MAY 1978

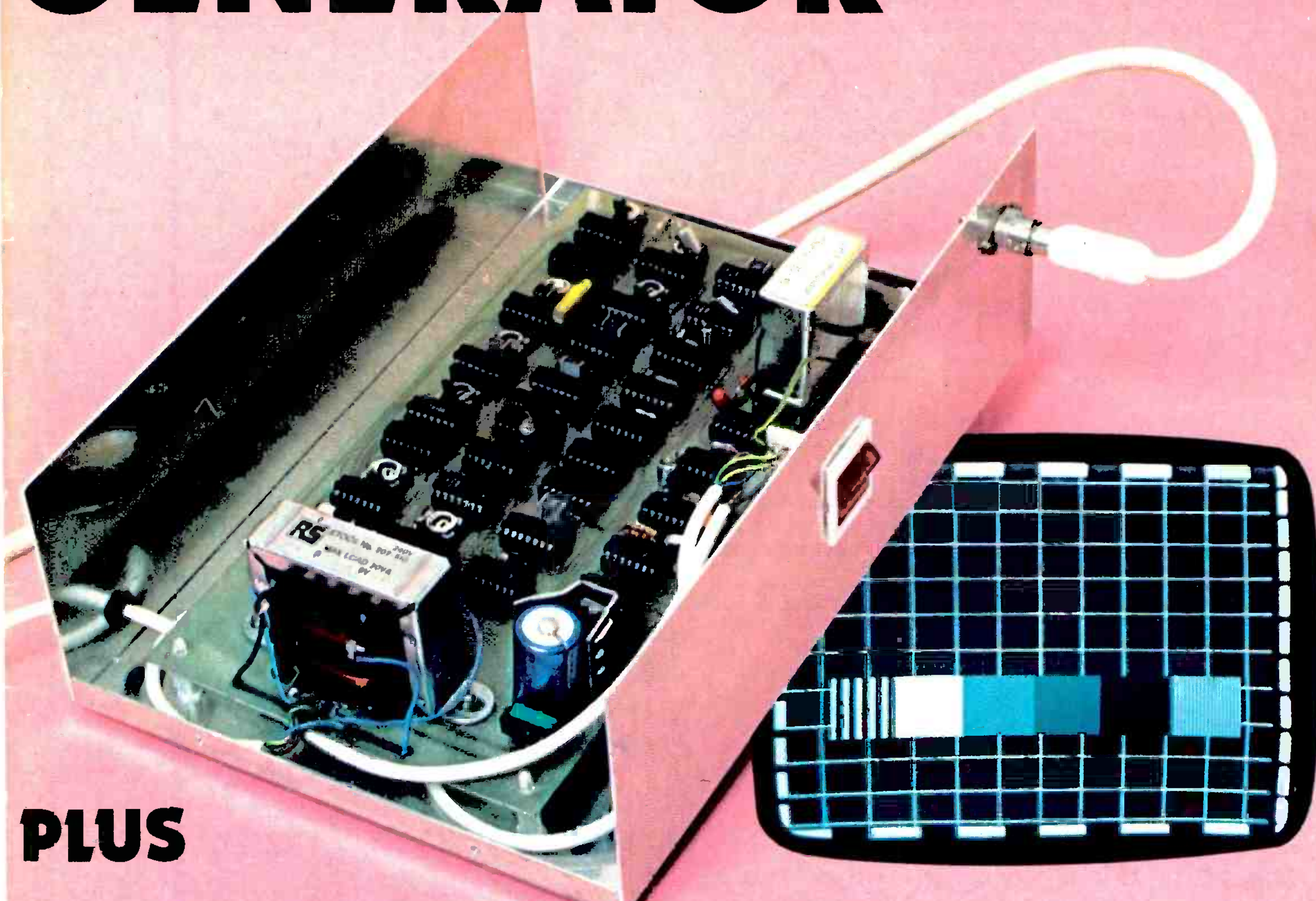
Australia 85c; Malaysia $2.50; New Zealand 85c

50p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

SIMPLE TEST CARD GENERATOR



PLUS

New Series: Transistors in TVs
Servicing S/S B&O Colour Sets

TELEVISION

May 1978

Vol. 28, No. 7
Issue 331

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

BINDERS AND INDEXES
Binders (£2.85) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Prices include postage and VAT. In the case of overseas orders add 60p to cover despatch and postage.

BACK NUMBERS
Some back issues, mostly those published during the last two years, are available from our Post Sales Department (address above) at 70p inclusive of postage and packing to both home and overseas destinations.

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

this month

341 **Crystal Gazing**

342 **Teletopics**

343 **Letters**

344 **Servicing the B & O 3500/4000/5000/6000 Chassis** — *by James Brice, B.Sc. (Eng.)*
Notes on some of the unusual circuits in the first B & O solid-state colour chassis, the setting up adjustments and a few stock faults.

349 **Long-Distance Television** — *by Roger Bunney*
Reports on DX reception and conditions, news from abroad and notes on aerial systems.

352 **Service Notebook** — *by G. R. Wilding*

354 **Transistors in TV Circuits, Part 1** — *by S. W. Amos, C.Eng., B.Sc., M.I.E.E.*
Start of a new series explaining how the characteristics of transistors are exploited in TV circuitry.

357 **The TBA120T and TBA120U ICs** — *by Phosphor*
The differences introduced with these two new versions of the widely used TBA120 intercarrier sound i.c.

358 **Servicing Saba Colour Receivers, Part 4** — *by P. C. Murchison*
The luminance circuitry in the H chassis.

360 **Simple Test Card Generator, Part 1** — *by Malcolm Burrell*
An electronic test pattern generator providing a crosshatch, castellated border, grey-scale and two sets of frequency gratings.

366 **Faults Analysed** — *by Robin D. Smith*
In addition to some faults, comments on the GEC C2110 series and on workshop safety.

368 **Unusual BBC Test Cards** — *by Keith Hamer and Garry Smith*
Occasionally the BBC departs from its normal captions and test patterns.

370 **TV Servicing: Beginners Start Here . . . Part 8** — *by S. Simon*
Resistors are a common cause of faults in TV sets. What happens to them and the effects on the picture are considered.

374 **Modification for the Philips N1700 VCR** — *by Angus Robertson*
How a battery and multivibrator can be added to provide a back-up supply for the clock circuits in the event of mains failure.

