Q)	1.00
TBA540	1.10
TBA560(Q)	1.10
TBA570	1.79
TBA690	1.50
TBA700	2.12
TBA720	2.64
TBA750	2.98
TBA800	1.62
TBA810AS	58
TBA820	1.70
TBA820M	1.25
TBA890	3.94
TBA920(Q)	1.20
TBA950(2X)	1.08
TBA970	4.09
TBA990	1.10
TCA760	2.30
TCA270SQ	2.50
TCA800	5.95
TCA830	3.44
TCA900	2.20
TCA910	2.20
TCA940	90
TCP4621AF6	13.87
TDA440	2.20
TDA1002	1.95
TDA1003A	5.50
TDA1006A	2.50
TDA1005	3.60
TDA1010	3.30
TDA1011	4.00
TDA1035	4.70
TDA1037	2.95
TDA1044	4.37
TDA1060A	4.44
TDA1083	1.68
TDA1170S	3.00
TDA1190	3.50
TDA1190P	3.50
TDA1180	2.91
TDA1236	3.44
TDA1270	3.95
TDA1327	1.70
TDA1352B	1.60
TDA1412	95
TDA1415	1.40
TDA1470	4.67
TDA1770	5.60
TDA1908A	1.95
TDA2002	75
TDA2003	1.00
TDA2004	1.60
TDA2006	1.45
TDA2010	2.40
TDA2140	5.95
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TDA2020	4.66
TDA2030	2.80
TDA2270	1.65
TDA1870	6.46
TDA2523	3.40
TDA2524	2.25
TDA2525	4.00
TDA2530	2.70
TDA2532	2.90
TDA2540	95
TDA2541	3.84
TDA2560	1.15
TDA2576A	3.75
TDA2577	4.73
TDA2578A	5.12
TDA2581	3.95
TDA2582	2.60
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	2.00
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	5.84
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
UPC1167C2	2.70
UPC1168C	3.20
UPC1176C	2.53
UPC1177H	3.15
UPC1178C	4.21
UPC1180C	1.84
UPC1181H	1.00
UPC1182H	1.00
UPC1183H	2.48
UPC1185H	3.45
UPC1186H	1.60
UPC1188H	4.99
UPC1190G	1.20
UPC1198C	4.00
UPC1200V	1.18
UPC1211V	2.70
UPC1212V	1.34
UPC1215V	1.66
UPC1216V	1.20
UPC1217G	2.24
UPC1218H	1.80
UPC1223C	2.20
UPC1225H	2.00
UPC1226C	1.50
UPC1227V	1.20
UPC1230H	4.39
UPC1238	2.50
UPC1245V	1.35
UPC1277	4.81
UPC1350C	4.15
UPC1353C	4.76
UPC1365C	6.38
UPC1356C2	2.08
UPC1367	2.00
UPC1358H	1.88
UPC1360C	2.20
UPC1363C	2.16
UPC1368H2	2.15
UPC1370C2	2.58
UPC1382C	1.08
UPC1384	3.78
UPC1394C	3.07
UPC1447H	58
UPC41C	2.80
UPC577H	2.46
UPC585C	1.28
UPC1167C2	2.70
UPD553C164	20.76
UPD7519G	17.13
UPD7538C020	11.06
UPD546C107	22.28
UPD547C049	11.18
U05G	1.27
V11N	1.27
10E2	43
10VT05	8.74

PRICES DOWN

The prices of the IC's which are underlined have been reduced to prices shown.

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

E.G.

BC327	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

PRICES ARE DOWN AND SERVICE STILL COUNTS!!! WE TRY TO BE FAIR TO YOU THE CUSTOMER SO WE PUT SOME PRICES DOWN!!

Post & Packing 87p + VAT up to 1 kilo weight

VALVES

30FL2	1.70
DY802	98
DY86/7	66
ECC81	1.50
ECC82	98
ECC83	1.07
ECC84	80
ECC85	98
ECC88	1.35
ECF80	1.30
ECF82	88
ECH81	1.60
ECH84	1.66
ECL80	84
ECL82	1.30
ECL86	1.99
EF80	95
EF86	2.20
EF183	99
EF184	1.09
EL90	1.75
EL34	3.50
EL84	1.05
EY86/7	68
EY500A	2.25
EZ80/81	56
GY501	1.45
GZ34	3.50
KT66	9.75
KT77	8.50
KT88 (alt type)	12.00
PC92	4.50
PC97	1.65
PCC85	85
PCC805	1.40
PCF80	1.00
PCF200	1.35
PCF800	1.38
PCF801	1.13
PCF802	1.12
PCF805	1.80
PCF808	1.63
PCH200	1.45
PCL82	1.20
PCL84	1.20
PCL805	1.09
PCL86	92
PFL200	1.86
PL36	1.87
PL81	94
PL95	2.25
6L6GT	2.30
12HG7	3.20
PL504	1.65
PL508	2.90
PL509/19	5.30
PY88	81
PY500A	2.30
PY800/1	69
UCH81	2.25
UCL83	1.82
UY85	1.35
PL802T	4.00
40KD6	5.30
21LU8	3.00
17DW4A	4.50
3AT2B	5.00
12BH7A	3.75

SPECIAL OFFERS

Multimeter HT7000
20,000Ω/V
£10.99

Pocket Meter £7.50

Universal Triplers £4.75

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3.5" MF 2DD DS/DD
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AMSTRAD SPARES

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AM5620X(542)	4.87
AN6320N	2.88
BS326	7.10
CX134	6.00
CX135	4.37
HA1377W/BO8203	3.65
HD74LS136N	1.25
HSF310/3170	11.82
LA6358	3.75
LA7800402	3.75
NC1377P	1.25
NN1512FUC	10.50
MN14847FCD	14.43
MSO120P	2.97
OEC1001	8.87
OEC0005	13.10
OEC1001A	7.50
OEC3002	4.06
SN74HC240N	2.06
TC74HC00	1.68
TC74HC04	1.68
TDA2030	2.80
TDA3652	8.60
TMM41257P-15	13.50
UPC1378H	2.50
UPC5743	3.75
UPC1394C	3.75
UPD8048	0.93
Z8080PU/Z8400AP	1.70
2N7400E	10.00
7293-1951	11.92
40007-4/40008	11.25
74HCUD4P	1.87
74LA00	2.75
74LS27N	0.35
74LS32	0.90
74LS74	0.65
74LS132	3.12
OEC3001A	7.50
HA1137	8.20

TRANSISTORS

BC212	0.07
BC237	0.07
BC239/C	0.93
BC337	0.18
BC547	0.08
KD471CV	0.62
KSC945C-O	0.62
KTA1015Y-BF195	0.93
KTC380	0.93
KTC732	0.93
KTC1015Y	0.93
KTC2120Y	0.93
KTC2229Y	0.93
KTC2230	0.93
TCP850	2.00
ZTX312L	0.93
2N5496	0.53
2SC838C	0.62
2SC950Y	0.93
2SC1317R	0.62
2SC1417H	0.93
2SC1573NC	1.27
2SC1815Y	0.93
2SC2621	1.25
2SC2634S	0.62
2SC3156A	2.46
2SD980	1.56
2SD1159	1.25
2SD1397	2.87
2SD1398	2.46
50033	0.93

WE HAVE OTHER PRODUCTS IN OUR RANGE FOR AMSTRAD AND SPECTRUM

EXPORT ORDERS WELCOME

REMOTE HAND SETS

SAME DAY DESPATCH
FAST – FAIR – EFFICIENT SERVICE

AMSTRAD

1422292	CTV2210	15.00
1422187	CTV2200	15.00
151910	TV/VIDEO	15.00
1409221	CTV1409	15.00
151175	VCR5200	17.00
150583	VCR7000	10.00
150878	VCR9000	10.00

DECCA

80/100	NON TXT	US	16.50
80/10	NON TXT	US8511	19.50
101	NON TXT	US8513	23.50

SONY

C5	RH75T	29.04
C6	RH72	22.62
C7	RHT200	45.00
C9	RHT213	45.00

ITT

305	IR8649	29.04
306	IR8650	22.65
CVC45 RG5	VS8262	25.00
CVC32 RG15	VS8573	25.00

PLEASE NOTE THAT SOME HANDSETS ARE MANUFACTURERS ORIGINALS BUT SOME MAY BE AN ALTERNATIVE TYPE.

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 20R/22R/140R	4 butt.	13.75

THORN/FERGUSON

T723	TX9/10	NON TXT IR	16.50
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

JVC

TP843	TXT IR	13.50

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, C2889H, C2290H	21.00
GCA510870	C2069, C2269H	27.50

GRUNDIG

RTP20/VRC112	TP16-21-21VHR	IR	13.50
RTP05/VRC138	TP8-120-120E	IR	13.50
RTP06/IR107N	TP160-160E	IR	13.50
RTP07/IR380N	TP200-300-390	IR	13.50
RTP400/IR401	TP400VT-500VT	IR	13.50
VRC204	TP12	US	13.50

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
KT3/30 (KONIG) NON TXT IR8331	15.85
KT3/30 (KONIG) TEXT IR8420	17.90
KT3/30/35/40 RC5	25.00

REPAIR KITS – FOIL/BUTTONS/INST.

KT3/K30 WITHOUT TEXT	8.95
KT3/K30 WITH TEXT	8.95

REMOTE CONTROL TESTER 29.94

ORDERS FROM GOVERNMENT ESTABLISHMENTS, SCHOOLS, ETC. WELCOME ON REQUISITION.

★ LOTS OF PRICES DOWN ★

NEW PRC6000

Programmable Remote Control

Will operate most infra-red remote equipment TV-HiFi-UCR etc.

PRC6000

Engineers need only carry 1.

Remote ONLY £52.95

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ACCESS – VISA

EXPORT ENQUIRIES WELCOME

VIDEO TAPE

★ "DOWN IN PRICE" ★

SKC

E60	2.00
E120	2.30
E180	2.45
E240	3.45
L750	2.70

SCOTCH

E30	2.90
E60	3.05
E120	2.89
E180	3.50
L750	3.65
VCC360	6.59
VCC480	7.50

VIDEO SPARES

WE HAVE A LARGER RANGE LISTED UNDER SPECIFIC MANUFACTURERS IN CATALOGUE FOR THORN, SONY, HITACHI, FIDELITY, NATIONAL PANASONIC, PHILIPS.

REFURBISHED HEADS (Exchange)
Equivalents Chart in Catalogue

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

REPLACEMENT VIDEO HEADS

AKAI

VS1	3HSSV	21.95
VS2	3HSSV	21.95
VS3	3HSSV	21.95
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

FERGUSON

3V00	3HSSV	21.95
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

HITACHI

VT6500	3HSSHA	25.50
VT7000	3HSSHA	25.50
VT8000	3HSSHA	25.50
VT8040	3HSSHA	25.50
VT8100	3HSSHA	25.50
VT8500	3HSSHA	25.50
VT8700	3HSSHA	25.50
VT9000E	3HSSHA	25.50
VT9300	3HSSHA	25.50
VT9500S	3HSSHA	25.50
VT9700	3HSSHA	25.50
VT9900	3HSSHA	25.50
VT4000	3HSSH	25.50
VT4200	3HSSH	25.50
VT5000	3HSSH	25.50
VT5500	3HSSH	25.50

ORION

VH1	3HSSN	21.95
VH2	3HSSN	21.95

JVC

HRD110	3HSSV	21.95
HRD111	3HSSV	21.95
HRD120	3HSSV	21.95
HRD121	3HSSV	21.95
HRD220	3HSSV	21.95
HRD225	3HSSV	21.95
HR2200	3HSSV	21.95
HR3300	3HSSV	21.95
HR3320	3HSSV	21.95
HR3330	3HSSV	21.95
HR3350	3HSSV	21.95
HR3360	3HSSV	21.95
HR3660	3HSSV	21.95
HR3860	3HSSV	21.95
HR4000	3HSSV	21.95
HR4100	3HSSV	21.95
HR7200	3HSSV	21.95
HR7600	3HSSV	21.95
HR7610	3HSSV	21.95
HR7650	3HSSV	21.95
HR7700	3HSSV	21.95

NEC

PV760	PS3BS	23.95
PV764	PS3BS	23.95
PV774	PS3BS	23.95
N830	3HSSV	21.95
N831	3HSSV	21.95
N832	3HSSV	21.95
N833	3HSSV	21.95
PV2300	PS3BS	23.95
PV2400	PS3BS	23.95

SONY

SLF1	PS4B2S	29.95
SLC5	PS3BS	23.95
SLC6	PS3BS	23.95
SLC7	PS3BS	23.95
SLC8	PS5B3S	39.95
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
SLF60	PS5B3S	39.95
SLK95	PS5B3S	39.95
SL200	PS5B3S	39.95
SL3000	PS3BS2	25.00
SL8000	PS3BS2	25.00
SL8080	PS3BS2	25.00

NATIONAL PANASONIC

NV100	3HSSU1N	25.99
NV230	3HSSU2N	36.97
NV250	3HSSU2N	36.97
NV270	3HSSU2N	36.97
NV280	3HSSU2N	36.97
NV300	3HSSN	21.95
NV322	3HSSN	21.95
NV330	3HSS3N	35.99
NV333	3HSSN	21.95
NV340	3HSSN	21.95
NV370	3HSSU1N	25.99
NV380	3HSSU1N	25.99
NV390	3HSSN	21.95
NV450	3HSSU2N	36.97
NV470	3HSSU2N	36.97
NV480	3HSSU2N	36.97
NV600	3HSS3N	35.99
NV777	3HSS3N	35.99
NV861	3HSSN	21.95
NV2000	3HSSN	21.95
NV3000	3HSSN	21.95
NV7000	3HSSN	21.95
NV7200	3HSSN	21.95
NV7500	3HSSN	21.95
NV7800	3HSSN	21.95
NV7850	3HSSN	21.95
NV8170	3HSSN	21.95
NV8200	3HSSN	21.95
NV8400	3HSSN	21.95
NV8600	3HSSN	21.95
NV8620	3HSSN	21.95

SHARP

110	3HSSSP	26.95
381	3HSSSP	26.95
383	3HSSSP	26.95
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
2000	3HSSSP	26.95
3300	3HSSSP	26.95
9100	3HSSSP	26.95
9300	3HSSSP	26.95
9400	3HSSSP	26.95
9500	3HSSSP	26.95
9600	3HSSSP	26.95
9700	3HSSSP	26.95

BETA ECCENTRICITY GAUGE £55.00

TOSHIBA

V31	PS3BT	30.00
V33	PS3BT	30.00
V55	3HSSV	21.95
V57	3HSSV	21.95
V5470	PS3BS2	25.00
V9600	PS3BT	30.00

SANYO/FISHER

FVHP615	3HSSSF	35.00
FVHP910	3HSSSF	35.00

PHILIPS

DV462	3HSSU1N	25.99
6460	3HSSU1N	25.99
6520	3HSSU1N	25.99

GENUINE HEADS

SONY 8000UB	49.39
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
SANYO 9300/9435/9500	53.00
SANYO 5000/4700/5300	53.00
PHILIPS V2000/V2023	64.00
PHILIPS 1700	71.00

VIDEO IDLER TYRES

	O.Dia	I.Dia	Width	
SONY	23 7	17 4	4 9	50p
SONY	24 2	18	5 1	50p
HITACHI	31 8	25	4 9	50p
PANASONIC	37	29	3 9	52p
AKAI	26	20	3 9	50p
JVC	39 3	32 8	3 9	56p
JVC	33	23 9	4	56p
NATPAN	31 2	25	3 1	56p

VIDEO PINCH ROLLERS

PANASONIC	NV7000	3.75
SANYO	VTC9300/VBS7000	3.75
SONY	C7/J7/SL17	3.75
JVC	TCE3V00/01/06/16/23/24	3.75
JVC	HR2200/3320/3330/3660/1100/7700	3.75
AKAI	VS9700	3.75
HITACHI	VT5000	3.75
SHARP	VC6300/6500	3.75
SONY	TC6 GEN	3.75

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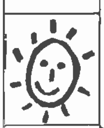

FULL RANGE OF VIDEO LAMPS UNDER SPECIFIC SPARES IN CATALOGUE ★

VIDEO BELT KITS

★ PRICES DOWN ★

VKIT 1	AKAI	9300/9500/9800	2.40
	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	VTC5000	0.95
VKIT 14	SANYO	VTC5300	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	1.47
VKIT 19	HITACHI	VT8000	1.05
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

★ PRICES DOWN ★

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WE HAVE A FULL RANGE OF VIDEO LAMPS AVAILABLE UNDER "SPECIFIC SPARES"

NAT. PAN/SHARP VIDEO LAMP 1.30

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VHS DRUM MOTOR	25.50
VHS CAPSTAN MOTOR	25.50
SANYO REEL MOTOR (5000)	12.95
SHARP REEL MOTOR	19.50
VHS (Gen Purp) THORN JVC TAKE UP CLUTCH ASSY	4.95
SHARP TAKE UP IDLER 0005/GEZZ 0006/GEZZ	2.20
SANYO REEL DRIVE PULLEY	5.10
HITACHI F/F IDLER VT11E/33E	2.90