374 **Readers' PCB Service**

375 **VCR Notes** — *by John de Rivaz, B.Sc. (Eng.)*
Using the N1700's heads on earlier machines, and a note on induction motors.

376 **Some Field Funnies** — *by L. A. Ingram*
Troubles in receiver field timebases.

377 **CRT Rejuvenator**
Board pattern and component layout.

378 **Transistor RGB Circuits** — *by G. R. Wilding*
A review of the diverse circuits found in colour receiver RGB output stages.

380 **Plemi VHF aerials** — *by Hugh Cocks*
A test report on some current models.

380 **Please Note . . .**

381 **Gate Crusher** — *by Les Lawry-Johns*
Amongst the month's servicing affairs there's an encounter with Mr. Shuttlecock's front gate.

383 **Next Month in Television**

384 **Your Problems Solved**

386 **Test Case 185**

OUR NEXT ISSUE DATED JUNE WILL BE PUBLISHED ON MAY 15

EX-EQUIPMENT SPARES

MONO TUBES
(tested)
19" Rimguard **£4.50**
23" Rimguard **£6.00**
20" Rimguard **£6.00**
24" Rimguard **£7.50**
+ £3.00 p.p.

MONO TUNERS
6 - button integrated all at **£6.50**
U.H.F. P/Button D/S **£4.50** U.H.F. P/Button S/S **£6.50** Rotary **£3.00**
+ £1. p.p.

MONO LOPTS
All D/Standard Lopts at **£4.00**
+ £1. p.p.
All S/Standard at **£4.00** +
£1. p.p.

MONO PANELS
i.e. Philips, Bush etc.
£3.50 + £1 p.p.
Quotations for complete S/Hand chassis if required. (Diff prices)

MISC. S/Output Trans.
£1 + VAT + £1 P&P
F/Output Trans.
£1.25 + VAT + £1. P&P
Scancoils £1.50 + VAT + £1. P&P. Other spares available. please write or phone for details.

VALVES (MONO & COLOUR)

PCL82	0.10	PCF802	0.10	PCC86	0.10	EY86/7	0.10	30PL1	0.10	PL509	1.00
PCL83	0.10	PCF805	0.25	PC97	0.20	EY8/7	0.10	30PL13/4	0.10	PY500	1.00
PCL84	0.10	PCF806	0.10	PC900	0.10	DY802	0.10	30P12	0.10	GY501	1.00
PCL85	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	30FL1/2	0.25	PL508	0.50
PCL86	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC82	0.10	PCH200	0.50
PFL200	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECC81	0.10	PCF200	0.50
PCF801	0.10	PCC86	0.10	EF184	0.10	PL81	0.10	ECH81	0.10	CEY51	0.15
30C1	0.10	30C15	0.10	6BW7	0.10	6/30L2	0.10	ECL80	0.10	PD500	1.00
30C17	0.10	30C18	0.10	ECC85	0.10	U26	0.10	ECL82	0.10		
PL83	0.10	PL84	0.10	EH90	0.10						

Please note there is 25p p.p. per order

D/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT	POWER	L/TB	F/TB
Bush/Murphy	6.50	6.50	6.50	–	–	6.50	1.50	6.50	–	–
GEC/Sobell	6.50	7.50	–	–	–	6.50	–	–	–	7.50
Philips	6.50	9.50	–	–	–	7.50	–	–	–	6.50
Decca	6.50	12.50	12.50	–	–	6.50	2.00 (19" only)	8.00	–	6.00
Thorn 2000	6.50	7.50	7.50	6.50	6.50	7.00	–	8.00	15.00	6.50
Pye	7.50	7.50	9.50	–	–	6.50	–	–	–	4.00
Baird	6.50	8.50	8.50	–	–	6.50	–	–	–	6.00

Postage & Packing £1.25

S/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	VIDEO	CON	POWER	L/TB	F/TB
Bush 184	9.50	–	20.00	–	8.00	6.00	20.00	–
GEC Hybrid	9.50	9.50	15.00	–	6.00	–	–	12.00
Philips G6 S/S	9.50	–	15.00	–	9.00	–	–	10.00
Thorn 3000	10.00	9.00	18.00	10.00	6.00	20.00	20.00	10.00
Pye 691/693	15.00	7.50	18.00	–	15.00	–	28.00	7.50
Thorn 3500	10.00	9.00	18.00	10.00	10.00	20.00	20.50	10.00

Korting and other foreign panels available on request.

Postage & Packing £1.25

COLOUR TUBES
19" 18.00
19" A49.192 £20
20" 20.00
22" 25.00
25" 18.00
26" 32.00
Plus P & P £4

COLOUR TUNERS
Bush 6.50
GEC 6.50
PhilipsG6 S/S 6.50
Thorn 3000 6.50 (£8 new)
Pye 691/697 7.50
Some new tuners in stock can suppy on request. Many Foreign Tuners also available on request. Plus P & P £1

COLOUR LOPTS
Most lopts available from £7.00. Both British & Foreign makes. Please ring or write.
P & P per lopt £1

MISC.
S/Output transformer from £1.50
F/Output from £1.25
Scancoils from £5.00
P & P £1
Other spares available on request.

CABINETS
Many British & Foreign cabinets available. Please state.
Speakers, masks, etc., available on request. Please phone or write.

T.V.'s (MONO)

Rotaries
GEC 3.00
Thorn 950 3.00
K.B. Trans–tuners 3.00
Pye 3.00
etc.

P/Button
Thorn 1400 7.00
Bush 161 7.00
Baird 7.00
Philips 210 7.00
Pye 7.00
etc.

D/S P/Button

	20"	24"
Bush		10.00
GEC		10.00
Philips		10.00
Pye		10.00
etc.		

S/Standard

	20"	24"
Bush		12.00
GEC		12.00
Philips		12.00
Pye		12.00
Thorn		12.00
etc.		

COLOUR T.V.'s

D/S Colour
19", 25" from £30
i.e. GEC. Bush Philips, Baird etc.,

S/S Colour
19", 20", 22" 26" from £40
Working from £65
includes many makes as well as foreign models.

REDUCTION ON QUANTITIES

WHY NOT TRY OUR EXPRESS MAIL ORDER ON ANY OF THE ITEMS LISTED.
PLEASE ADD 12½% V.A.T. TO ALL ITEMS AND OVERSEAS AT COST. CASH WITH ALL ORDERS.

BRIARWOOD TELEVISION LTD.

Legram Mills, Summerville Road, Bradford, West Yorkshire BD7 1NS Tel (0274) 306018

BRIARWOOD TELEVISION LTD.

Legrams Mills, Summerville Road, Bradford, West Yorkshire BD7 1NS. Tel: (0274) 306018.

All transistors, IC's, offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc.

Please add 12½% VAT to all items and overseas at cost.

P & P U.K. 25p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

TYPE	PRICE £
AC107	0.23
AC113	0.17
AC115	0.17
AC117	0.24
AC125	0.20
AC126	0.18
AC127	0.19
AC128	0.15
AC131	0.13
AC141	0.23
AC142	0.16
AC141K	0.29
AC142K	0.29
AC151	0.17
AC165	0.16
AC166	0.16
AC168	0.17
AC176	0.15
AC176K	0.28
AC178	0.25
AC186	0.26
AC187	0.21
AC188	0.19
AC187K	0.34
AC188K	0.34
AD130	0.50
AD140	0.65
AD142	0.73
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.41
AD162	0.48
AD161 / AD162	1.30
AF106	0.42
AF114	0.20
AF115	0.22
AF116	0.22
AF117	0.22
AF118	0.58
AF121	0.43
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24
AF170	0.29
AF172	0.20
AF178	0.49
AF180	0.49
AF181	0.60
AF186	0.29
AF239	0.43
AU113	1.29
BA130	0.06
BA145	0.14
BA148	0.12
BA155	0.08
BAX13	0.03
BAX16	0.08
BC107	0.07
BC108	0.09
BC109	0.09
BC113	0.08
BC114	0.14
BC115	0.12
BC116	0.09
BC117	0.13
BC119	0.24
BC125	0.12
BC126	0.09
BC136	0.14
BC137	0.14
BC138	0.24
BC139	0.21
BC140	0.31
BC141	0.22
BC142	0.19
BC143	0.19
BC147	0.07
BC148	0.06
BC149	0.08
BC153	0.12
BC154	0.08
BC157	0.07
BC158	0.09
BC159	0.10
BC160	0.28
BC161	0.28
BC167	0.13
BC168	0.09
BC169C	1.00

TYPE	PRICE £
BC171	0.07
BC172	0.11
BC173	0.15
BC177	0.14
BC178	0.11
BC179	0.11
BC182L	0.08
BC183L	0.07
BC184L	0.11
BC186	0.12
BC187	0.08
BC209	0.14
BC212	0.13
BC213L	0.09
BC214L	0.14
BC237	0.07
BC240	0.31
BC281	0.24
BC262	0.20
BC263B	0.20
BC267	0.19
BC301	0.26
BC302	0.30
BC307	0.10
BC337	0.09
BC338	0.09
BC307A	0.12
BC308A	0.12
BC309	0.14
BC547	0.09
BC548	0.11
BC549	0.11
BC557	0.11
BD112	0.39
BD113	0.65
BD115	0.29
BD116	0.47
BD124	1.00
BD131	0.32
BD132	0.34
BD133	0.37
BD135	0.23
BD136	0.24
BD137	0.24
BD138	0.23
BD139	0.40
BD140	0.28
BD144	1.39
BD145	0.64
BD222/T1P31A	0.39
BD225/T1P31A	0.39
BD234	0.34
BD222	0.50
BDX22	0.73
BDX32	1.98
BDY18	0.75
BDY60	0.80
BF115	0.24
BF121	0.21
BF154	0.19
BF158	0.19
BF159	0.24
BF160	0.27
BF163	0.27
BF164	0.14
BF167	0.23
BF173	0.21
BF177	0.28
BF178	0.24
BF179	0.28
BF180	0.30
BF181	0.34
BF182	0.29
BF183	0.29
BF184	0.23
BF185	0.29
BF186	0.30
BF194	0.09
BF195	0.09
BF196	0.09
BF197	0.10
BF198	0.15
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.54
BF219	0.12
BF220	0.12
BF222	0.80
BF221	0.21
BF224	0.19
BF256	0.37
BF258	0.24
BF259	0.25

TYPE	PRICE £
BF260	0.24
BF262	0.39
BF263	0.25
BF271	0.20
BF273	0.12
BF336	0.35
BF337	0.24
BF338	0.29
BFT42	0.26
BFT43	0.24
BFX84	0.27
BFX85	0.27
BFX88	0.24
BFY37	0.22
BFY50	0.18
BFY51	0.17
BFY52	0.18
BFY53	0.27
BFY55	0.27
BHA0002	1.90
BR100	0.16
BSX20	0.23
BSX76	0.23
BSY84	0.36
BT106	1.18
BT108	1.23
BT109	1.09
BT116	1.23
BT120	2.08
BU105/02	1.87
BU105/04	2.25
BU126	1.40
BU205	1.97
BU208	2.49
BY126	0.09
BY127	0.10
OC22	1.10
OC23	1.30
OC24	1.30
OC25	0.45
OC26	0.40
OC28	0.60
OC35	0.45
OC36	0.58
OC38	0.43
OC42	0.45
OC44	0.18
OC45	0.18
OC46	0.35
OC70	0.22
OC71	0.28
OC72	0.35
OC74	0.35
OC75	0.35
OC76	0.35
OC77	0.50
OC78	0.13
OC81	0.20
OC810	0.14
OC82	0.20
OC820	0.13
OC83	0.22
OC84	0.28
OC85	0.13
OC123	0.20
OC169	0.20
OC170	0.22
OC171	0.27
OA91	0.05
BRC4443	0.85
R20108B	1.79
R2008B	1.79
R2010B	1.59
R2305	0.38
R2305/BD222	0.37
SCR957	0.81
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
T1590	0.19
T1591	0.19
TV106	1.09
DIODES	
1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.28
1N4751A	0.11
1N5401	0.10