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CM7261 P.U.	11.80
CM7262 P.U.	12.86
CM7065 UHF/VHF WB	15.05
CM7066 UHF/WB	14.04
CM7068 VHF H.Gain A/B/CD	16.74
CM7253 Behind Set (mains)	15.06
CM7243 Second Set Amp	14.03
CM7093 Three Set Amp	16.83
CM7063 Dist. Amp VHF/UHF	25.77
CM7108 8+1 Dist. Amp	45.42
CM9700 27MHz CB Suppressor	4.90
CM6011 Outdoor Splitter	8.22
CM9003/00 Flush Sing. Outlet	1.95
CM9003/01 Flush Sing. Out Isolat.	2.15
CM9010 Flush Twin Outlet	2.25
CM9034 UHF Filters A/B/CD	8.89
CM9033 6 Way Pass Split	10.72
CM7042 TV Games Combiner	3.24
CM9009 Flush TV/FM Emulator	3.53
CM9006 VHF/UHF Diplexer	4.17
CM7122 Televerta Up VHF to UHF	39.91
CM7057 Televerta Down UHF to VHF	45.21
CM7294 Dist Amp. UHF/VHF	23.78
CM7274 4 Way Dist Amp	21.45
CM7082 UHF/VHF Dist. Amp	68.98
CM7080/10 UHF MHA	15.71
CM7271 UHF Wideband 15db	8.66

BELLS/BOXES

GG1	CHALLENGER PANEL BKII	27.95
A75	SHORROCK ACORN 75 PANEL	32.50
B1	EUROBELL (No. S.A.B.)*	21.00
B2	EUROBELL (with S.A.B.)*	26.95
BV	6V BATTERY FOR EUROBELL	3.75

*Price includes Multi Adaptor to use with "C" type bell boxes

T1	12V BELL (Tan)	12.95
B5	'C' TYPE Polyprop. Boxes (comp)	4.55
B6	'C' TYPE Polycarb. Boxes (comp)	7.80
B12	'C' TYPE DUMMY COVER (no back)	3.25
B13	'C' TYPE Translucent	7.80

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817S	SHORROCK	P.I.R.	22.50
815S	SHORROCK	P.I.R.	41.50
817SM	SHORROCK	P.I.R.	24.15
815SM	SHORROCK	P.I.R.	43.57
01	ORION	P.I.R.	24.00
04	ORION EXTERNAL	P.I.R.	48.00
05	ORION EXTERNAL with built in Floodlight		60.00
SL5	HALOGEN FLOOD with Lamp		17.74
SL5R	SPARE LAMPS SL5		4.50
SL8	INFRASCAN EXTERNAL	P.I.R.	62.94
ST	TASLEY AUTO LANTERN		27.00

WE ARE AUTHORISED DISTRIBUTORS FOR SHORROCK SECURITY PRODUCTS

RECHG. BATTERIES

12V	1.2A	7.23
12V	2.6A	7.87
12V	6A	10.73
12V	1.9A	7.77

S.A.B. MODULES

SHORROCK S.A.B.	8.76
SHORROCK DE LUXE	11.49

PANIC BUTTONS

STND.	2.88
BRASS	3.24

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DON'T BE – IT'S EASY!
TYPICAL PACKAGE FOR 3 BED HOUSE

£120

Includes:
- 2 Zone Panel with connection diagram ★
- Rechargeable Battery ★
- Outside Bell Box with Bell ★
- Inside Multitone Sounder ★
- Roll 6 core cable ★
- 2× Infra Red Detectors ★
- 5 Pairs Window Contacts ★
- Panic Button ★
- Buzzer ★
- Tamper Switch ★

JUST ASK!!

SOUNDERS/SIRENS

S2	712 EXTERNAL SIREN	(116db)	5.75
S4	1010/2010 EXTERNAL SIREN	(116db)	5.96
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
	12V MUSICAL BUZZER		1.56
M801	722 BUZZER		0.60
802	PMB27 BUZZER		0.70

SUNDRIES

XENON FLASHERS

XE1	12 PCL 128 Red/Amber/Blue	6.75
XE3	LOW PROFILE 121PCL Red/Amber/Blue	6.90

TAMPER SWITCHES 2.5" 0.60

SELF CONTAINED ALARM 25.00

CONTACTS

C10	5 TERM FLUSH	0.56
C11	4 WIRE FLUSH	0.62
C12	5 TERM SURFACE	0.59
C13	4 WIRE SURFACE SLIMFIT	0.62
C6	ROLLER SHUTTER CONTACTS	6.10
C9	ROLLER SHUTTER CONTACTS PLASTIC	2.28

PRESSURE MATS

PM1	STAIR MAT	1.20
PM2	STANDARD MAT	1.34

ACCESS VISA

ANTEX

C15 Iron 240v	6.20
C240 Element	2.75
Bits 102, 106, 820, 821	1.10
CS 17W Iron 240v	6.40
CS240 Element	2.75
Bits 1100, 1101, 1106	1.10
XS25W Iron 240v	6.50
XS240 Element	2.75
Bits 50, 51	1.10
Temperature Control 30W Iron CSTC	16.95
40W Iron XSTC	16.95
Unit TCSV1	68.95
Antex Stand	2.10
MLXS Auto Rep. Kit	8.40
Cordless Gas Iron	15.99
Tips for Gas Iron	5.00
Turbo Rech. Iron Kit	16.99

★ NEW WICKMANN WERKE FUSE KITS ★

These are a new range of sub-miniature, circuit protection Fuses, and are used in most modern TVs, Videos, etc. This kit has 170 asstd. plug in Fuses and 10 holders.

Q.8. 250ma 1A, 1.25A, 1.6A, 2A.
A.5. 160ma, 200ma, 315ma, 500ma, 630ma, 800ma, 1A, 1.25A, 1.6A, 2A, 2.5A, 3.15A, 4A.

YOU'LL NEED SOME!! £33.95

WE HAVE A FULL RANGE OF POPULAR SOFTWARE TITLES FOR AMSTRAD – SINCLAIR SPECTRUM – AMIGA – COMMODORE 64 etc. IN OUR COMPUTER SECTION – PLEASE ASK FOR LIST.

SERVISOL

Freeze It	1.34
Super Servisol	1.18
Foam Cleanser	1.18
Plastic Seal	1.26
Silicone Grease	1.46
Silicone Grease (Tubes)	1.82
Aero Klene	1.04
Excel Polish	1.08
Video Head Cleaner	0.96
Super 40	1.80
Fire Extinguisher	3.80
Heat Sink Compound	1.20
Solda Mop Std	0.78
Hylosil Silicone Rubber	2.98
Aero Duster	1.40
Coldklene 110 Degreasing Solvent	1.78
Antistatic Spray	1.18

RECTIFIER TRAYS

Thorn 1500 3 Stick	5.20
Thorn 1500 5 Stick	5.99
Thorn 3500	7.98
Thorn 8000	6.95
Thorn 8500/8800	7.15
Thorn 9000	8.70
Decca 1730/1830	5.48
Decca 30	6.76
Decca 80	7.12
Decca 100	7.50
Decca/Tatung 120/130	6.50
GEC 2100	7.40
GEC 2200 (20AX)	6.50
GEC 2040/2028	6.60
GEC 2110 (pre Jan '77)	7.00
Philips G8 Short Focus Lead	7.12
Philips G8 Long Focus 550	7.12
Philips G9	6.37
Pye/Philips KT3	7.00
Pye 691/3	7.58
Pye 713 4 Lead	8.79
Pye 713 5 Lead	8.79
Pye 731/25	8.75
R.B.M. A823 plug in	8.75
Rank T20/22	7.12
ITT CVC5/9	7.50
ITT CVC20/25/30 (Mullard)	7.12
ITT CVC45	8.65
Universal ★ See Special Offer	
TV 13	1.26
TV 14	1.29
TV 18	1.10
TV 20	1.43

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Hitachi 4 way	12.36
Philips G8 (early)	17.82
Philips G8 (late)	18.97
Philips G11 Tip Switch unit	26.50
Philips KT3	16.67
Philips KT30	13.22
Thorn 9000 6 way	20.60
Pye 697 repair kit	10.35
Pye 725-735 (also Red Mk. 1)	12.60
Pye 725-735 tuning head with PCB	12.50
Decca 4 way	7.93
Decca 6 way	9.17
Decca 4/6 way conversion kit	17.50
Decca 7 way piano key rep. kit	15.62
GEC 2110 6 way	10.92
GEC 6 way slim	10.29
GEC/ITT/PYE 7 way	16.67
GEC Conversion kit	16.50
Rank A823	12.36
Rank T20A	11.21

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Philips 210/300 Mono	10.00
Philips G8	8.75
Philips G9	9.50
Philips KT3	15.95
Philips K30	17.94
Philips TX2	13.39
Philips TX3	14.41
Philips G11	15.58
Pye 713/715	10.00
Pye 725 90°	10.50
Pye 169	10.00
Pye 741	9.90
Bang & Olufson (2000,3000)	14.69
Decca 80	8.58
Decca 100	8.58
Decca 1700	9.00
Decca 1730	8.58
Decca 2230	8.58
GEC 2110	16.75
GEC 2040	9.50
ITT CVC 1/9	10.85
ITT CVC 25/30/32	8.65
ITT CVC 20	8.60
ITT CVC 45	9.50
R.B.M. T20	13.95
R.B.M. BUSHRANGER T16A	10.00
R.B.M. BUSHRANGER T18A	10.00
Thorn 3000 EHT	9.95
Thorn 3000 SCAN	7.95
Thorn 8500	17.50
Thorn 3000/3500 Mains	10.00
Thorn 1615	12.50
Thorn 1691	9.68
Thorn TX9	23.85
Thorn 9600 (Gen Thorn)	21.79
Thorn 9000	25.53

VARICAP TUNERS

ELC1043-05	8.40
ELC 104305 Mullard	12.50
ELC1043-06	8.40
ELC2003	19.50
Philips G8/G9	10.50
Philips G11 (U321)	9.90
TX90	18.34
U322	7.30
U341	9.50
U342	8.50

SEND FOR CATALOGUE

Push Button (Cont.)

ITT CVC 8/9 (mod)	13.80
ITT 6 way with VCR	8.90
Thorn 8500	6.50
GEC 7 B/P c neons	10.50

AERIAL EQUIPMENT

10 Ele. UHF	1.62
3 Ele. VHF	6.70
4 Ele. VHF	8.03
Omnidirect (Round) F.M.	8.93

SET TOP AERIALS

Olympic II	2.30
Loop Aerial	1.00
Anti-Silver Sensor	7.40
Anti-Super Set Top	6.50
Anti-Caratenna	7.20
Anti-Traveller	11.50

FULL RANGE LISTED IN CATALOGUE.

NOTE:

Most aerial equipment has to be sent by carrier (not set tops) £7.50 + VAT

NEXT DAY DELIVERY

TELEPHONE ACCESSORIES

Phone Ext. Kit	7.50
Cable Ext. Kit	5.95
Ext. Socket Surface	1.68
Ext. Socket Flush	1.75
Cable Tidy	0.99
5m Ext. Lead	2.95
3m Ext. Lead	2.23
Dual Adaptor	2.50
4 Way Line Plug	0.25
Line Cord (4 Spade)	1.35
I.D.C. Inserter	0.35
Tone Ringer	5.50
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- ★ Restores tubes with low emission.
- ★ Checks shorts/leakages.
- ★ Indicates tracking between guns.
- ★ Checks "life" of tubes.
- ★ Repairs shorts between cathode and G1.

only £345 + VAT

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Solder Sucker Nozzles	81
Solda Mop Stnd.	77
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AA119	9p
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AC127	21p
AC128	21p
AC128K	26p
AC141K	30p
AC142K	30p
AC153K	23p
AC176	22p
AC176K	28p
AC187	21p
AC187K	28p
AC188	21p
AC188K	28p
ACY18	48p
ACY19	48p
AD142	100p
AD149	60p
AD161	35p
AD162	35p
AD164	200p
AF124	50p
AF125	50p
AF126	50p
AF127	50p
AF139	30p
AF239	30p
AF201	70p
AL100	450p
AL112	300p
AM150	28p
AM151	30p
AM154	35p
AM156	35p
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ASZ15	100p
ASZ17	100p
AU113	800p
BA145	10p
BA148	10p
BA154	6p
BA157	12p
BAY78	250p
BAY82	20p
BB101	13p
BB103	16p
BB105B	18p
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BC107	8p
BC108	8p
BC109	8p
BC109C	10p
BC115	10p
BC118	11p
BC140	20p
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BC183L	7p
BC184	7p
BC184L	7p
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BC213	7p
BC213L	7p
BC214	7p
BC214L	7p
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BC238	7p
BC300	20p
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BC302	20p
BC303	20p
BC327	7p
BC328	7p
BC337	7p
BC338	7p
BC446	8p
BC449	15p
BC489	20p
BC490	18p
BC516	22p
BC528	22p
BC537	25p
BC546	8p
BC547	8p
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BC556	8p
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BC559	8p
BC560	8p
BC637	20p
BC638	20p
BCY32	200p
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BD245	50p
BD278	50p
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BD332	40p

BD370	30p
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BD440	40p
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BD442	40p
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BD679	40p
BD680	40p
BD681	45p
BD682	45p
BDX32	100p
BDX65	80p
BDW23	55p
BDW24	55p
BDY20	100p
BDY92	100p
BF137	35p
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BF178	30p
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BF195	7p
BF196	8p
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BF198	10p
BF199	8p
BF200	16p
BF240	16p
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BF472	28p
BF479	30p
BF493	18p
BF494	16p
BF506	25p
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BF615	30p
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BF869	22p
BF870	22p
BF871	22p
BF872	23p
BF960	38p
BF961	35p
BF963	40p
BF964	38p
BF966	40p
BFR40	25p
BFR51	21p
BFR62	21p
BFR79	25p
BFR90	52p
BFR91	99p
BFR94	500p
BFT37	130p
BFT42	30p
BFT43	30p
BFW84	30p
BFW92	35p
BFX29	20p
BFX84	20p
BFX85	20p
BFX87	15p
BFX88	15p
BFX89	60p
BFY17	30p
BFY18	40p
BFY41	28p
BFY50	14p
BFY51	14p
BFY52	14p
BFY56	25p
BFY57	25p
BFY64	25p
BFY90	45p
BLY48	85p
BLY49	85p

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BR101	43p
BR103	37p
BRY39	55p
BRY49	38p
BRY56	33p
BSS74	33p
BSX20	15p
BSX26	18p
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BT100A	70p
BT106	120p
BT109	90p
BT116	80p
BT119	100p
BT120	100p
BT138	60p
BT146	99p
BT151	58p
BTY79	140p
BU100A	110p
BU104	100p
BU105	80p
BU108	100p
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BU111	140p
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BUX85	65p
BUY69A	200p
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MEO411	38p
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ME6002	15p
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ME9021	12p
MJ10012	300p
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MJ15002	300p
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MJ15004	370p
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MJ2501	110p
MJ2955	55p
MJ3000	115p
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MJE30A	30p
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MJE520	30p
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MP8111	40p
MP8112	45p
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MPSA06	15p
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MPSA70	15p
MPSA92	20p
MR510	35p
MR856	36p
MRF479	350p
MV1622	80p
MV209	48p
MV2209	48p
OC28	250p
OC29	250p
OC35	250p
OC36	250p
OC45	50p
OC71	30p
OC72	50p
OC200	180p
OT121	120p
R2008B	100p
R2010B	100p
R2030	100p
R2306	55p
S2800D	52p
S2800M	72p
T2800D	52p
T2800M	72p
TAG4442	76p
TAG4443	76p
TAG4444	76p
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TIP30	25p
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TIP31A	24p
TIP31C	30p
TIP32	24p
TIP32A	24p
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TIP42A	22p
TIP42C	25p
TIP47	40p
TIP48	40p
TIP50	60p
TIP51	120p
TIP52	120p
TIP53	120p

TIP54	140p
TIP105	65p
TIP106	65p
TIP107	65p
TIP110	47p
TIP111	50p
TIP112	40p
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TIP142	90p
TIP145	65p
TIP146	90p
TIP147	100p
TIP2955	42p
TIP3054	45p
TIP3055	42p
TIS43	45p
TIS44	40p
TIS61	15p
TIS88A	45p
TIS90	15p
TIS91	18p
TIS93	20p
VK1010	88p
VN.10KM	60p
VN.46AF	88p
VN.66AF	100p
VN.88AF	115p
VN.89AF	110p
Y723	75p
Y827	75p
Y860	22p
Y969	65p
ZTX107	11p
ZTX108	11p
ZTX109	12p
ZTX212	27p
ZTX300	13p
ZTX301	16p
ZTX302	16p
ZTX303	24p
ZTX304	17p
ZTX320	29p
ZTX326	29p
ZTX500	13p
ZTX501	13p
ZTX502	18p
ZTX503	18p
ZTX504	25p
ZTX550	24p
2N.696	26p
2N.697	22p
2N.698	40p
2N.699	45p
2N.706	22p
2N 708	22p
2N.914	28p
2N.918	36p
2N.930	18p
2N.1131	28p
2N.1132	28p
2N.1613	24p
2N.1711	24p
2N.1893	30p
2N.2102	50p
2N.2160	300p
2N.2218A	24p
2N.2219	24p
2N.2221	23p
2N.2222	23p
2N.2369	15p
2N.2484	20p
2N.2646	40p
2N.2904	20p
2N.2905	20p
2N.2906	18p
2N.2907	18p
2N.2926	8p
2N.3019	28p
2N.3053	18p
2N.3054	40p
2N.3055	38p
2N.3055H	50p
2N.3440	58p
2N.3442	85p
2N.3525	150p
2N.3583	90p
2N.3585	120p
2N.3702	9p
2N.3703	9p
2N.3704	9p
2N.3705	9p
2N.3706	9p
2N.3707	9p
2N.3708	9p
2N.3710	12p
2N.3711	12p
2N.3771	85p
2N.3772	90p
2N.3773	110p
2N.3799	18p
2N.3819	29p
2N 3866	68p
2N.3903	11p
2N.3904	11p
2N.3905	11p
2N.3906	11p
2N.4031	25p
2N.4036	25p
2N.4037	25p
2N.4058	13p
2N.4058	13p
2N 4062	12p
2N.4064	100p
2N.4240	150p
2N.4248	130p
2N.4401	12p
2N 4403	12p
2N.4443	76p
2N.4444	76p
2N.4904	75p
2N.5061	20p
2N.5062	28p
2N.5088	20p
2N.5163	45p
2N.5192	50p
2N.5241	500p
2N.5245	45p
2N.5294	30p
2N.5296	30p
2N.5303	200p
2N 5320	90p
2N.5321	60p
2N.5366	25p
2N.5401	12p
2N.5448	12p
2N.5496	80p
2N.5777	40p
2N.6106	40p
2N.6107	40p
2N.6109	40p
2N 6254	110p
2N.6292	40p
2N.6384	120p
2N.6385	120p
2N.6403	160p
2N.6649	140p

3N.128	55p
3N.143	65p
DIODES	
AA119	9p
BY100	40p
BY103	32p
BY126	6p
BY127	8p
BY133	8p
BY164	40p
BY176	85p
BY179	35p
BY182	32p
BY184	32p
BY187	32p
BY196	20p
BY206	11p
BY207	11p
BY208	18p
BY210	22p
BY223	72p
BY225	120p
BY226	18p
BY227	19p
BY228	32p
BY296	20p
BY298	26p
BY299	28p
BY476	90p
BYX10	15p
BYX55/350	30p
BYX55/600	30p
BYX55/800	32p
BYX70/300	29p
BYX70/500	32p
BYX70/800	36p
BYX71/600	80p
OA47	6p
OA90	6p
OA91	8p
OA200	7p
OA202	7p
IN.914	2p
IN.4001	4p
IN 4002	4p
IN.4003	4p
IN.4004	4p
IN.4005	4p
IN.4006	4p
IN.4007	5p
IN.4148	2p
IN.5400	9p
IN.5401	10p
IN.5402	10p
IN.5403	11p
IN 5404	11p
IN.5405	12p
IN.5406	13p
IN.5407	13p
IN.5408	13p
LOW PROFILE SOCKETS	
8pin	6p
14pin	8p
16pin	9p
18pin	12p
20pin	14p
22pin	16p
24pin	18p
28pin	20p
40pin	25p
ZENERS	
400MV	
BYZ88 RANGE	
2V7 to 39V	6p
1.3W	
BZX61 RANGE	
2V7 to 39V	12p
VOLTAGE REGULATORS	
7805	35p
7812	35p
7815	35p
7818	35p
7824	35p
7905	35p
7912	40p
7915	40p
7918	40p
7924	40p
78L05	28p
78L12	28p
78L15	28p
78L18	28p
78L24	28p
79L05	40p
79L12	45p
79L15	48p
7818KC	100p
7824KC	100p
LM309K	100p
LM317K	220p
LM317T	180p
LM323K	420p
LM723	40p
78HGKC	570p
78HO5KC	800p
78H12KC	700p
78GU1C	190p
79GU1C	215p
79HGKC	800p
VALVES	
DAF96	60p
DF96	50p
DL92	60p
DY86	50p
DY87	60p
DY802	75p
EABC80	60p
E891	44p
EBF80	45p
EBF89	50p
ECC82	80p
ECC83	80p
ECC84	70p
ECC85	80p
ECH81	100p
ECH84	70p
ECL80	65p
ECL82	80p
ECL84	70p
ECL85	70p
ECL86	90p
EF80	65p
EF85	65p
EF89	85p
EF183	75p
EF184	85p
EL34	250p
EL36	90p
EL84	75p
EL95	85p
EL500	100p
EL504	130p
EY86	45p
EY87	45p
EY88	65p
EZ35	65p
EZ80	70p
EZ81	55p
GZ34	200p
PC97	100p
PCC85	60p
PCF80	80p

PCF200	135p
PCF801	110p
PCF802	80p
PCF806	115p
PCH200	100p
PCL81	62p
PCL82	80p
PCL84	50p
PCL85	80p
PCL86	80p
PCL805	80p
PFL200	110p
PL36	120p
PL82	60p
PL83	60p
PL84	80p
PL95	180p
PL500	110p
PL504	120p
PL508	200p
PL519	450p
PY81	90p
PY88	70p
PY500A	190p
LINEAR IC'S	
AN-124	230p
AN-127	250p
AN-136	250p
AN-203	210p
AN-210	165p
AN-214Q	170p
AN-228	280p
AN-234	450p
AN-235	450p
AN-236	235p
AN-238	400p
AN-239Q	400p
AN-240P	150p
AN-241	135p
AN-245	290p
AN-247	230p
AN-252	150p
AN-259	250p
AN-262	140p
AN-270	200p
AN-271	230p
AN-272	480p
AN-274	250p
AN-294	380p
AN-295	340p
AN-301	330p
AN-303	250p
AN-304	360p
AN-305	320p
AN-306	800p
AN-313	270p
AN-315	210p
AN-316	350p
AN-318	460p
AN-331	295p
AN-360	100p
AN-362	140p
AN-366	150p
AN-610	160p
AN-612	160p
AN-3320K	900p
AN-5151	600p
AN-5430	280p
AN-5612	400p
AN-5620	330p
AN-5712	350p
AN-5722	140p
AN-5730	160p
AN-5732	160p
AN-5753	170p
AN-6100	425p
AN-6120	400p
AN-6135	150p
AN-6300	600p
AN-6320	300p
AN-6330	380p
AN 6340	830p
AN-6341	350p
AN-6344	440p
AN-6350	610p
AN-6359	810p
AN-6360	400p
AN-6362	480p
AN 6371	510p
AN-6387	560p
AN-6430	390p
AN 6431	400p
AN 6677	550p
AN-6811	130p
AN-6876	270p
AN-6884	240p
AN-7105	210p
AN-7110	130p
AN-7114	150p
AN-7115	150p
AN-7116	130p
AN-7120	130p
AN-7130	110p
AN-7222	300p
AN-7310	90p
AN-7311	90p
AN-7410	250p
AN-7420	250p
AN-7140	450p
AN-7145	195p
AN-7146	210p
AN-7154	180p
AN-7156	240p
AN-7158	310p
AN-7168	260p
AN-7178	270p
AY3-1015	290p
AY3-1270	800p
AY3-1350	450p
AY3-8910	360p
AY3-8912	400p
AY5-3600	570p
BA-301	65p
BA-302	90p
BA-308	100p
BA-311	80p
BA-313	60p
BA-314	100p
BA-318	120p
BA-333	100p
BA-340	150p
BA-401	60p
BA-402	60p
BA-501	450p
BA-511	160p
BA-514	160p
BA-516	150p
BA-521	160p
BA-524	240p
BA-526	220p
BA-527	140p
BA-532	140p
BA-534	290p
BA-535	600p
BA-536	210p
BA-612	160p
BA 658	380p
BA-684	400p
BA-685	400p
BA-1310	160p
BA-1320	110p
BA-1330	160p
BA-1360	160p
BA 4403	220p
BA-5101	500p
BA-5102	250p
BA-5402	250p
BA-5406	280p
BA 6104	250p

BA-6135	250p
BA-6208	250p
BA-6304	190p
CA-3011	110p
CA-3012	150p
CA-3014	250p
CA-3018	75p
CA-3019	75p
CA-3020	190p
CA-3023	190p
CA-3028A	95p
CA-3035	230p
CA-3036	240p
CA-3043	240p
CA-3045	360p
CA-3046	60p
CA-3048	190p
CA-3052	190p
CA-3054	95p
CA-3059	300p
CA-3060	280p
CA-3065	210p
CA-3080E	60p
CA-3085	135p
CA-3086	55p
CA-3088E	200p
CA-3089Q	250p
CA 3130E	80p
CA-3130S	100p
CA-3134E	38p
CA-3160	85p
CA-3161E	140p
CA-3162E	450p
CA-3189E	230p
CA-3193E	230p
CA-3240E	90p
CA-3260E	170p
CA-3290E	150p
CX-108	750p
CX-130	450p
CX-136	610p
CX-139A	1150p
CX-143A	580p
ER-1400	200p
HA-1125	150p
HA-1137W	160p
HA-1144	380p
HA-1156	110p
HA-1197	150p
HA-1199	160p
HA-1306W	170p
HA-1319	240p
HA-1338	300p
HA-1339A	350p
HA-1342	350p
HA-1366WR	160p
HA-1367	300p
HA-1368	160p
HA-1371	300p
HA-1372	300p
HA-1374	230p
HA-1377	210p
HA-1388	320p
HA-1389	210p
HA-1392	230p
HA-1394	280p
HA-1397	250p
HA-1398	240p
HA-1452	120p
HA-1457	120p
HA-11221	210p
HA-11223	340p
HA-11225	170p
HA-11226	410p
HA-11235	210p
HA-11701	310p
HA-11703	390p
HA-11705	620p
HA-11710	340p
HA-11715	560p
HA-11724	800p
HA-13001	260p
HA-13008	800p
ICL-7016	650p
ICL-7017	950p
ICL-7611	90p
ICL-7660	240p
ICM-7555	60p
ICM-7556	130p
LA-1111	180p
LA-1150	150p
LA-1201	80p
LA-1210	140p
LA-1222	80p
LA-1230	130p
LA-1231	210p
LA-1352	120p
LA-1364	200p
LA-1365	120p
LA-1368	220p
LA-1369	260p
LA-1385	170p
LA-1460	220p
LA 2000	150p
LA-2100	260p
LA-2101	270p
LA-2200	190p
LA-3100	125p
LA-3101	160p
LA-3120	125p
LA-3155	100p
LA-3160	120p
LA-3201	80p
LA-3210	65p
LA-3300	140p
LA-3301	110p
LA-3350	110p
LA-3361	100p
LA-3375	300p
LA-4030	180p
LA-4031	140p
LA-4032	140p
LA-4050	130p
LA-4100	100p
LA-4101	90p
LA-4102	120p
LA-4110	160p
LA-4112	160p
LA-4120	270p
LA-4125	200p
LA-4126	240p
LA-4135	250p
LA-4137	180p
LA-4140	70p
LA-4160	220p
LA-4180	300p
LA 4182	190p
LA-4190	300p
LA-4192	180p
LA 4200	130p
LA-4201	120p
LA-4210	150p
LA-4220	120p
LA 4230	175p
LA 4250	260p
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LA 4422	130p
LA-4430	130p
LA-4440	230p
LA-4445	260p
LA-4450	150p
LA-4460	170p
LA-4461	180p
LA-4500	230p

LA-4505	260p
LA-4507	360p
LA-4508	260p
LA-4510	160p
LA 4520	230p
LA-5112	120p
LA-5700	300p
LA-7520	500p
LA-7800	180p
LA 7801	280p
LA-7802	300p
LA-7803	400p
LA-7805	400p
LA-7806	260p
LA-7820	250p
LA-7910	150p
LAP-512	310p
LAG-552	200p
LAG-552	200p
LAG-600	200p
LAG-634D	30p
LAM-508	200p
LC-7120	280p
LC-7130	280p
LC-7131	260p
LC-7132	400p
LC-7137	450p
LF-347	110p
LF-351	45p
LF-353	48p
LF-355	60p
LF-356	60p
LF-357	70p
LF-398	300p
LM-301	26p
LM-307	42p
LM-308CN	70p
LM-310	220p
LM-311	35p
LM-318	120p
LM-319	165p
LM-324	35p
LM-325	45p
LM-334Z	115p
LM-335Z	120p
LM-336	140p
LM-337	250p
LM-339	37p
LM-348	55p
LM-358	45p
LM-377	220p
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LM-381	150p
LM-382	130p
LM-383	300p
LM-384	130p
LM-386	85p
LM-387	100p
LM-389	150p
LM-391	160p
LM-392	100p
LM-393	55p
LM-394CH	370p
LM-558	160p
LM-709DIL	30p
LM-710	45p
LM-711	85p
LM-723	40p
LM-725CN	380p
LM-733	60p
LM-741DIL	18p
LM-741MET	45p
LM-747	58p
LM-748	35p
LM-1458	33p
LM-1889	400p
LM-3900	40p
LM-3909	80p
LM-3911	160p
LM-3914	250p
LM-3915	255p
LM-3916	290p
LM-856C	300p
LM-016H	3200p
M-5155	150p
M-50120	600p
M-51102	290p
M-51316B	540p
M-51513L	160p
M-51514	160p
M-51515BL	220p
M-51516	260p
M-51517L	260p
M-51518	200p
M-54836	600p
MB-3705	150p
MB 3712	140p
MB-3722	310p
MB-3730	240p
MB-3731	300p
MB-3756	230p
MB-3759	200p
MB-8719	360p
MC-1310P	130p
MC-1327	70p
MC-1413	65p
MC-1455	45p
MC-1458	33p
MC-1469	290p
MC-1488	65p
MC-1489	65p
MC-1494	670p
MC-1495	285p
MC-1496	65p
MC-1569	210p
MC-3302	70p
MC-3401	45p
MC-3403	60p
MC-3423	75p
MF-10	295p
ML-920	480p
ML-922	380p
NE-531	115p
NE-544	170p
NE-555	20p
NE-556	40p
NE-564	380p
NE-565	110p
NE-566	130p
NE-567	115p
NE-570	360p
NE-571	290p
NE-592	85p
NE-5532P	140p
NE-5533P	150p
NE-5534P	110p
SAS-560	110p
SAS-570	110p
STK-011	370p
STK-013	700p
STK-014	700p
STK-015	490p
STK-016	800p
STK-020	540p
STK-022	700p
STK-025	700p
STK-041	700p
STK-043	980p
STK 050	1450p
STK 077	600p
STK 078	620p
STK 080	710p
STK 082	720p
STK-086	910p
STK-430	500p
STK-433	490p

STK-435	510p
STK-436	490p
STK-437	600p
STK-439	550p
STK-441	740p
STK-443	740p
STK-457	580p
STK-459	610p
STK-460	720p
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STK-463	780p
STK-465	800p
STK-501	580p
STK-563	480p
STK-0025	420p
STK-0029	430p
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STK-0040	560p
STK-0049	570p
STK-0050	570p
STK-0059	620p
STK-0060	900p
STK-0070	1100p
STK-0080	690p
STK-1039	550p
STK-1040	700p
STK 1049	800p
STK 1070	1200p
STK-2025	800p
STK-2028	650p
STK-2029	500p
STK-2129	610p
STK-2139	800p
STK-2230	580p
STK-3041	600p
STK-3042	580p
STK-3062	600p
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STK-4352	700p
STK-5315	650p
STK-7308	800p
STK-8250	700p
STK-4833	1200p
STR-440	520p
STR-441	480p
STR-451	500p
STR 6020	600p
T2800D	52p
TA-7054	190p
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TA-7066	120p
TA-7072	300p
TA-7073	200p
TA-7089	300p
TA-7108	130p
TA-7109	220p
TA-7119	150p
TA-7120	55p
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TA-7137	83p
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TA-7212	300p
TA-7213	200p
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TA-7225	300p
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TA-7227	190p
TA 7229	300p
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TA-7238	400p
TA-7240	260p
TA-7241	260p
TA-7245	450p
TA-7247	800p
TA-7269	850p
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TA-7271	400p
TA-7299	400p
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TA-7313	110p
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TA-7320	300p
TA-7324	200p
TA-7325	90p
TA-7328	200p
TA-7335	200p
TA-7357	400p
TA-7358	200p
TA-7401	400p
TA-7607	270p
TA-7608	360p
TA-7609	270p
TA-7611	280p
TA-7614	230p
TA-7621	520p
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TA-7640	150p
TA-7641	170p
TA-7658	130p
TA-7668	160p
TA-7688	250p
TAA-550	20p
TBA-120S	50p
TBA-395	60p
TBA-396	70p
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TBA-540	120p
TBA-560	120p
TBA 750	120p
TBA-800	40p
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TBA-820	65p
TBA-920	120p
TBA-950	120p
TBA-990	120p
TC-9109	500p
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TCA-830	90p
TCA-940	100p
TDA-1170	100p
TDA-1412	100p
TDA-2002	80p
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TDA-2532	120p
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TDA-2560	120p
TDA-2575A	100p
TDA-2600	580p
TDA 2690	100p
TDA 4600	260p
TEA1002	650p
TLO61	40p
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TLD71	38p
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TLO83	67p
TLO84	80p
UCN5801A	560p
ULN-2002	70p
ULN-2003	69p
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ULN-2803	130p
ULN-2804	170p
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UPC1383	250p
UPC1384	260p
UPC1394	170p
UPC1397	450p
UPC1470	200p
ZN-423	100p
ZN-424	100p
ZN-425	320p
ZN-426	260p
ZN-427	560p
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2SA-1012	130p
2SA-1015	30p
2SA-1102	200p
2SA 1103	200p
2SA 1104	220p
2SA 1105	250p
2SA 1106	250p
2SB 022	80p
2SB 324	55p
2SB-370	45p
2SB-616	190p
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2SB-951	190p