TYPE	PRICE £
1N5404	0.12
1N5406	0.13
1N5408	0.16
VALVES	
DY87	0.52
DY802	0.64
ECC82	0.52
EF80	0.40
EF183	0.60
EF184	0.60
EH90	0.60
PC86	0.76
PC88	0.76
PCC89	0.65
PC189	0.65
PCF80	0.70
PCF86	0.68
PCF801	0.70
PCF802	0.74
PCL82	0.67
PCL84	0.75
PCL86	0.78
PCL805	0.70
PCF200	1.00
PL36	0.90
PL84	0.74
PL504	1.00
PL509	2.45
PX88	0.63
PX500A	1.50
PX81/800	0.57
E.H.T. TRAYS MONO	
950 MK2 1400	2.26
1500 18" 19" stick	2.37
1500 24" 5 stick	2.48
Single stick Thorn TV 11.16K 70V	0.75
TV 20 2 MT	0.75
TV20 16K 18V	0.75
IC's	
SN76013N	1.48
SN76013ND	1.20
SN76023N	1.50
SN76023ND	1.20
SN76226DN	1.50
SN76227N	1.20
TBA341	0.97
TBA520Q	1.50
TBA530Q	1.40
TBA540Q	1.45
TBA 550Q	1.50
TBA560CQ	1.90
TBA570Q	1.40
TBA800	1.00
TBA810	1.50
TBA920Q	1.80
TBA990Q	1.60
TCA270SQ	1.45
TCA270SA	1.45
TCA1327B	1.00
E.H.T. TRAYS COLOUR	
Pye 691 693	4.81
Decca (large screen) CS2030/2232/2630/2632/2230/2233/2631	5.67
Philips G8 520/40/50	5.66
Philips G9	5.79
GEC C2110	5.97
GEC Hybrid CTV	5.57
Thorn 3000/3500	5.50
Thorn 800	2.42
Thorn 8500	5.23
Thorn 9000	6.10
GEC TVM 25	2.50
ITT/KB CVC 5/7/8/9	5.96
RRI (RBM) A823	5.89
Bang & Olufsen 4/5000 Grundig 5010/5011/5012/6011/6012/7200/2052/2210/2252R Tandberg (radionette) Autovox	6.60
Grundig 3000/3010 Saba 2705/3715 Telefunken 709/710/717/2000	6.80
Korting	6.80

TELEVISION TUBE SHOP

NEW TUBES AT CUT PRICES

A28-14W	£18.95
A31-410W	£16.95
AW59-91/CME2303	£15.50
CME1220/A31-120W	£15.95
CME1420/A34-100W	£16.50
CME1520/A38-160W	£17.50
CME1602/A40-12W	£13.50
CME1713/A44-120	£17.50
CME1906/A47-13W	£12.50
CME2013/A50-120	£17.95
CME2313/A59-23W	£18.95
CME2413/A61-120W	£18.95
TSD217/282	£8.50

JAPANESE etc. TUBES

9AGP4	£17.50
190AB4	£15.00
190CB4	£15.00
230ADB4	£15.95
230DB4/CT468	£15.95
CT507	£17.50
240AB4A	£15.95
310DMB4/DGB4	£19.00
310DWB4/DJB4	£19.00
310EDB4	£18.75
310EUB4	£19.50
310EYB4	£16.50
310FDB4	£19.95
310FXB4 Equivalent	£15.95
310GNB4A	£25.19
310HCB4	£19.95
340AB4	£19.50
340AYB4	£22.00
340CB4	£23.00
340RB4	£23.00
340AHB4	£24.50

COLOUR TUBES

12VARP22	£62.50
330AB22	£61.50
470FUB22B	£79.50
A47-342X	£69.50
A49-191X/120X	£52.00
A51-220X/510DJB22	£64.00
A56-120X	£59.50
A56-140X/410X	£62.00
A66-120X	£75.00
A63-11X/120X	£69.50
A67-120X	£82.00
A66-140X/410X	£70.50

ALL TUBES GUARANTEED 12 MONTHS

CARRIAGE:
Mono £1.75. Colour £2.50
N. Ireland £4.00

ADD VAT TO ALL PRICES

TELEVISION TUBE SHOP

52 BATTERSEA BRIDGE RD., LONDON. SW11. Tel. 228 6859

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.46
AC117	0.38
AC126	0.36
AC127	0.54
AC128	0.46
AC128K	0.55
AC141	0.65
AC141K	0.70
AC142	0.60
AC142K	0.65
AC151	0.31
AC152	0.36
AC153	0.42
AC153K	0.52
AC154	0.41
AC176	0.45
AC178	0.51
AC179	0.55
AC187	0.56
AC187K	0.65
AC188	0.52
AC188K	0.61
AC193K	0.70
AC194K	0.74
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.02
AD140	1.79
AD142	1.90
AD143	1.78
AD149	1.98
AD161	0.68
AD161/162	1.22
AD162	0.71
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.42
AF118	0.98
AF121	0.68
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.86
AF139	0.58
AF147	0.52
AF149	0.45
AF178	1.35
AF179	1.36
AF180	1.35
AF181	1.33
AF186	1.48
AF202	0.27
AF239	0.63
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.45

Type	Price (£)
AU103	2.60
AU107	2.75
AU110	2.40
AU113	2.60
BC107*	0.16
BC108*	0.15
BC109*	0.16
BC113	†0.22
BC114	†0.22
BC115	†0.24
BC116*	†0.25
BC117	†0.30
BC118	†0.24
BC119	†0.54
BC125*	†0.30
BC126	†0.30
BC132	†0.20
BC134	†0.22
BC135	†0.21
BC136	†0.22
BC137	†0.30
BC138	†0.32
BC140	0.36
BC141	0.37
BC142	0.35
BC143	0.38
BC147*	†0.12
BC148*	†0.12
BC149*	†0.13
BC152	†0.42
BC153	†0.38
BC154	†0.41
BC157*	†0.13
BC158*	†0.12
BC159*	†0.14
BC160	0.40
BC161	†0.41
BC167B	†0.15
BC168B	†0.14
BC169C	†0.15
BC170*	†0.15
BC171*	†0.15
BC172*	†0.14
BC173*	†0.22
BC174A & B	†0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	†0.15
BC182L*	†0.15
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.15
BC184L*	†0.15
BC185	0.36
BC186	0.25
BC187	0.27