2SC-461	30p
2SC 495	60p
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2SC-828	25p
2SC-945	40p
2SC-1060	99p
2SC-1061	200p
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2SC-1161	110p
2SC-1172	150p
2SC-1173	80p
2SC-1213	70p
2SC-1214	50p
2SC-1279	30p
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2SC-1342	130p
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2SC-1384	70p
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2SC-1509	110p
2SC-1675	100p
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2SC-1758	30p
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2SC-2611	65p
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2SC-3293	85p
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2A/200V	33p
2A/400V	37p
2A/600V	43p
2A/800V	43p
3A/200V	43p
3A/400V	43p
3A/600V	44p
6A/200V	80p
6A/400V	72p
25A/100V	150p
25A/200V	165p
25A/400V	185p
25A/600V	200p
25A/800V	240p
35A/100V	185p
35A/200V	200p
35A/400V	220p
35A/600V	230p
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2716	200p
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2764	240p
27C64	550p
27128	350p
27256-25	400p
41256-15	300p
256DRAM	300p
4116	75p
4164	110p
6116	160p
6264-15	250p
6502	300p
6502A	400p
65CO2	930p
6503	570p
6520	170p
6522	330p
6530	1050p
6532	460p
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6551	530p
6800	210p
6802	220p
6803	800p
6808	500p
6809	600p
6810	150p
6818	380p
6820	140p
6821	140p
6840	310p
6845	620p
6850	110p
8080A	400p
8085A	300p
8155	360p
8156	360p
81LS95	120p
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8224	270p
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8228	270p
8243	250p
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8255	310p
8256	1200p
8257	350p
8259	360p
8271	3400p
8272	1200p
8279	450p
8282	300p
8283	400p
8284	440p
8287	360p
8288	650p
8748	1100p
8755	1400Pp
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74S188	175p
74S189	210p
74S201	240p
74S287	190p
74S288	160p
74S289	180p
74S387	200p
75107	80p
75108	80p
75109	110p
75110	80p
75112	140p
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75154	110p
75158	140p
75159	200p
75160	400p
75161	400p
75162	700p
75172	720p
75182	100p
75183	100p
75188	60p
75189	60p
75195	185p
75322	130p
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HR-3300/3600	(9)	£2.20
HR-3330	(7)	£2.20
HR-3360/3660	(7)	£1.90
HR-7200	(3)	£1.40
HR-7700	(3)	£1.40
NATIONAL		
NV-333	(5)	£1.60
NV-2000	(5)	£1.55
NV-3000	(6)	£1.80
NV-7000	(5)	£1.50
NV-8600	(7)	£2.00
SONY		
SL-C7/SL-JL	(6)	£1.95
SANYO		
VTC-5300	(5)	£1.90
VTC-5500	(3)	£1.10
VTC-9300	(4)	£2.40
HITACHI		
VT-5000	(7)	£1.95
VT-8000	(3)	£1.10
VT-11	(5)	£2.20
TOSHIBA		
V-5475	(6)	£1.90
V-7540	(5)	£1.90
V-8600	(6)	£1.50
SHARP		
VC-7300	(5)	£1.60

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12V CCW	£2.90
12V CW	£2.90
13.2V CW	£2.90
13.2V CCW	£2.90

CASSETTE TAPE HEADS

MONO HEAD	£1.30
STEREO HEAD	£2.20
MONO MINI HEAD	£2.50
AUTO REVERSE HEAD	£2.60

VIDEO MOTORS

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REEL MOTOR (RM11) P/N 4-529V-10800	£8.00
CAPSTAN MOTOR 4-527V-51000	£24.00
SONY	
CAPSTAN MOTOR BHF-1100D	£23.00
SHARP	
REEL MOTOR RMOTV 1007 GEZZ	£17.50
REEL MOTOR RMOTV 1008 GEZZ	£17.50
LOADING MOTOR RMOTM 1017	£10.00
JVC	
CAPSTAN MOTOR PU-55371V	£22.00
CAPSTAN MOTOR PU-45979	£22.50
DRUM MOTOR PU-46414	£22.50
TOSHIBA	
CAPSTAN MOTOR 70125101	£28.00

IDLERS & PULLEYS REPLACEMENTS

SANYO	
REEL PULLEY 143-0-662T-01201	£5.20
SONY	
REW PULLEY A-6706-348-B	£4.00
REW PULLEY A-6706-391-A/B	£3.00
SHARP	
IDLER SHARP NIDL0005 GEZZ	£2.25
HITACHI	
IDLER ASSEMBLY 6886971	£3.00
IDLER ASSEMBLY V-6861482	£3.85
JVC	
IDLER ASSEMBLY PU-47752	£5.00

VIDEO PINCH ROLLERS

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NV-7000	£4.75
SANYO	
VTC-9300	£4.75
VTC-5500	£4.75
SONY	
SL-T7	£4.75
SL-C7	£4.75
JVC	
HR-3300	£5.00
HR-3330	£5.00
HR-3360/3660	£5.00
HR-7200	£5.00
AKAI	
VS-9700EG	£3.60
HITACHI	
VT-5000	£4.75
SHARP	
VC-6300/6500	£5.00

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Price per pack is **£1.00.*** Order 12 you may choose another free. Items marked (sh) are not new but guaranteed ok.

1 – 5 13 amp ring main junction boxes
2 – 5 13 amp ring main spur boxes
5 – 3 flush electrical switches
7 – 4in flex line switches with neons
8 – 2 80 watt brass cased elements
9 – 2 mains transformers with 6V 1A secondaries
10 – 2 mains transformers with 12V ½A secondaries
11 – 1 extension speaker cabinet for 6½" speaker
12 – 5 octal bases for relays or valves
13 – 12 glass reed switches
14 – 4 OCP 70 photo transistors
16 – 4 tape heads, 2 record, 2 erase
17 – 1 ultrasonic transmitter and 1 ditto receiver
18 – 2 15000 mfd computer grade electrolytics
19 – 2 light dependent resistors
20 – 5 different micro switches
21 – 2 mains interference suppressors
22 – 2 25 watt crossover units 2 way
23 – 1 40 watt 3 way crossover unit
28 – 1 6 digit counter mains voltage
30 – 2 Nicad battery chargers
31 – 1 key switch with key
32 – 2 humidity switches
34 – 96 × 1 metre lengths colour-coded connecting wires
36 – 2 air spaced 2 gang tuning condensors
37 – 2 solid diaelectric 2 gang tuning condensors
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 × 12V DC or 24V AC, 4 CO relays
51 – 1 × 12V 2 CO very sensitive relay
52 – 1 12V 4 C relay
55 – 1 locking mechanism with 2 keys
56 – 1 Miniature Uniselector with circuit for electric jigsaw
57 – 5 Dolls House switches
60 – 5 ferrite rods 4" × 5/16" diameter aerials
61 – 4 ferrite slab aerials with L&M wave coils
62 – 4 200 ohm earpieces
63 – 1 Mullard Thyristor trigger module
64 – 10 assorted knobs ¼ 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 ¾" stack – ¼" shaft
86 – 2 5" ali fan blades fit ¼" shaft
87 – 2 3" plastic fan blades fit ¼" 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 2½ hours delay switch
103 – 1 6V mains power supply unit
104 – 1 4½V mains power supply unit
105 – 1 5 pin flex plug and panel socket
107 – 1 5" speaker size radio cabinet with handle
109 – 10 ¼" 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 teak 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 × 95mm, average depth 45mm
241 – 1 car door speaker (very flat) 6½" 15 ohm made for Radiomobile
243 – 2 speakers 6" × 4" 15 ohm 5 watt made for Radiomobile
266 – 2 mains transformers 9V ½A 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 2¼in. 60ohm loudspeakers
454 – 2 2¼in 8ohm 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 l.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 1½" 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

3½ floppy Disk Drive, made by the Chinon 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 3½ and 5¼ drives. Brand new with copy of makers manual. Offered this month at **£28.50** post and VAT included.

CASE – adaptable for 3" or 3½" 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 4P8 price **£8** or with case **£11**.

MULLARD UNILEX AMPLIFIERS

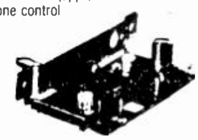
We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules – i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for **£6.00** plus £2 postage.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

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" × 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" × 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 M24/306W. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and EHT 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 3½" and 5¼" 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 snip 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 ETI and similar circuits. Will refresh your home, office, shop, workroom etc. Makes you feel better and work harder – a complete mains operated kit, case included **£11.50** + £3 P&P.

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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 & B/card orders accepted. Brighton (0273) 734648 or 203500.

NEW ITEMS

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

SUPER WATER PUMP – Approx ⅓hp 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 8¼" x 4¾" plated steel – with ample perforations to cooling. Front panel has on/off switch and E.E.C. 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. 5P111

MINIATURE BCD 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 fsd – centre zero scaled 0 to –10 and 0 to +10 Price £1 each Ref. DB602

LARGE 2 SPEED MOTOR – 1hp at 2500rpm and ¼hp 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 5P109

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 "Bootiful" 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 (6½" × 4" × 2" approx.). 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. 10P34

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 move 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 d.p.d.t. and latching. Price – 2 for £1. Ref. BD607

WIRE BARGAIN – 500 metres 0 7mm solid copper tinned 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.

TELEVISION

EDITOR

John A. Reddihough

Please note that the telephone numbers below are for contact with the advertisement departments only. Editorial enquiries should be sent to the editor at the address given on page 321.

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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.

The Japanese Onslaught

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 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.

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,(0082)	;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		

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 chose 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 . . .

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 2,000μF. 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.

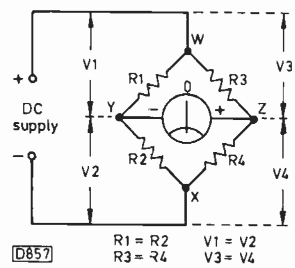
Because bench space is always at a premium the instrument has been designed for compactness: it measures 7·5 × 4·33 × 2·22in. (19 × 11 × 5·6cm). Battery operation was chosen for three main reasons. First so that the instrument can be carried easily for field servicing, without the need to hunt around 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 × (standard R/ratio 2).

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



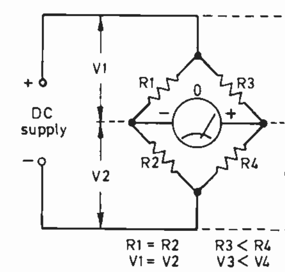
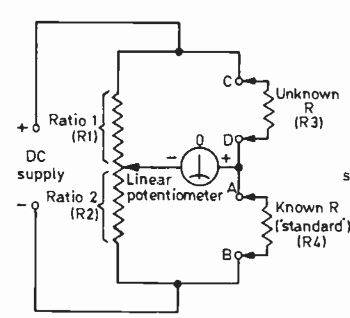


Fig. 1 (left): Wheatstone bridge in the balanced condition.

Fig. 2 (right): Unbalanced Wheatstone bridge.



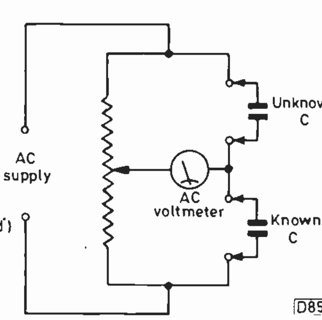


Fig. 3 (left): Wheatstone bridge with balance potentiometer.

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

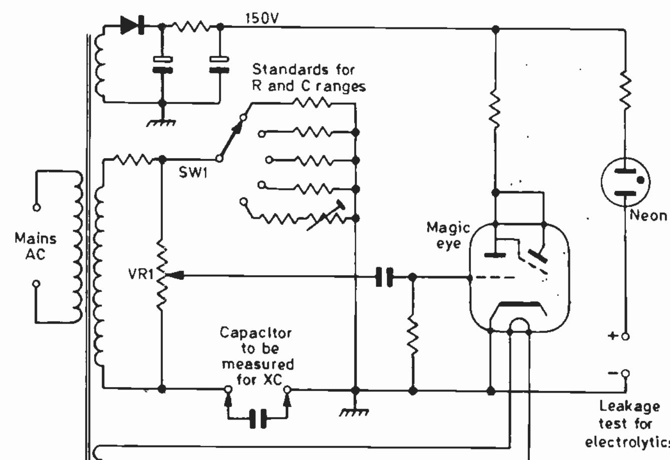


Fig. 5: Basic circuit arrangement used in the Hunt's Capacitance Analyser.

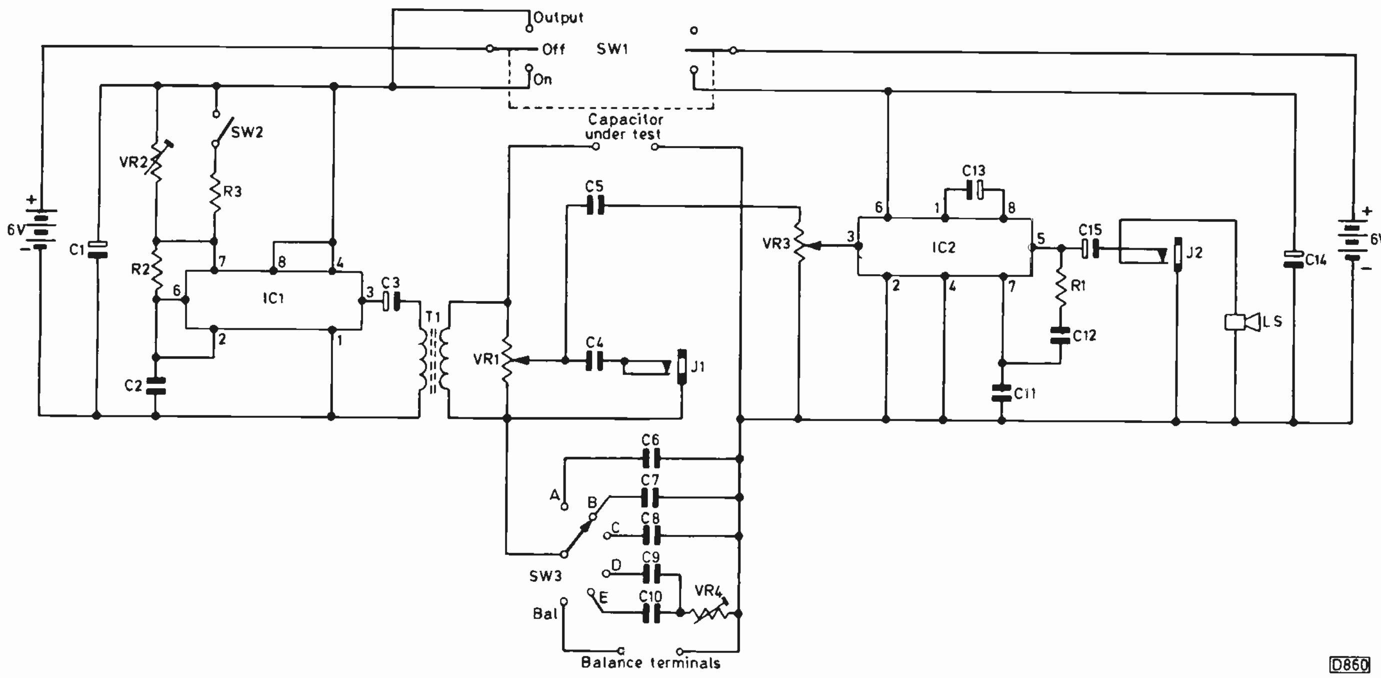


Fig. 6: Circuit of the wide-range capacitance bridge.

(10/20) = 40, i.e. the value of the unknown resistor is 40 Ω. 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 Xc that's given by the equation Xc = 1/(2 × 3·14159 × f × 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 1μF capacitor is 3,180Ω and that of an 0·1μF capacitor 31,800Ω. These instruments usually had a range of 0·0001 – 100μF and about 5Ω – 10MΩ, 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 C2 (0·1μF), R2 (1kΩ) and the setting of VR2. With SW2 in the open position the frequency is 146Hz. When SW2 is closed R3 is connected in parallel with VR2 and the frequency is increased to approximately 456Hz.

The squarewave oscillator's output is applied to the primary winding of transformer T1, whose secondary feeds the bridge. VR1 is the calibrated balance potentiometer while capacitors C6-C10 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 100kΩ, 10kΩ, 1,000Ω, 100Ω, and 10Ω as the standard balancing resistors. Fig. 7 shows the additional circuitry. The range covered is from 1MΩ 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.