Type	Price (£)
BC192	0.56
BC204*	†0.39
BC205*	†0.39
BC206*	†0.37
BC207*	†0.36
BC208*	†0.37
BC209*	†0.39
BC211*	†0.36
BC212*	†0.17
BC212L*	†0.17
BC213*	†0.16
BC213L*	†0.16
BC214*	†0.18
BC214L*	†0.18
BC225	†0.42
BC237*	†0.16
BC238*	†0.15
BC239*	†0.22
BC251*	†0.25
BC252*	†0.26
BC253*	†0.38
BC261A*	†0.28
BC262A*	†0.28
BC263*	†0.26
BC267*	0.20
BC268*	0.28
BC286	0.40
BC287	0.49
BC291	0.27
BC294	†0.37
BC297	0.21
BC300	0.62
BC301	0.38
BC302	0.56
BC303	0.64
BC304	0.44
BC307*	†0.17
BC308*	†0.14
BC309*	†0.18
BC317*	†0.15
BC318*	†0.15
BC319*	†0.19
BC320	†0.17
BC321A & B	†0.18
BC322	†0.28
BC323	0.94
BC327	†0.24
BC328	†0.21
BC337	†0.22
BC338	†0.19
BC340	0.19
BC347*	†0.17
BC348A & B	†0.17
BC349B	†0.17
BC350*	†0.24
BC351*	†0.22
BC352A*	†0.24
BC360	0.59

Type	Price (£)
BC377	0.22
BC394	0.32
BC440	0.52
BC441	0.59
BC461	0.78
BC477	0.20
BC478	0.19
BC479	0.19
BC547*	†0.16
BC548*	†0.16
BC549*	†0.16
BC550	†0.18
BC556	†0.16
BC557*	†0.16
BC558*	†0.16
BC559*	†0.16
BCY10	0.30
BCY30A	0.96
BCY32A	1.09
BCY34A	0.93
BCY72	0.27
BD115	1.35
BD123	1.50
BD124	1.85
BD130Y	1.56
BD131	0.58
BD132	0.68
BD133	0.56
BD135	†0.42
BD136	†0.48
BD137	0.42
BD138	0.46
BD139	0.50
BD140	0.53
BD144	2.24
BD145	0.75
BD150A*	†0.41
BD155	†0.90
BD157	0.51
BD158	0.75
BD159	0.68
BD160	2.79
BD163	0.67
BD165	0.66
BD166	0.88
BD175	0.90
BD177	0.58
BD178	0.92
BD181	1.94
BD182	2.20
BD183	1.34
BD184	2.20
BD187	1.20
BD188	1.25
BD189	0.71
BD222	0.78
BD225	0.91
BD232	0.94
BD233	0.78

Type	Price (£)
BD234	0.78
BD235	0.85
BD236	0.82
BD237	0.93
BD238	0.98
BD253	1.58
BD410	1.65
BD433	0.79
BD435	0.76
BD436	0.83
BD437	0.88
BD438	1.17
BD519	0.68
BD520	0.88
BD599	0.87
BD600	1.23
BD663BR	0.86
BDX18	1.55
BDX32	2.95
BDY16A	0.43
BDY18	1.55
BDY20	2.20
BDY38	1.38
BF115	0.53
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.48
BF125	0.55
BF127	0.51
BF137F	0.78
BF152	†0.19
BF158	†0.19
BF159	†0.27
BF160	†0.20
BF161	0.45
BF163	†0.65
BF164	†0.95
BF166	0.38
BF167	0.48
BF173	0.45
BF177	0.36
BF178	0.46
BF179	0.58
BF180	0.50
BF181	0.50
BF182	0.44
BF183	0.52
BF184	0.44
BF185	0.42
BF186	0.42
BF194*	†0.14
BF195*	†0.13
BF196	†0.14
BF197	†0.15
BF198	†0.29
BF199	†0.29
BF200	†0.25
BF218	†0.42

Type	Price (£)
BF222	†0.26
BF224 & J	†0.22
BF240	†0.32
BF241	†0.31
BF244*	†0.51
BF245*	†0.43
BF254	†0.48
BF255	†0.58
BF256L*	†0.49
BF257	†0.47
BF258	†0.52
BF259	†0.54
BF262	0.73
BF263	0.88
BF270	0.47
BF271	0.52
BF272A	0.80
BF273	†0.33
BF274	†0.34
BF336	0.54
BF337	0.60
BF338	0.68
BF355	†0.65
BF362	†0.66
BF363	†0.66
BF367	†0.29
BF451	0.43
BF457	0.53
BF458	0.59
BF459	0.63
BF594	†0.16
BF596	†0.17
BF597	†0.27
BFR39	†0.39
BFR40	†0.29
BFR41	†0.30
BFR50	†0.29
BFR52	†0.33
BFR61	†0.29
BFR62	†0.28
BFR79	†0.30
BFR80	†0.29
BFR81	†0.30
BFR88	†0.42
BFT41	†0.48
BFT43	0.55
BFW11	0.98
BFW30	3.15
BFW59	†0.19
BFW60	†0.20
BFW90	†0.65
BFX29	0.38
BFX84	0.42
BFY50	0.38
BFY51	0.37
BFY51	0.36
BFY53	0.36
BFY90	1.98
BPX25	1.90

Type	Price (£)
BPX29	1.82
BR101	0.48
BR103	0.64
BR303	1.06
BRC4443	0.96
BRY39	0.65
BRY56	†0.44
BSS27	0.92
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	2.85
BU105	†1.80
BU105/02	†1.95
BU108	†2.98
BU126	†2.41
BU204	†2.38
BU205	†2.64
BU206	†2.95
BU208	†4.93
BU407	†1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	†0.56
D40N1	0.64
E1222	0.47
E5024	†0.19
GET872	0.46
MC140	†0.36
ME0402	†0.18
ME0404	†0.18
ME6001	†0.18
ME6002	†0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.96
MJE3055	1.22
MPF102	†0.40
MPS3702	†0.33
MPS3705	†0.30
MPS6521	†0.36
MPS6523	†0.36
MPS6566	†0.44
MPSA05	†0.30
MPSA06	†0.32
MPSA55	†0.43
MPSA56	†0.45
MPSA93	†0.56
MPSL01	†0.33
MPSU01	0.61