VR1 is a linear, wirewound 10kΩ 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 C5 and the preset gain potentiometer VR3 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 VR4 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 J1 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.

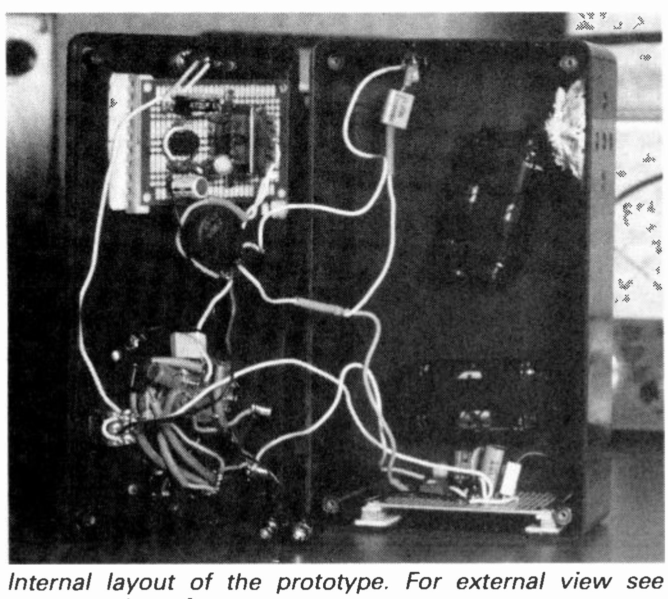
Fig. 8 shows the recommended layout for the controls and the terminals – the positions were chosen to avoid unwanted circuit coupling. The i.c.s are mounted on two separate experimenters' "perfboards", Tandy catalogue no. 276-150. Each perfboard is held in place securely with double-sided sticky pads (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 scale as shown it's essential to fit the specified RS Components 10kΩ 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.



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

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 0·1μF, 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 3·3μF and 0·002μF – 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 0·1μF, 47 stands for 0·47μF, 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 0·01μF. Scale numbers in μF divided by 1,000.

Range C: Centre scale 0·1μF. Scale numbers in μF divided by 100.

Range D: Centre scale 10μF. Scale reads in μF directly.

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

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

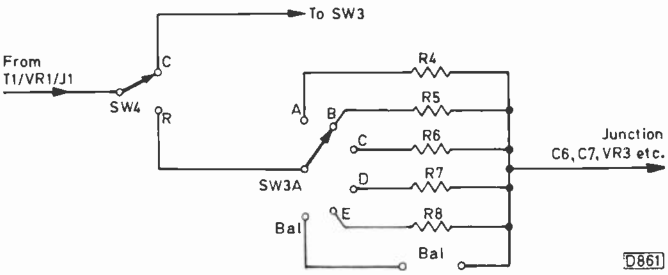


Fig. 7: Extra components required to add resistance ranges. SW3/SW3a comprise a two-pole, six-way switch.

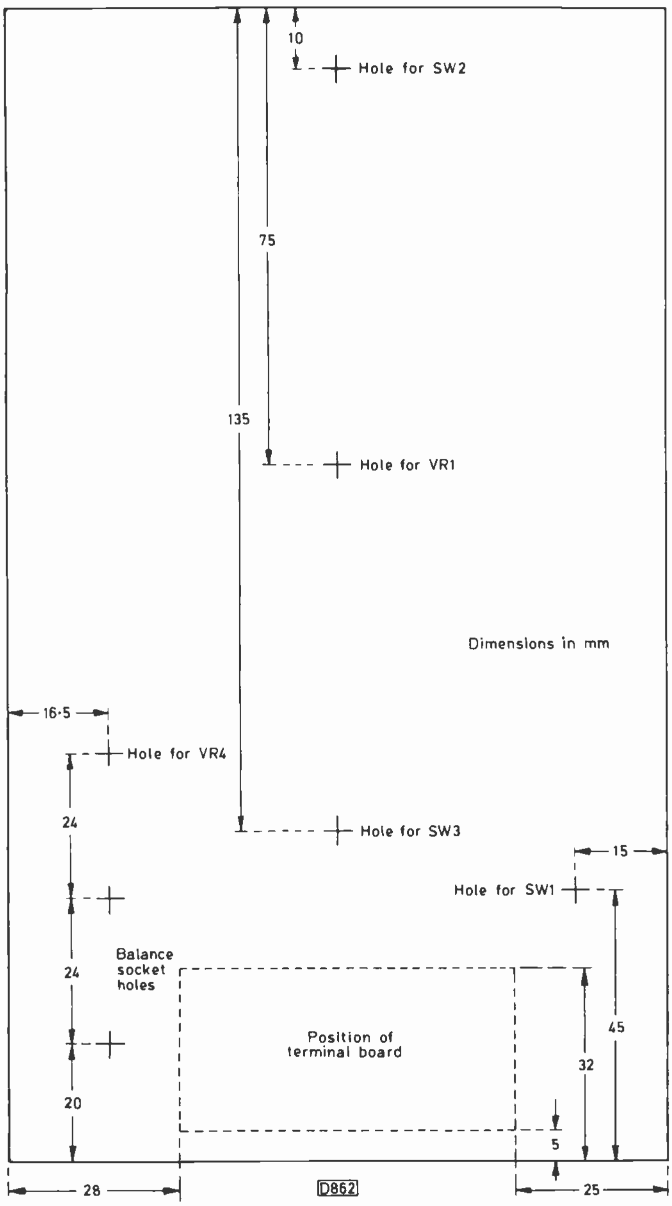


Fig. 8: Suggested drilling details for the case top. Hole sizes depend on the components used.

Table 1: Components for precise calibration.

Capacitors: 3·3μF, 1μF, 0·47μF, 0·33μF, 0·22μF, 0·15μF, 0·1μF, 0·068μF, 0·047μF, 0·033μF, 0·022μF, 0·015μF, 0·01μF, 0·005μF, 0·002μF, 10pF (silver mica 2%), 5pF (silver mica 2%).

Use range C. Divide scale numbers by 100.

Resistors: 3·3kΩ, 1kΩ, 470Ω, 330Ω, 220Ω, 150Ω, 100Ω, 68Ω, 47Ω, 33Ω, 22Ω, 15Ω, 10Ω, 5Ω, 2Ω.

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

Components List

R1	10Ω	0·25W
R2	1kΩ	0·25W
R3	39kΩ	0·25W
VR1	10kΩ	1W linear wirewound, RS173-237
VR2	470kΩ	miniature horizontal preset
VR3	10kΩ	miniature horizontal preset
VR4	1kΩ	miniature linear panel-mounting control
C1	470μF	25V tubular electrolytic
C2	0·1μF	150V tubular
C3	10μF	25V tubular electrolytic
C4	0·1μF	150V tubular
C5	0·05μF	150V tubular
C6	100pF	1% silver mica, RS 124-780
C7	0·01μF	polystyrene, RS 113-409
C8	0·1μF	100V epoxy cased ceramic plate, RS 125-733
C9	10μF	25V electrolytic
C10	100μF	25V electrolytic
C11	0·1μF	150V tubular
C12	0·1μF	150V tubular
C13	10μF	25V tubular electrolytic
C14	1μF	25V tubular electrolytic
C15	100μF	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	

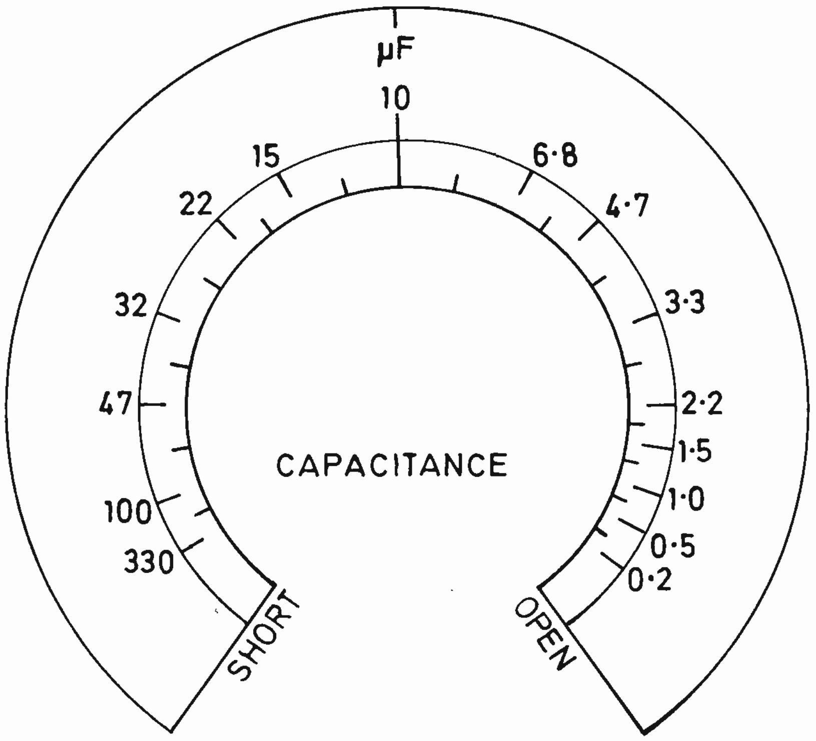
Two 3·5mm jack sockets
Miniature 8Ω, 2in. loudspeaker
Two penlight battery holders each to hold four batteries, plus snap-on connectors. Tandy 270-383 or similar
Two perfboards. Tandy 276-150 or similar
Plastic case, e.g. Tandy 270-224
Self-sticking cushion feet. Tandy 64-2346 or similar

Additional components for resistance ranges:
R4 10Ω RS149-616, R5 100Ω RS149-644, R6 1kΩ RS 149-694, R7 10kΩ RS149-818, R8 100kΩ RS 149-925
SW4 SPDT miniature switch

accurately calibrated C range of the bridge to measure a number of 10μF and 100μF 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 digitial 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.



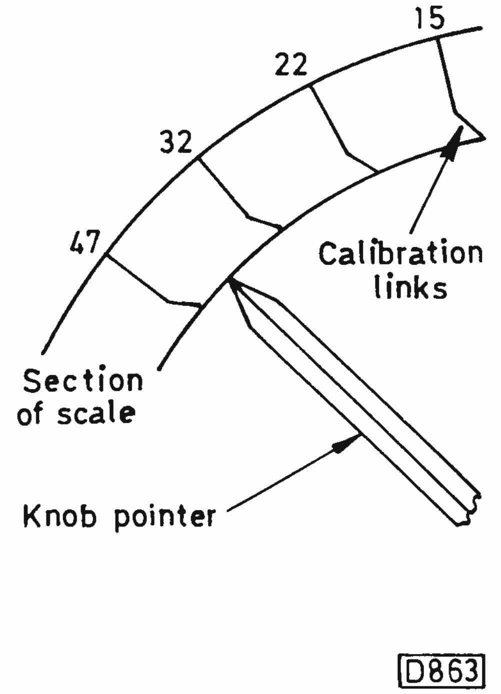


Fig. 9 (left): Full size calibrated scale for the bridge.

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

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.

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 dabbler" 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 techiques 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.

DABBLERS 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 DABBLERS?

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-tried 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 polarotor 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

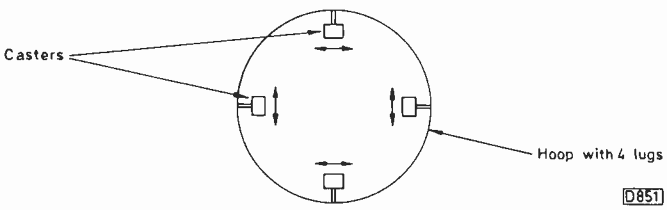


Fig. 1: Fixing the casters to the frame (not to scale). The patio mount casters are fixed at 90° positions on the flanges provided. Lock the caster wheels (see text) to allow movement in one plane only – parallel with the adjacent frame, as shown here.

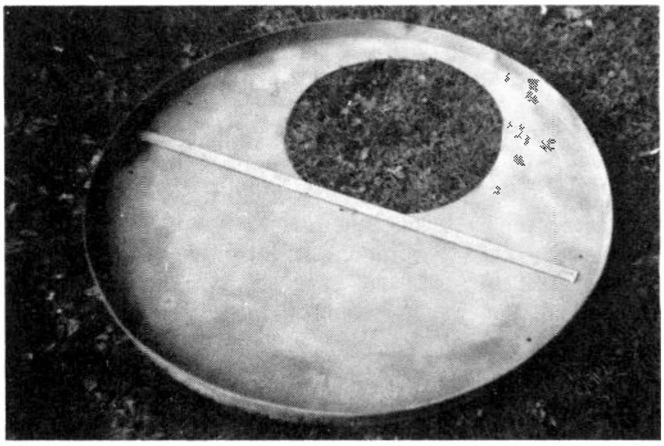


Photo 1: The industrial dustbin lid, with access cut-away, treated with an anti-rusting chemical.

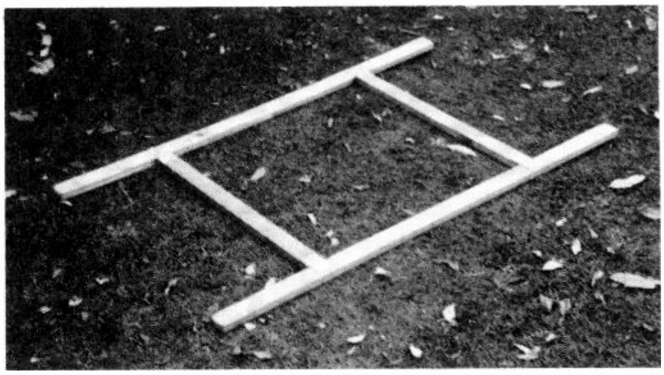


Photo 2: The wooden frame, held together with timber connectors, on which the dustbin lid will rest.

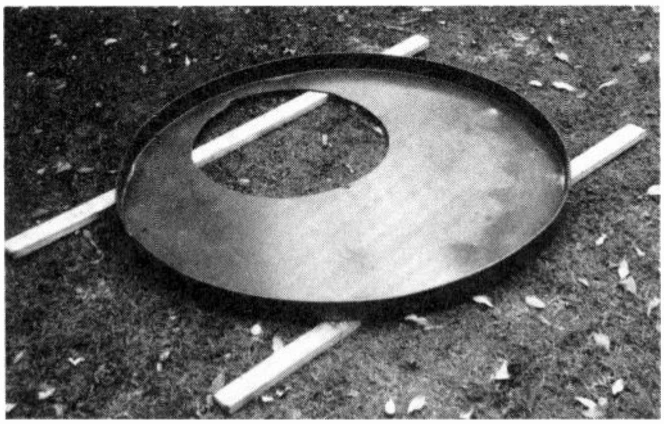


Photo 3: The now painted dustbin lid at rest on the wooden frame. Take care not to cut away the access hole lip too close to the main outside lip.

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. × ¾in., 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

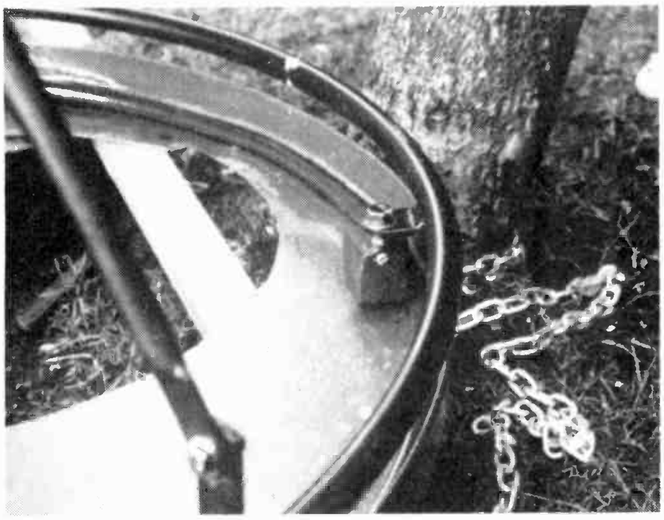


Photo 4: One of the casters bolted to the patio frame hoop. Fix the casters to prevent movement around the vertical spindle. To do this, hold the caster unit in a vice and drill a hole through the side of the caster shroud, then the spindle itself. Fit a self-tapping steel screw of sufficient length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

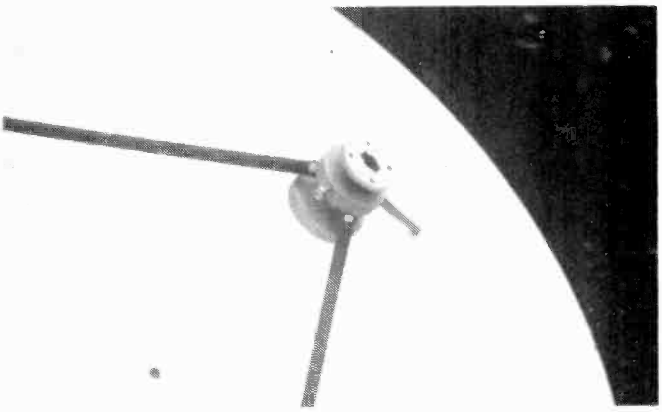


Photo 6: Close-up of the head assembly minus LNB. The support arms with PVC tubing make fixing easy: the protruding screw allows polarisation and focus adjustment. All very simple – you can't go wrong with the equipment I purchased.