Type	Price (£)
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
MPSU60	0.82
MPSU131	†0.59
OC26	1.90
OC28	1.49
OC29	1.60
OC35	1.25
OC36	1.25
OC42	0.90
OC44	0.68
OC45	0.63
OC70	0.65
OC71	0.73
OC72	0.73
OC81	0.83
OC81D	0.95
OC139	1.30
OC140	1.35
OC070	0.80
OC171	0.82
OC200	3.90
OC201	3.95
OC202	2.40
OC205	3.95
OCP71	1.98
ON236A	0.94
R2008B	†2.62
R2010B	†2.79
R2322	†0.75
R2323	†0.85
ST2110	0.49
ST6120	0.48
TIC44	†0.25
TIC46	†0.35
TIC47	†0.45
TIP29A	0.47
TIP30A	0.50
TIP31A	0.51
TIP31C	0.67
TIP32A	0.56
TIP32C	0.72
TIP33A	0.77
TIP34A	0.84
TIP41A	0.72
TIP42A	0.80
TIP2955	0.77
TIP3055	0.58
TIS43	†0.44
TIS73	†1.36
TIS90	†0.23
TIS91	†0.28
ZTX108	†0.14
ZTX109	†0.16
ZTX213	†0.20
ZTX300	†0.16
ZTX304	†0.26

Type	Price (£)
ZTX500	†0.18
ZTX502	†0.22
ZTX504	†0.28
2N404	1.30
2N696	0.40
2N697	0.41
2N706A	0.33
2N708	0.29
2N914	0.32
2N916	0.36
2N918	0.52
2N930	0.29
2N1164	8.29
2N1304	1.40
2N1305	1.29
2N1306	1.49
2N1307	1.32
2N1308	1.53
2N1711	0.57
2N1893	0.52
2N2102	0.71
2N2217	0.55
2N2218	0.38
2N2219	0.42
2N2221A	0.26
2N2222A	0.41
2N2369A	0.40
2N2401	0.80
2N2484	0.55
2N2570	0.74
2N2646	0.82
2N2784	1.15
2N2869	2.08
2N2894	0.85
2N2904*	0.40
2N2905*	0.43
2N2906*	0.26
2N2926G	†0.15
2N2926O	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.38
2N3054	0.86
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	12.70
2N3703	†0.17
2N3704	†0.19
2N3705	†0.17
2N3706	†0.16
2N3707	†0.18
2N3708	†0.17
2N3715	1.70
2N3771	2.39
2N3772	2.58
2N3773	3.90
2N3794	†0.40

Type	Price (£)
2N3819	†0.47
2N3820	†0.72
2N3866	1.38
2N3904	†0.20
2N3905	†0.20
2N3906	†0.20
2N4036	0.84
2N4123	†0.17
2N4124	†0.17
2N4126	†0.17
2N4236	1.60
2N4289	†0.32
2N4292	†0.32
2N4416	0.85
2N4444	1.90
2N4921	0.80
2N5042	1.65
2N5060	†0.28
2N5061	†0.30
2N5064	†0.63
2N5086	†0.49
2N5087	†0.50
2N5208	†0.59
2N5294	0.66
2N5296	0.68
2N5298	0.71
2N5322	1.16
2N5449	†0.18
2N5457	†0.46
2N5458	†0.40
2N5459	†0.58
2N5494	0.85
2N5496	1.05
2N6027	0.55
2N6107	0.71
2N6122	0.60
2N6178	1.07
2N6180	1.39
2N6211	2.74
2SB337BP	4.28
2SC458C	0.78
2SC643A	2.25
2SC930D	1.50
2SC1061	1.45
2SC1172Y	3.55
2SD234	1.48
3N128	1.60
40250	0.98
40251	1.14
40327	0.67
40361	0.48
40362	0.50
40410	0.94
40429	0.88
40530	0.79
40595	1.39
40603	1.13
40636	1.25
40654	0.89

Alternative gain versions available on items marked*.

For matched pairs add 20p per pair.

LINERS IC's

Type	Price (£)
BRC1330	†0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	†1.74
CA3068	1.90
CA3130S	1.57
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N	1.30
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
MC1350P	†1.22
MC1351P	†1.42
MC1352P	†1.42
MC1357P	†2.92
MC1358P*	†2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC4008	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	2.56
ML231	†3.57
ML232	†3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	†5.70
SAA1025	†10.35
SAS560	†2.01
SAS570	†2.01
SC9503P	†1.40
SC9504P	†1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.20
SL917B	†5.60
SL918A	†4.95
SN72440N	†2.21
SN76001N	†1.67
SN76003N	2.22

Type	Price (£)
SN76008KE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	1.62
SN76116N	1.78
SN76131N	1.32
SN76226N	†2.00
SN70227N	†1.61
SN76228N	1.80
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.85
SN76546N	†1.85
SN76570N	†1.81
SN76620AN	†0.99
SN76650N	†1.48
SN76660N	†0.64
SN76666N	†0.96
TA7073P	†3.51
TAA263	†2.20
TAA300	†2.20
TAA320	1.10
TAA350A	†2.48
TAA370A	3.18
TAA435	†1.70
TAA450	†3.39
TAA521	1.10
TAA522	2.09
TAA550	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.20
TAA611B	1.85
TAA621AXI	2.43
TAA630Q	3.91
TAA630S	4.18
TAA661A	1.75
TAA661B	1.75
TAA700*	†2.80
TAA840	†3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	†2.25
TAA970	†2.48
TAD100	†2.66
(Filter)	0.98
TBA120A	†0.90
TBA120S*	†0.99
TBA120SA	†1.02
TBA231	1.32

Type	(Price (£)
TBA240A	†3.98
TBA281	†2.07
TBA395*	†2.58
TBA396	†2.40
TBA400	†2.20
TBA480Q	†1.84
TBA500*	†2.21
TBA510*	†2.21
TBA520P*	†3.40
TBA530*	†2.24
TBA540*	†2.88
TBA550*	†3.13
TBA560C*	†3.18
TBA570*	†1.29
TBA611B	2.88
TBA641	2.55
TBA641A12	2.55
TBA641B11	2.90
TBA651	†2.42
TBA673	†2.19
TBA700*	†2.50
TBA720AQ	†2.38
TBA720Q	†2.38
TBA750*	†2.18
TBA800	2.05
TBA810AS	2.00
TBA920*	†3.80
TBA940	†3.52
TBA950	†2.78
TBA990*	†2.90
TCA270A*	†3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	1.98
TCA440	1.67
TCA640	2.76
TCA650	2.76
TCA660	2.76
TCA730	3.54
TCA740	3.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	†4.36
TDA1003	1.52
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	1.98
TDA2610	2.86
TDA2640	2.86
ZN414	1.45

* Indicates Q version is also available.