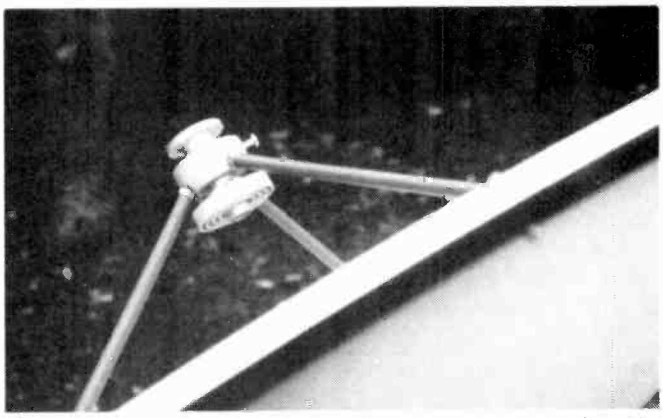


Photo 7: Another view of the scalar ring assembly – its adjustment screw can just be seen. This enables the ring assembly to be slid up and down the feed tube. Careful observation of a weak signal on a TV screen while adjusting the ring will show clearly where it peaks.

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.

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 (10μF) 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 is 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 (220Ω, 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.

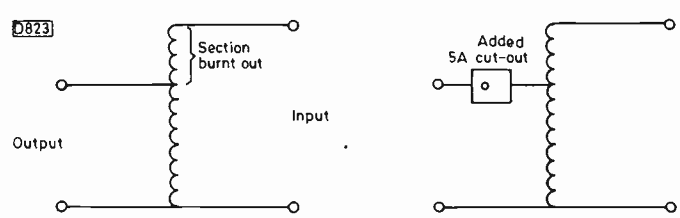


Fig. 1: Variac circuit.

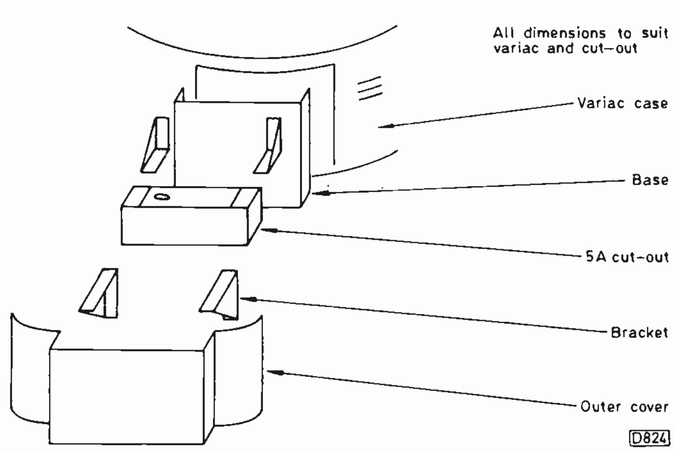


Fig. 2: Variac mechanical details.

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 (47μF 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 (1kΩ) 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, 100μF) 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 (68Ω, 0·5W) in the feed to the line driver stage had gone open-circuit. A couple of ordinary 33Ω 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 (1kΩ) 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 Wrocklaw. 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. Rl; 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) IA; 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 Quadrantids 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 experiements 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 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

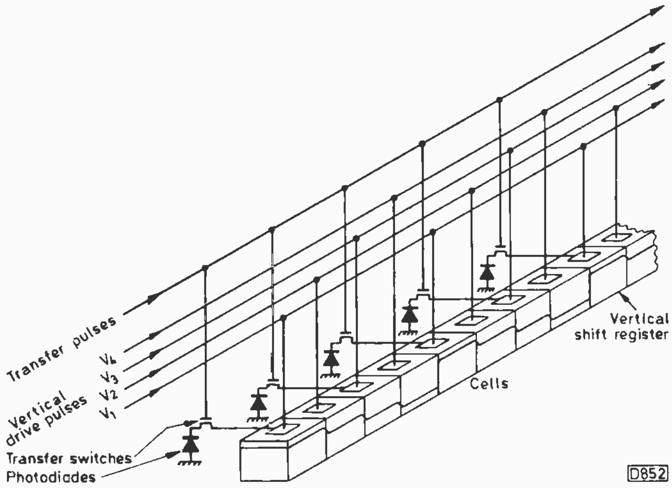


Fig. 1: Photodiode charge transfer. The diodes on the left represent one column of image sensors: the "progressive bucket" effect of the transfer charge voltage applied to each cell of the register on the right is represented by the depth lines on their sides.

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

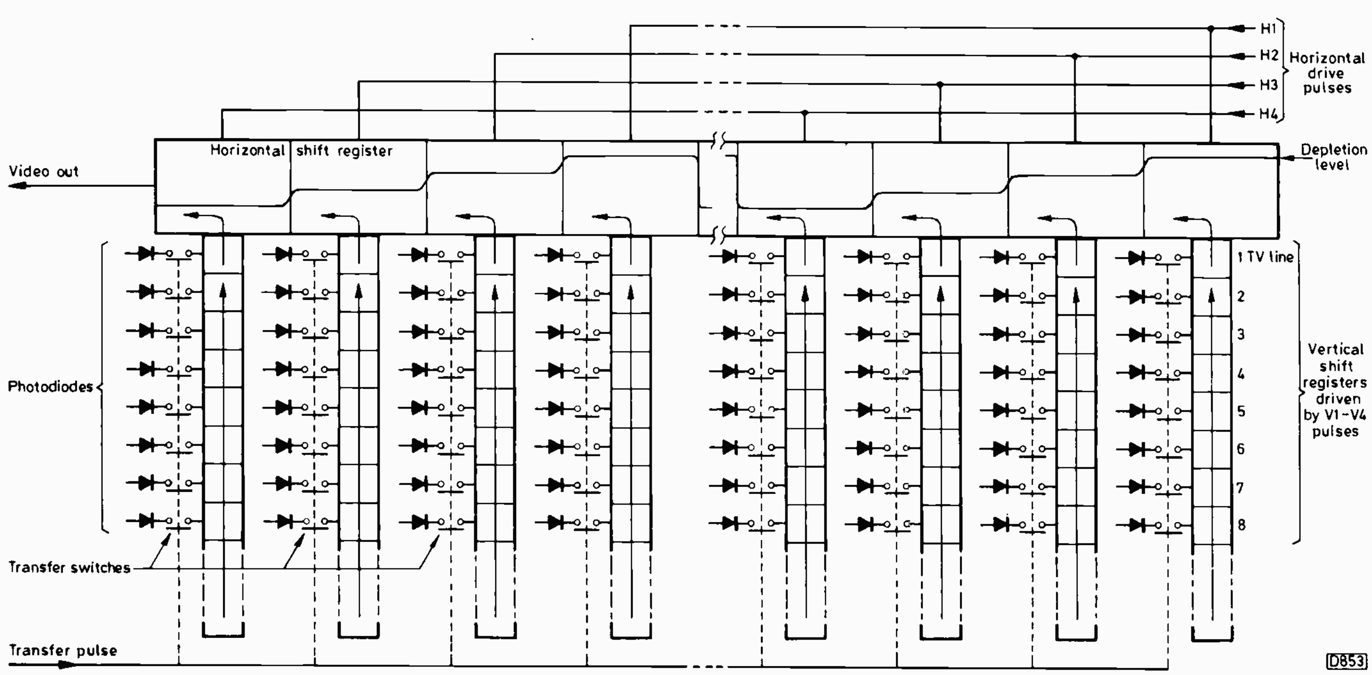


Fig. 2: Representation of a complete CCD image sensor, simplified to show 64 sensors in an eight-by-eight matrix. Typical practical arrays for consumer cameras would have about 250,000 elements arranged in a 579 × 422 matrix. The switched charges progress upwards along the vertical shift registers then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

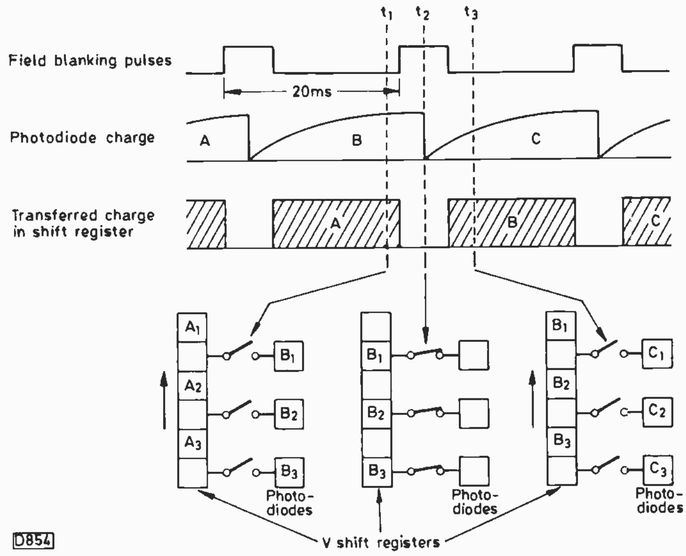


Fig. 3: Photodiode charging and transfer switching at the normal (20msec) shutter speed. Three successive fields, identified as A, B and C, are shown.

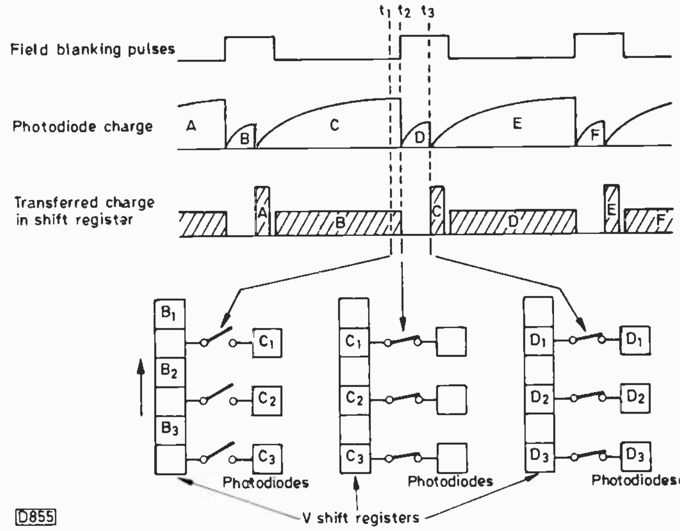


Fig 4: Photodiode charging (two-cycle) and transfer switching in the high-speed shutter mode. Between t2 and t3 a fast discard clocking pulse train sweeps all the C information out of the vertical shift registers.

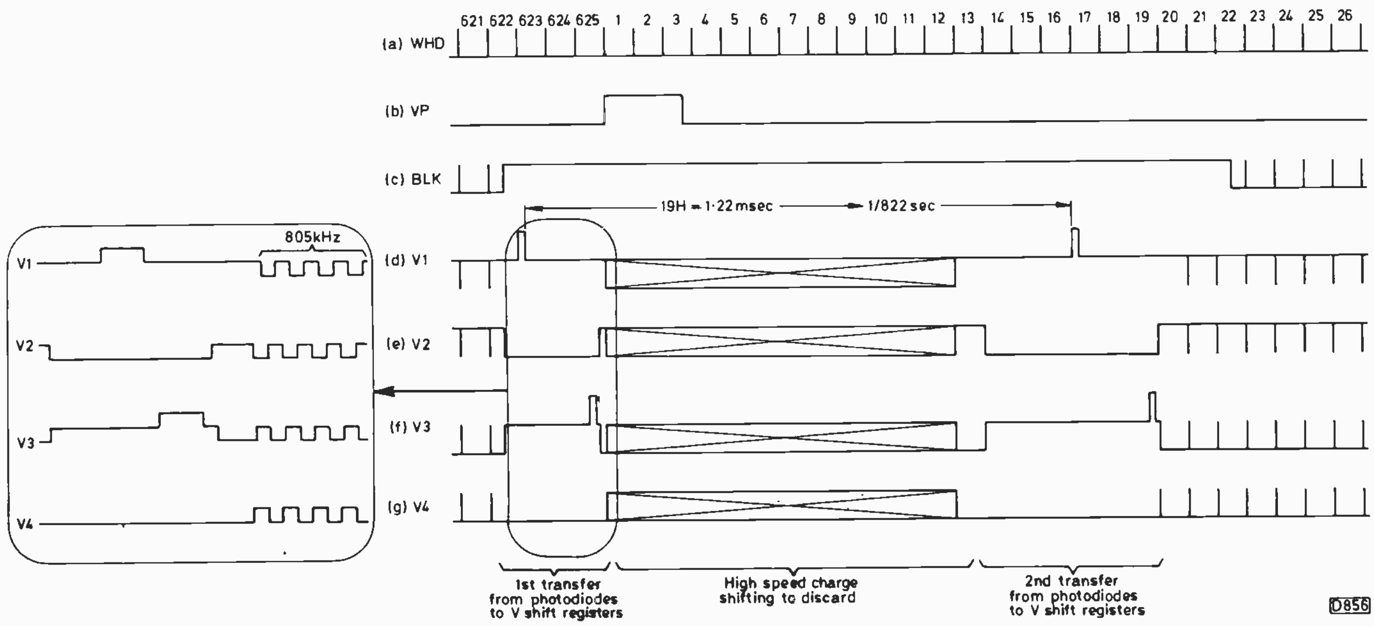


Fig. 5: Time-related waveforms for the high-speed shutter mode, (a) line sync pulses, (b) field sync pulse, (c) composite blanking, (d-g) three-level vertical drive pulses in the image sensor section – the highest levels V1 and V3 trigger photodiode charge transfer. The 805kHz pulse trains in the waveforms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

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.

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 $10\mu F/16V$ 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 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.

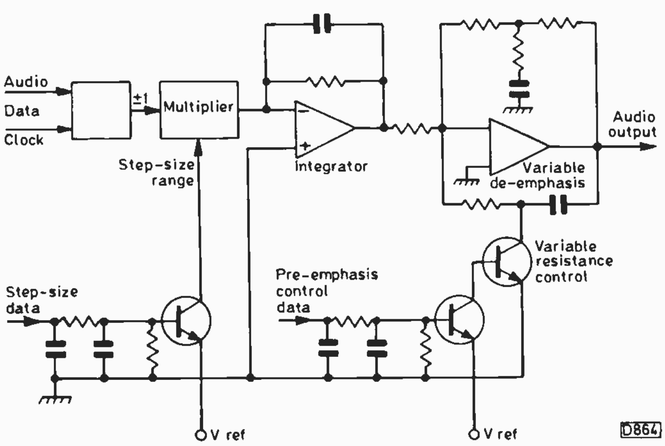


Fig. 1: Dolby ADM decoder.

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

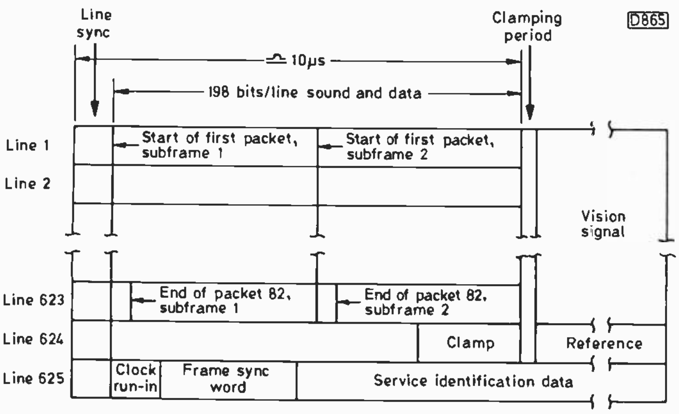


Fig. 2: Frame multiplex structure used for C-MAC and D-MAC Packet systems (not to scale).

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° 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 10μsec period. The reduced bit rate of 10·125Mb/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.

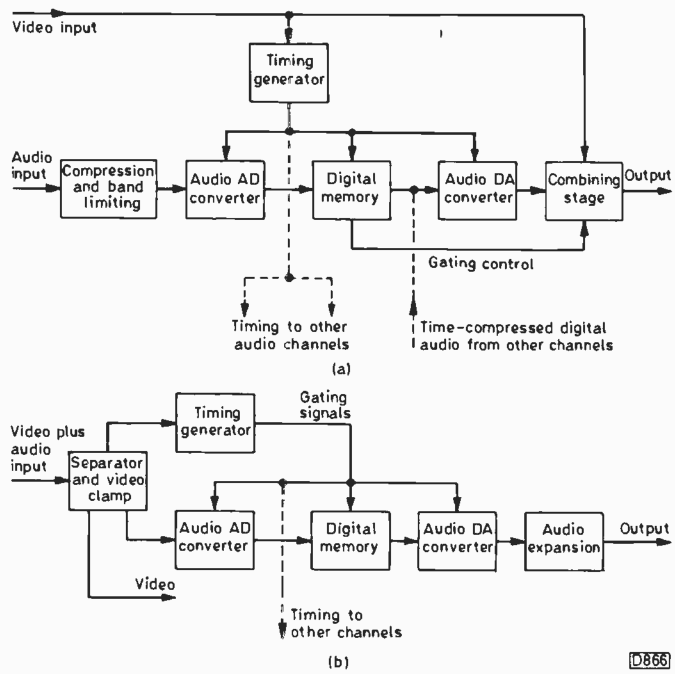


Fig. 3: The VIMCA system. (a) Block diagram of the encoding arrangement. (b) Decoder block diagram.