DIODES

Type	Price (£)
AA133	0.17
AA119	0.21
AA129	0.28
AA143	0.18
AAY30	0.16
AAZ13	0.30
AAZ15	0.32
AAZ17	0.26
AY102	2.55
BA100	0.24
BA102	0.28
BA110	0.80
BA111	0.70
BA115	0.15
BA116	0.38
BA121	0.85
BA129	0.39
BA145	0.19
BA148	0.19
BA154	0.19
BA155	0.16
BA156	0.15
BA157	0.25
BA158	0.28
BA159	0.40
BA164	0.14
BA170	0.18
BA182	0.24
BA201	0.13
BA202	0.14
BA203	0.14
BA216	0.08
BA219	0.11
BA243	0.45
BA317	0.06
BA318	0.07
BAV10	0.12
BAV21	0.18
BAW62	0.06
BAX13	0.07
BAX16	0.09
BAX17	0.20
BAY72	0.16
BB104B	0.52
BB105B	0.33
BB105G	0.30
BR100	0.40
BY100	0.35
BY103	0.35

Type	Price (£)
BY114	0.60
BY118	1.10
BY126	0.30
BY127	0.34
BY133	0.35
BY140	1.40
BY164	0.82
BY176	2.80
BY179	0.91
BY182	1.14
BY184	0.39
BY189	5.30
BY190	4.90
BY206	0.26
BY238	0.25
BYX10	0.31
BYX38/600	0.70
BYX70/500	0.53
FSY41A	0.51
ITT44	0.08
ITT210	0.63
ITT827	0.80
MCR101	0.43
MR854	1.10
OA5	0.88
OA10	0.58
OA47	0.20
OA81	0.19
OA90	0.13
OA91	0.15
OA95	0.20
OA200	0.11
OA202	0.13
OA210	0.89
TIL209	0.14
TIL211	0.18
TV20	2.25
IN914	0.06
IN916	0.09
IN4001	0.06
IN4002	0.07
IN4003	0.08
IN4004	0.08
IN4005	0.09
IN4006	0.10
IN4007	0.12
IN5400	0.15
IN5401	0.17
IS920	0.09
IS921	0.11

ZENER DIODES

400mW plastic	3.0-33V	14p each
1/1.3W plastic	3.3-180V	18p each
1.5W flange	4.7-75V	£1.08 each
2.5W plastic	7.5-75V	67p each
20W stud	7.5-75V	92p each
76W stud	7.5-75V	£6.88 each

VDR's, etc. (†)

Type	Price (£)
E295ZZ	
/01	0.21
/02	0.21
E298CD	
/A258	0.24
E298ED	
/A258	0.21
/A260	0.21
/A262	0.21
/A265	0.21
/P268	0.21
E298ZZ	
/05	0.24
/06	0.21
E299DD/P116-P354	all 0.20
E299DH	
/P230	0.72
R53	1.75
VA1015	0.92
VA1026	0.79
VA1033/34/38/39/40/53	all 0.17
VA1055s/56s/66s/67s	all 0.22
VA1074	0.17
VA1077	0.31
VA1091	0.29
1096/97/98	all 0.19
VA1103	0.31
VA1104	0.44
VA1108/09/10/11/12	All 0.23
VA8650	1.20
2322 554 02221	0.59
2322 662 98003	0.85

VALVES (†)

Type	Price (£)
DY86/87	0.54
DY802	0.54
ECC81	0.54
ECC82	0.54
ECC83	0.54
ECH81	1.33
ECL80	0.79
EF80	0.54
EF183	0.70
EF184	0.70
EH90	0.94
EL34	1.08
EY51	1.06
EY86/87	0.54
PCC84	0.65
PCC85	0.79
PCC89	0.74
PCC189	0.94
PCF80	0.65
PCF86	0.74
PCF200	1.16
PCF801	0.74
PCF802	0.79
PCF805	1.43
PCF808	2.00
PCL82	0.65
PCL83	0.74
PCL84	0.65
PCL86	0.74
PCL805/85	0.74
PD500	3.75
PFL200	0.94
PL36	1.08
PL81	0.94
PL84	0.79
PL504	1.05
PL508	1.33
PL509	3.10
PL519	3.10
PL802	3.25
PY81/P810	0.58

BRIDGES

Rating	Price (£)	Rating	Price (£)
1½A 50V	0.27	2A 100V	0.36
100V	0.28	200V	0.40
200V	0.32	400V	0.47
400V	0.40	600V	0.53
600V	0.50	800V	0.60
800V	0.58	1000V	0.87
3A 100V	0.52	6A 100V	0.66
200V	0.55	200V	0.68
400V	0.61	400V	0.74
600V	0.67	600V	0.80
800V	0.80	800V	0.86
1000V	1.20	1000V	0.95

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) (†)	Ca	10 of one value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.49	£6.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.49	£6.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£6.40	£26.60

Mixes of a minimum of 10pcs of any value totals: 50pc, 100pc, 500pc

Wirewound (5%)

2½W 0.22Ω-270Ω	18p
4W 1.0Ω-10kΩ	22p
7W 1.0Ω-22kΩ	24p
11W 1.0Ω-22kΩ	28p
17W 1.0Ω-22kΩ	33p
Vertical mounting pillars	3p

Dropper Sections (5%)
7, 10, 12, 14, 17.5, 22, 25, 33, 40, 47, 56, 86, 87, 100, 120, 160, 180, 220, 250, 300, 400, 470, 560, 720Ω, 1, 2kΩ **all 46p each**

FUSES (all packs of 10)

20mm Time Delay (BEAB)

40mA	£3.68
50, 63mA	£2.55
100mA	£1.86
160, 200, 250mA	£1.44
315, 500, 800mA, 1.6, 2, 2.5, 3.15, 5A	all £1.19

20mm quick-blow (BEAB)

100mA	68p
200, 250, 315, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A	all 56p

2A circuit breakers metal £1.52, plastic £1.48

LABGEAR (Details of full range on request)

COLOURTEXT ADAPTOR 7026
Full facility Colourtext decoder to place between aerial and receiver. All you would expect of a quality ready-made unit. Leaflet on request. †£340.20

COLOUR BAR GENERATOR
CM6052/DB. VHF/UHF gives standard 8 band colour bars + variable tuning + front panel on/off switch + sync trigger output + blank raster + red raster + crosshatch + greyscale stepwedge + colour bar + centre cross + dot pattern + centre dot. £182.25