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 (6·552MHz = 9 × 728kHz). 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

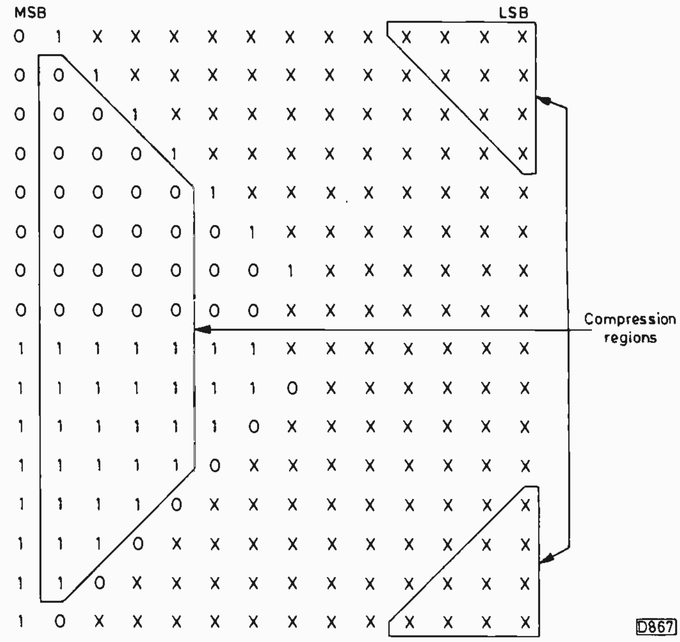


Fig. 4: Coding scheme for NICAM 728 companding.

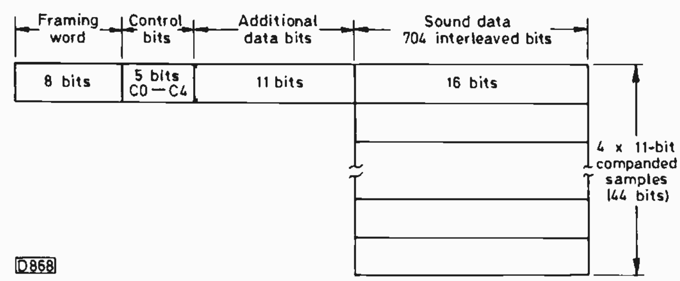


Fig. 5: NICAM 728 frame multiplex.

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 twos 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

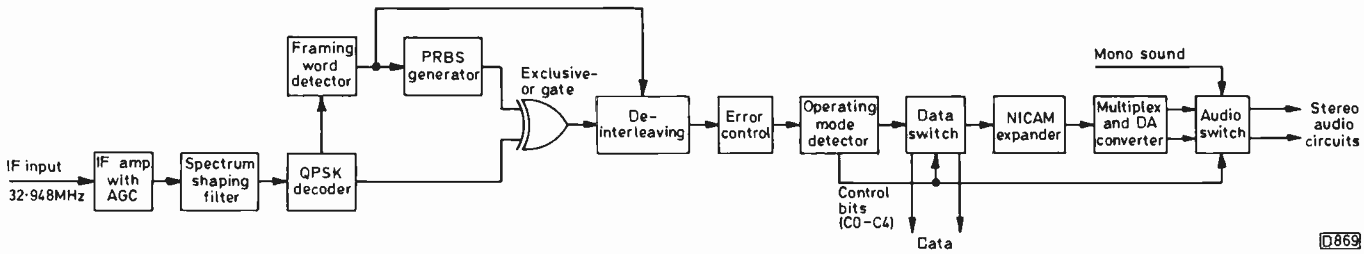


Fig. 6: Decoding the NICAM 728 stereo signal.

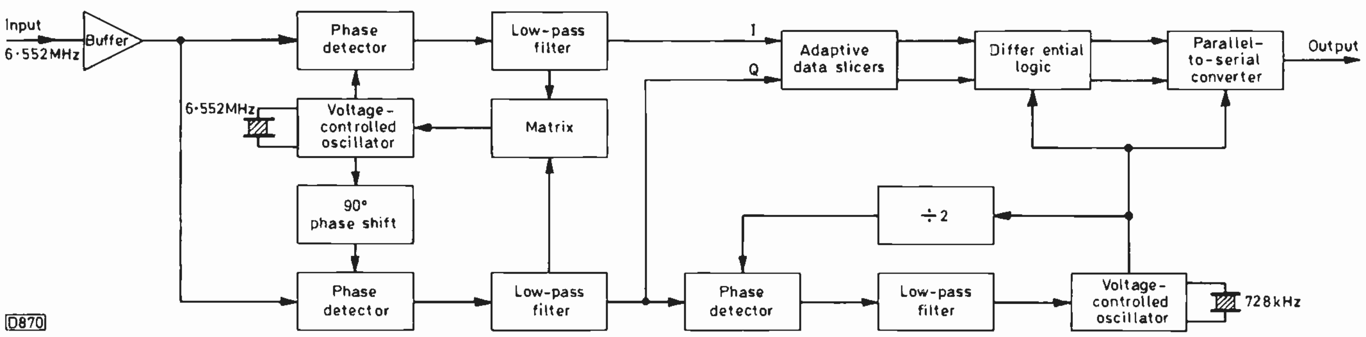


Fig. 7: DQPSK signal decoding.

done by adding via exclusive-or logic a PRBS of length 2^9-1. 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 PRB 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 (100kΩ), C631 (100μF) and R631 (0·68Ω). 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.

A common cause of this problem is ringing in the scan yoke (field section) or the pincushion distortion correction transductor. Check the following: R364, R362 (pincushion amplitude), L125 and R354 (vertical shift). A dry-joint on the transductor 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 (150kΩ) in the power supply and C614 (100μF) 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

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TELEVISION MARCH 1988

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 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.

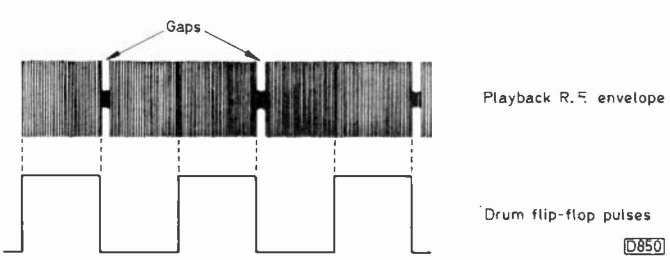

Fig. 1: Top, the waveform at the faulty machine's playback head amplifier. Bottom, the correctly timed 25Hz drum flip-flop waveform.

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 750kΩ, which is not normally carried as a spare – it's not a preferred value. Since the technician didn't have two 1·5MΩ resistors to connect in parallel he fitted an 820kΩ resistor and readjusted R47A to obtain the correct black level.

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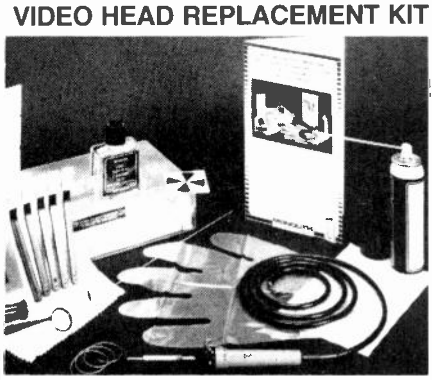

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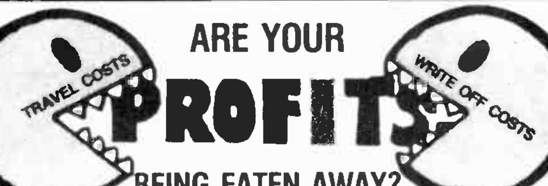

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VT11/14/33	5458415	44.71
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VT65	5458161	41.65
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NV230	VEH0296	41.40
NV333	VEH0103	41.40
NV366	VEH0174	62.10
NV688	VEH0210	62.10
NV777	VEH0177	62.10
NV788	VEH0201	70.38
NV810	VEH0294	69.11
NV830	VEH0266	70.38
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NV870	VEH0288	93.84
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SL-C9	DSR-21R	48.60
SL-C5/6/7/8000	DSR-36R	48.60

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NV333/366 IDLER	VXP0401	1.24
NV333/366 (PLAY/TAKE UP)	VXP0433	3.06
NV370/430 IDLER	VXP0521	2.56
NV810/30/50/70 IDLER	VXP0521	2.56
NV600/688 IDLER	VXP0515	3.18
NV730 IDLER	VXP0581	3.18
NV777/778 IDLER	VXP0463	3.18
NV2000 SERIES IDLER	VXP0329	1.24
NV2000 (PLAY/TAKE UP)	VXP0331	1.24
NV7000 SERIES IDLER	VXP0344	1.24
NV7000 (PLAY/TAKE UP)	VXP0343	5.76
NVG7/G10 IDLER	VXP0521	2.56
P ROLLER NV333/366	VXP0432	8.51
P ROLLER NV370	VXL1154	7.93
P ROLLER BV730	VXL1209	7.58
P ROLLER NV2000	VXP0330	10.66
P ROLLER NV7000	VDP0759	2.56
TENS BAND NV333/66/777	VXZ0129	2.08
TENS BAND NV370/730	VXZ0165	1.95
TENS BAND NV2000/2020	VXZ0076	5.92
TENS BAND NV7000/7200	VXZ0073	3.00
REEL MOTOR NV333/366	MYN13V5L	15.03

ORIGINAL SONY VIDEO SPARES

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SPLIT -MOD SLF25/HF100/C20 ETC	51.10
GUIDE PIN KIT SLF1/C9/C20/30/40	6.65
DC/DC CONVERTOR SLC9	22.53
CARRIAGE MOD KIT SLC9	6.40
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IDLER KIT SLC6	3.68
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SHARP REEL DR IDLER VC481 ETC	2.85

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CAPSTAN MOTOR HRD120/3V35	24.75
DRUM MOTOR HR3660/3V22	24.75
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T/UP IDLER HR7200/3V29	1.30
T/UP CLUTCH HR7200/3V29	2.20
REEL IDLER HR7200/3V29	2.96
REEL IDLER HRD120/3V35	2.80
T/UP CLUTCH HRD110/120/125	2.20
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PANASONIC NV-7000 SERIES	3.65
SONY SLC5/7	5.40
SONY SLC6	8.26
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(REPLACEMENT)

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SANYO VTC-5500	2.20
SANYO VTC-6500	1.78
JVC HR-3330/3360/3660/3V16/22	2.50
JVC HR-7700	2.10
JVC HR-7650	2.10
HITACHI VT11	1.70
HITACHI VT5000	2.50
HITACHI VT8000	1.31
SHARP VC7300	2.20
SHARP VC8300	2.20
SHARP VC9300	2.20
TOSHIBA 7540	2.50
TOSHIBA 9600	1.60
SONY SLC5/6/7	2.79

REMOTE CONTROL UNITS
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RM641 KV2092/2096	37.50
RM651 KV1442	27.50
RM661 KV21XRU	31.13
RMT211 SLF1	51.08
RMT213 SLC9	43.76
RMT216 SLC20/30/40/HF100 GREY	42.01
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RMT230 SLF30	37.50
RMT405 EVS600/700	37.50

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NV777	NV-A17E	30.58
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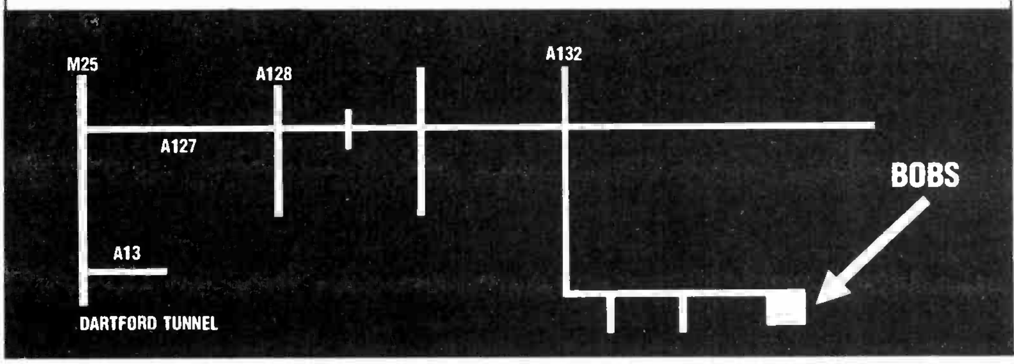

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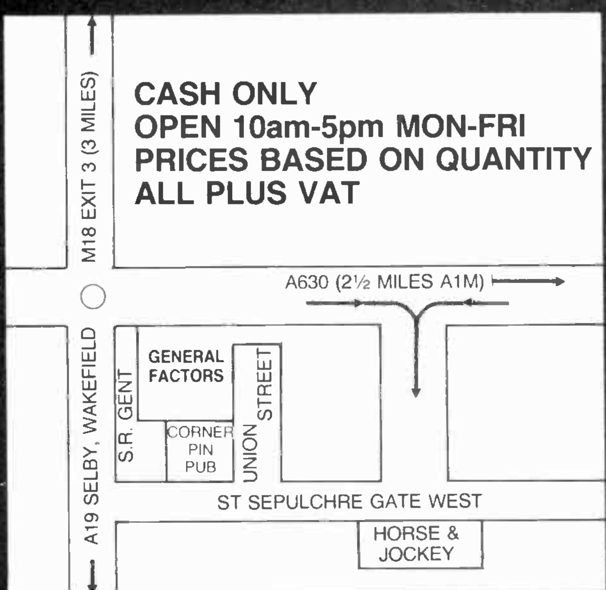

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TEST EQUIPMENT, TOOLS, general components and spares

Willow Vale Electronics Ltd

11, Arkwright Road, Reading, Berks. RG2 0LU.

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also at:
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Rank front panel Z950 £5

6 TAG print mains switch PREH 1983 ITT 75p

Rank T603A tuner on panel £6

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GEC switch mode trans 20AX
ITT mains CVC9 to CVC33 print type 60p
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2110 GEC L.O.P.T. Panel £6
2110 GEC Power Panel £5
Line o/p frame panels GEC 20AX £10.00
ITT CVC40 Push Button Unit & Mains Switch £12

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T 6036 40p
T 6040 40p
T 6047 40p
T 6049 40p
T 6051 40p
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BYF 3126 40p
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BYX 10 10p
BYX 36/600 35p
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BYX49/600R 75p
BYX 55/350 10p
BYX 55/600 (Bead) 10p
BYX 71/350 20p
BYX 71/600 50p
BYX 72/300 20p
BYX 36/600 50p
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BVY 95C 12p
BYV 96D 10p
BYZ 106 10p
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BZV 15/30 30p
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LD57CA 15p
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Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit £6

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Decca-TTT etc.
FEO4/1/250AC/4 Mains filters (grey type) × 4 **50p**

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KBL 005 30p
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KBP 04 30p
W02 15p
W004 15p
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GP15Q 10p

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

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Thorn Aerial Socket TX10 £1

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Double 1.5 Digital Display.
High brightness 20p

Quantity Reductions
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KT3 touch button black 6 for £1
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BU205 10 for £8.00
BU105 10 for £6.00
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40 glass reed switch £1
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100 500M/A Fuse £1
Mixed V/Cap Pots ITT-GEC-Hitachi-Philips etc, 20 for £1
ITT Mains Switch with Remont CMC113 £1

SENDZ COMPONENTS
TO ORDER SEE BACK PAGE

SENDZ COMPONENTS

TO ORDER SEE BACK PAGE

Matsushita PY34220 Tuner	£7
C Cam Decoder with TDA3591	£5
Toshiba VHF/UHF FG522F	£6
Mitsumi MEC1-F51	£5

Thorn Spares

New 9000 Decoder	£8.50
9000 Frame panel	£8
9000 Cyclops panel	£1.50
8800 convergence panel	£6
8500 convergence panel	£6
4000 Power supply	£3
1600 Mains lead, switch	
T605 1vNPN T066 80v/6A	10p
9000 Sound output panel	£1
3500 Focus unit	£1.50
3500 Mains Trans	£4
3500 cut outs	10 for £4
3500 IF panel	£2
3500 Frame panel	£3
3500 Line panel	£3
3500 A1 Diode	20p
Export 3500 IF panel	£2
IC board with set of SN74LS	£1
4000 Tube base	£4
3500 A1 pots	50p
Beam limiter panel	£1.50
3500 Power panel with Y969	£1
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Rank/Toshiba preh unit 0354	£9.50
4 Push button unit preh	£1.00
6 Push button VHF/UHF for v/cap. GEC-Decca type	£7.00
7 Push button for CVC5 ITT	£8.00
KT3 12 Push button unit	£2.00
KT3 (Export) 12 P.B.u	£2
6 Push button Unit Thorn	£1.00
6 Push button GRC	£6.00
6 Push button PYE 731	£6.00
Hearing aid unit	£3
Rank Z718 4 P/B Unit MECH	£4
7 Button Unit GEC with Lamps	£7
697 Push Button Unit	£6.00
Z916B panel	£5.00
T513AP panel	£5.00

Mains Droppers

Pye 731 3+56+27R	50p
Thorn 50/17/1K5	£1.00
120/20/20/48/117	£1.00
270/10/6 for Thorn 4000	50p
18/320/70/39	£1.10
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GEC, ITT, Philips, Pye	25p
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Thorn 1600-1700	£1.50
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Speakers

6×4 G11	25 ohm	£1.00
5½×2½	3 ohm	£1.00
5×3	80 ohm	70p
5×3	50 ohm	50p
5×3	35 ohm	70p
6×4	15 ohm	£1.00
6×4 speaker	16 ohm	
7×3	70 ohm	£1.00
8×5	8 ohm 15 watt	£2
8×5	8 ohm	£1
5×3	8 ohm	70p
7×3	16 ohm	£1.00
5" dia	16 ohm	£1.00
5" dia	8 ohm	£1.50
6½" dia	4 ohm	£1.50
6½" dia	3 ohm	£1.50
2¾" dia	8 ohm	75p
3" dia	8 ohm	75p
4½" sq.	15 ohm	75p
KT3 speaker	K30	75p
3" dia	15 ohm	60p
1690 5×3	12 ohm	£1
K45 Philip	15 ohm	75p
K30 15 watt		£1

KT3-K30

OF-425		
OF-550	E.W.	10p
OF-513	correction	10p
OF-557		50p

DIODES

BY 126	10p
BY 127	10p
BY 133	10p
BY 134	10p
BY 164	50p
BY 176	25p
BY 179	40p
BY 184	25p
BY 187	10p
BY 190	40p
BY 196	30p
BY 198	10p
BY 204/4	8p
BY 206	8p
BY 208/800	8p
BY 210/400	5p
BY 210/800	10p
BY 223	60p
BY 224/600: 4.8A/600v bridge	50p
BY 226	15p
BY 227	15p
BY 228 1500v	20p
Flat BY229 black	15p
BY 299 Red	20p
BY 229/400	30p
BY 299/60p Tag	30p
BY 237	5p
BY 254	10p
BY 255	30p
BY 298	10p
BY 299	10p
BY 406	8p
BY 527	20p
BY 407a	10p
BY 527	10p
BY 602	10p
F 247	10p
GP20G	5p
GRP80G (TX10)	60p
XK 3102	50p
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Line O P Trans Mono T X. 12"-14" Philips	
27482	£10
4822	£10
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CVC32 Line Tran	£7.00
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CVC 45	£5.00
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GEC Portable G10T2046	£3.00
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LOPT Rank Z763	£5.00
K35 Split Diode 3122/13835930	£10.00

Black Triplers

KT3 Triplers	£6.00
S T C Universal Tripler	£6.00
11 TJT	£2.50
11 TGA	£2.00
ITT CVC 5-8-9	£3.50
Rank T25LE Tripler	£2.00
Rank 11TCP A823	£3.50
TU 25 30K Rank	£3.00
11 TEZ Rank	£3.00
G9 Philips	£4.00
GEC 2110	£4.00
3500 Thorn	£3.00
8500 Thorn	£4.00
9000 Thorn	£7.00
9500 Thorn	£4.50
9600 Thorn	£4.00
2040 GEC	£3.50
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Universal Tripler	£5.00
G8 Tripler	£5.00
CVC20-32	£5.00
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11HY	£4.00
D22 for Pye 18" colour portable	£4.00
LP 1193/63	£4.00
BG 100/41	£3.25
LRO Tripler print type with loads PO7 BG2087	£5
T/text ultrasonic rec'r panel	£14.00
12-14V 20 for £5.00 200 for £25.00	
GEC 8 touch unit assy complete with all IC's + pots	£4.00
G11 E W Transformer	50p
G11 E W coils	£1.00
G11 Transient Suppressors 245V	20p
G11 Scan Coils	£5.00
G11 100K tuner pots	12 for £1
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KT3 line OSC transformer	£1
KT3/K30 infra-red receiver head	£1
K30 drawer unit with IC's (home)	£10
K30 drawer unit with IC's (export)	£10
KT3 AE Sockets	50p
KT3 receiver panel	£8
KT3 line driver transformer	50p
Pye, K30, GEC, etc Pre-mains stand-by switch	£1
Decca 80/100 IF panel	£5
NPN PNP 80V 6 Amp TO66 O P Trans	pair 25p
5 button touch tuner BBC1/2 ITV1/2 video with ic SAS 560T/570T	£7.00
Control panel 5 sliders + mains lead	£1.50
G11 8 touch button unit replaces old 6 P B U	£24
Tube base + base unit for 820 Euro chassis	£4.00
GEC Line O/P Trans. & Rec Stick for Portable	£3.00
CVC 20/25/30/35/40 decoder panel	£10
CVC 20/25/30/35/40 decoder panel (untested)	£5
CVC 40/45 IF panel	£5
40K Transducer	50p
PHILIPS NI 511N	£1.20
LM337M Reg.	30p
20 GEC Black Spark Gaps	£1.00
KT3 Front Panel Control Assy	£2.50
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BTW 92/800R	£3
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Rank T20 Z136 Panel	£6.00
NEW GEC 20AX Power Supply Switch Mode	£12.00
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GEC 2110 tuner unit + IF Panel	£12.00
Pye/Chelsea Line op panel	£12.00
Pye 205 T/unit	£3.90
Pye 205 Line op panel	£7.50
Pye 713 IF panel and tuner	£7.00
Pye 713 Chroma	£10.00
Pye/Chelsea Timebase panel with LOPTI	£10.00
Pye 731 Frame Panel	£5.00
Pye 731 Convergence Panel	£5.00
Pye 731 Chroma	£10.00
Pye 731 IF panel + tuner	£10.00
Pye CDA/205 panel	£6.00
GEC portable chassis + LOPTI 2114 New	£4.00
Thorn 1613/1713 chassis	9.75
G9 Power Panel	£6.00
Mono RANK Chassis 127A NEW	£10.00
NEW G9 Frame Panel	£4.00
NEW G11 IF Panel	£10.00

25% OFF ALL PANELS

G8 Tuner Unit + Panel	£4.00
G8 IF & Chroma	£6.00
G8 Chroma	£3.00
G11 IF Detector	£3.00
G11 Selector gain module	£3
Complete CVC 825 Chassis (both panels)	£40.00
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Z714 RANK IF Panels 6MHz 1 I.C. SL437F	£3.00
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K35 II	£6.00
Z743 RANK IF Panel Export 5.5MHz 3 I.C.'s TBA750+SC9504P+SC9503P	£1.50
Pye G11 Front panel with transducer, pots, tuner pots, 6 pb switch+lead	£5.00
Pye 6 button switch portable	£1.00
GEC V/cap VHF/UHF tuner and IF+ sound O/P PC 706B3 (Export)	£12.00
GEC Line O/P PC 659B3	£6.00
2110 GEC Power Panel	£8.00
CVC 20 Front panel with sliders + mains input panel	£4
CVC 40 PUSH BUTTON ASSY with sliders: complete with lamp assy + pots 8 button units	£9.00
CVC9 slider pots panel	50p
Universal Focus. Fits Pye, Thorn and Decca Units.	
T147 Rank tube base on panel	£1.00
Z718 Focus Unit	£1.50
T20 Focus Unit	£1.00
Large Type	75p
Decca Small	75p
KT3 Focus Unit	75p
K30 Focus Pot	75p
K30 Tube base on panel	£1.00
TX10 Focus Units	£8.50
CVC 32 Focus Unit	75p
Fedility Focus Unit 14R-14S	30p
3500 Thorn Focus Unit	£1.00
ITT Small for use with Split	
Z718 Bush Focus	£2.00
Diode	50p
TV11	50p
Remo TV12SP	50p
1600 Thorn EHT Rec and Lead	50p
TV13	50p
TV14	50p
TV18	60p
TV20	£1.00
TV45	50p
Thorn 14/1500 rec stick	5p
TX10 8 Button Unit	£10.00
TX10/TX100 16 Button	£10.00
G11 drawer ASS 3 pots Mains switch and lead	£2.00
K30 Drawer Ass with pots cable forme	£1.00
TX10 Drawer with 8 way pots. ass.	£2.50
TX10 Ex. port with band switch (drawer)	£2.50
Line O/P panel GEC 2217/2218/2213/2214/2226/2227/2228	£10

PHILIPS BATTERIES (Small Types) HAND SETS

SR41	40p
SR43	40p
SR44	40p
SR54	40p
LR43	40p
LR44	40p
LR54	40p
CR2032	40p
10 500PF 2KV	20p
.22/1000	20p
.1/250AC	20p
.1/100	5p
1MFD-250AC	25p

F100 × 10	30p
22/100	10p
4.7M/100	5p
470/100	20p
4700/100	75p
47 160	10p
300 300/300V	80p
800/160	50p
.1/250 Pulse	5p
2.2 250v	10p
7N5 1500V	15p
3n3/250 A C	10p
.33/250V	20p
.39/250V	15p
4n7/250 tested 5KV	25p
22/250	15p
47/250	10p
100/250	20p
G11 470/250V	£1.75
GEC600/250	60p
700/250	£1
300+300 MFD 350v	£1.00
800/250	40p
32/300	20p
4/350	5p
8/350	8p
4.7M/350v	10p
33/350	20p
220/350	30p
300/350	40p
400/350	50p
22/375	15p
220/385 (ITT)	75p
330/385 CVC 820ITT	60p
0 1/400	15p
KT3 E/W 39/400	15p
.56K 400v	20p
4700pf/400	10p
.22/400	10p
8/400	15p
33/400	20p
400/400	40p
394K/400V	20p
220/450	40p
.47/500	25p
0 1/600	15p
0 1/1200V wire end	20p
0 1/450 A/C wire end	20p
.22/1000	20p
.047/600	15p
0.047/1000	10p
0.01/1000	10p
0.1/1000	10p
.47/1000v	65p
.47/250V A C	10p
.001K 1250	10p
0.0047/1500	10p
.005/1500	10p
.0105/1500	10p
1n8/1500	15p
2n0/1500	10p
2n2/1500	15p
.01/1600	15p
G11 8200/2KV	15p
0.1/2KV	20p
3n9/2KV	15p
0.0015/2KV	10p
6n2/2KV	15p
2n0/2KV	15p
2n2/2KV	15p
470pf 4KV	10p
7500pf/2KV	10p
3000PF/3000V	10p
4n7/2KV	15p
6n2/2KV	10p
7n1/1500V	10p
8n2/1500V	10p
9n1/2000V	10p
8n2/2KV	15p
0.0082/2500	15p
150/3500	10p
1800/4KV	5p
4.7nf/5KV	10p
170/8KV	10p
180/8KV	10p
210/8KV	10p
1000/10KV	10p
.47/100V	80p
Tube Thermpath 167	£1.00
Rank Secam Decoder Panel UHF & VHF T115A	£13.00
10 off 91 CAP G11	£2.00
Philips K4 CAP 150M/385V	50p

CVC 20-25-30 Mains Switches	60p
Infra Red and Ultrasonic G11 Teletext Decoder Panel	£30
RANK & ITT Mains Remote On-Off Switch (720R)	£1.50
RANK & ITT Remote Switch 2800 ohm	£1.50
G11 Mains Switch	50p
4 amp Mains Switch	25p
GEC Mains Switch 4 amp	30p
KT3 Mainswitch	£1.00
G8 Mains Switch	75p
G11 Preh Red LED P/Button for C.H. Change	20p
RANK TOSHIBA Transductors TPC-2011	50p
Mains Switch ITT Long Type Print	75p
Mains Switch Philip Long Type TAG	75p
Mains Switch GEC Long Type TAG	75p
2000 Chassis Fidelity Mains Switch (4 TAG)	60p
250V/4A White Lorlin Mains Switch	60p
KT3-K30-K35 Full Remote Mains Switch (6 TAG)	£1
Teletext Adaptor Kit TY-500 Panasonic	£12

Multi-Caps

220 MFD Sprague 385V	50p
350V 300M + 300M	£1.00
400V 400M	60p
350V 400M	60p
Thorn 3500	
175/100/100/350v	£1.00
KT3/200/25/25/385v	£1.00
KT3-K30 220+40+40	75p
200+200+75+25M 325V	£1.00
300+300+150+100+50MFD 350V	£2.00
G11 CAP 470/250	£2.50
47/220/350v	60p
150/150/100/100/100/320v	£2.00
2500/2500/63v	50p
150/200/200/300v	70p
300/100/100/16/275v	£1.50
100/200/325v	40p
150/150/100/375v	£1.50
200/200/75/25M 375V	£1.00
Thorn TX9 Caps 500+500M 175V	£1.00
300/300/100/32/32/300v	2.00
1500/2000/30v	50p
150/150/100/100/320v	£2.00
100/350 + 300/200/100/16/275v	£2.00
225+25/380 GEC	70p
200/100/100/350v	£1.50
500/500/25v	50p
150/150/100/300v	75p
200/150/150/300v	1.00

ITT 8 and 6 Push Button	£1.00
Pye 725 LOPTs	£6.00
Pye 731 LOPTs	£6.00
Thorn 8500-8800 LOPTs	£5.00
CMC 301 front panel	£8.00
CMC 303 front panel	£8.00
CMC 302 Panel with TC mains switch etc	£8.00
CMD 800 Decoder	£8.00
UPC 574	30p
BSS 38	30p
G11 1 I.C. Receiver Panel	£1.50
3 I.C. Power Supply G11 Full Remote Receiver Panel	£3.00
FET Power VN88AF	50p
PHILIPS SBC 469 Stereo Microphone	£23.00
Meters Hills 520	£17.00
Meters Hills 420	£15.00
Hills HD5000 Digital Meter 1000V DC 750AC 10 Amp 20 MRG Rangers	£28
HT100 Multimeter	£6.75
HT300 Multimeter	£7.75
HT500 Multimeter	£9.00
HD1000 Digital	£20.00
HD3000 Digital	£25.00
HD5000 Digital	£25.00
HD6000 Digital	£32.00
HD8000 Digital	£37.00
HD9500 Digital with capacity Temp Trans Volts Ohms and Amps ranges	£60

Infra Red Hanset Tester

Works at 24 feet – Sound repeater Works off 9 volt battery Fits in top pocket	£8.00
Handset Tester with LED	£4.50

Repaired Handsets

Philips K4-K35, RC5350-RC5300, RC5370, RC5375, repaired same day	£10.00
RC4001 Full Remote KT3 K30 Teletext Handsets exchanged	£15.00
GEC Full Remote Infra-red 1983 models	£15.00
Timers, 60 mins, small	£1.00

TOSHIBA HAND SETS

24 Button CT938 Fulremote	£5.00
32 Button CT983 Videotext	£6.00

THORN

VCR Front Display Panel	£7.00
Large type ITT TV and V.C R Handset	£15.00
GEC Ultrasonic 8CH Full Remote	£15.00
G11 Full Remote Ultrasonic	£32.00
G11 Ultrasonic Teletext Handset	£20.00
8 C H Ultrasonic GEC Full Remote C2014H/C2219H	£15.00
New Replacement for G11 Ultrasonic Full Remote	£12.00
Thorn 4000 insert with 7 buttons	£5.00
Decca RC 11	£14.00
Decca RC 12	£14.00
G11 Infra-red full teletext	£24.00
Dynatron-Full remote CTV 62 63, 64	£19.00
Hitachi infra red handset	£18.00
Philips full remote KT3, 16C928/20C934, 7228/7324; K12 26C 797/1ST 66K 1826	£12.00
G11, Full remote top button assy	£12.00
G11, Full remote repair service (exchange unit)	£18.00
G11, Full remote new ultrasonic	£32.00
GEC infra red full remote 8 channel (I.C.SAA1250)	£14.00
Philips infra red full remote 9 channel for 60 CP2605	£6.00
Philips infra red full remote 12 channel for 60 CP2605	£12.00
K35	
KT3/K30 T/Text	£15.00
KT3/K30 Full remote	£15.00
KT3 Power supply	£4.00
GEC infra-red 2236-2026	£4.00
GEC 8 button full remote	£14.00
GEC push pad handset button blobs each	10p
Pye & Philips handset KT3-K30 chassis. No RC5150-RC5176-RC5171-RC5177 **Special Price**	£13.00
RC4001 KT3 and Teletex	£14.00
IT CVC 32 handset repaired	£15.00
CVC 32 Hand Set	£15.00
CVC 45 3 and 2 Pin	
TX10 Hand Set Text	£19.00
TX9 with Text	£19.00
TX9 & TX10 button print	£3.50

PHILIPS UNIVERSAL HAND SET £15.00 KT3 – K45

We have all parts for Philips Handsets

RC5353	£15.00
RC5300	£12.00
Philips RC5	£15.00

TEX-TYPE

Replace Hand Set for Philips KT3-K30, K4 etc	£12.30