VHF to UHF CONVERTER
CM6022/RA. "Televerta" for DX-ing or uhf receiver use on relay systems, Eire, etc. †£24.40

P. & P. UK: £0.12 per order. **Overseas:** At cost.
Please add VAT at 8% and 12½% on items marked†.
It is only possible to show part of our range here. Our catalogue (30p refundable) shows Serrirol products, 7400 series, CMOS, op amps, SCRs etc., hardware, capacitors, special TV items and many more transistors, diodes, i.c.'s and valves.
Giro A/c 23 532 400. *A/c facilities available*

EAST CORNWALL COMPONENTS

CALLINGTON – CORNWALL
PL17 7DW
TEL: CALLINGTON (05793) 2637. TELEX: 35544
(OFFICE OPEN 9.30-5.00 MON-FRI)

TELEVISION

EDITOR
John A. Reddihough

ASSISTANT EDITOR
Luke Theodossiou

ART EDITOR
Roy Palmer

ADVERTS MANAGER
Roy Smith 01-261 6671

CLASSIFIED ADVERTS
Colin R. Brown 01-261 5762

Crystal Gazing

The danger with prophesy is that you can be badly wrong – soon! That doesn't stop people having a go at what can be a fascinating pastime however. But with the present rate at which technical developments are being brought into use, speculation on the future is particularly risky. One can see a couple of years ahead reasonably clearly – but ten years? The last ten years in the domestic television field have been dominated by colour and the increasing use of solid-state techniques. Ten years ago one stood a reasonable chance of forecasting the state of affairs in 1978. But to suggest how things will stand in 1988 is problematic indeed. How far will digital techniques have gone in TV? Will the TV set be the user part of a massive information system? Perhaps you'll wake up in the morning to find on your screen a list of reminders and a timetable of the day's engagements. It would be a brave man who would stand up and pronounce – yet that's precisely what Dr. Boris Townsend, Head of the IBA's Engineering Information Service, did recently at an IBA lecture. Interesting, since he if anyone should be in a position to give an informed guess.

Before turning to what Dr. Townsend had to say however a cautionary tale. Not so long since we were sent an editorial written by Hugo Gernsback in the January 1950 *Radio-Electronics*. "Television in 1975" it was headed, which strikes us as being a trifle rash. After all, colour was then in its infancy, and TV itself as a practical system pretty new. Yet Hugo wrote "We in television 25 years ago had a pretty good idea of what television could and would do by 1950." We in television in 1925?! Anyway, what was it going to be like in 1975? "It's a safe bet that every 1975 set will have color". Not bad that – but it would probably be "electronic-color", and it would be a "four-color" system instead of three... Next, the picture would be three-dimensional and the "television antenna will be right in the set itself". While the aerial was disappearing into the set, there would be "automatic electronic ghost elimination". I should think so! Finally, there'd be just "a single knob for off-and-on and for sound control" – and just one programme presumably. No mention of solid-state possibilities, though "the average table model of 1975 will have 12 tubes or fewer". Actually, we'd already got there: the Baird Everyman Model T29 had just twelve valves (including the c.r.t.) and two knobs – in 1949.

So from 25 years ago to ten years hence, what does Dr. Townsend think we have in store for us? Actually, Dr. Townsend's concern was with broadcasting as a whole rather than the domestic environment, and of course it's part of the job of the broadcasters to keep technical developments and possibilities under review. We should pay attention to him therefore, though only one or two points from a wide ranging review can be mentioned here. From the domestic viewpoint, microcircuits will become micromicrocircuits, making practical signal processing of much greater complexity; the c.r.t. will still be there; direct broadcasting from satellites into everyone's home will become practical (the system's already planned); we can expect the domestic set "to be as much a computer visual display unit as it is a television set, while television broadcasting will face even more competition than does radio"; there's no particular indication that anyone is anxious for three-dimensional television; and "two quite different forms of television service" may emerge, the present networks plus "community television."

On the studio side it will be digital all the way – digital recorders and telecine equipment, and instead of scenery "the scenery camera will look at a flatly lit photograph of the required background and a graphics computer will adjust the perspective and the shadows of the transmitted image as required". Not only will the scenery go – so too will the operational and maintenance engineers: equipment will incorporate "a self-diagnostic fault-analysis routine" so that the factory computer can interrogate it – by satellite if necessary. And "cameras will automatically produce suitable television pictures almost regardless of scene lighting" as a result of "novel signal-processing ideas."

Summing up, Dr. Townsend commented "I have ignored the two or three unpredictable breakthroughs in basic science and materials engineering which we can reasonably and statistically expect in this period. One could assert that there will be nothing remarkable in the 1980s, because almost anything we wish to do with our technology will be feasible."

The only point we'd add, in our rather dour fashion, is that the slow economic growth prospects (standstill?) could well result in some loss of impetus in technological development. Maybe almost anything will be feasible: the questions are more likely then to be "will we really want it, and will we be able to afford it?"

Teletopics

VHS VCR LAUNCHED IN UK

The first Japanese videocassette recorder has now been launched on the domestic UK market – JVC's VHS (Video Home System) machine. It's the first to offer three hours' playing time, and cassettes will be available giving three, two, one and half an hour playing times. The machine plays back via a TV set's aerial socket, and can be used with a video camera for home recording or to transfer 8mm film material on to tape using the camera and a simple telecine attachment. The basic machine (Model HR-3300) is expected to sell at around £700 plus VAT, with distribution through about 150 JVC appointed dealers only. The HR-3300 is compact, measuring 453×147×314mm and weighing 13·9kg. The ferric tape cassettes are being marketed by JVC but will also be produced under licence by other well known tape manufacturers, including EMI and 3M. Prerecorded cassettes are expected to follow.

PHILIPS EXTEND VCR PLAYING TIME

Meanwhile, Philips have extended the playing time available from their recently introduced N1700 VCR with the introduction of a new long play two and a half hour tape. The extra playing time is achieved by using improved superchrome tape with a thickness of 15μ. Philips comment that the vast majority of UK TV output falls within the limit of two and a half hours, so that the new tape should meet all possible needs. It will also increase the playing time possible with the earlier N1500/N1501/N1502 series of VCRs to just under seventy minutes.

1977 FIGURES

BREMA have now released the full figures for TV set deliveries during 1977. 1·64 million colour sets were delivered to dealers, an increase of 8.9 per cent compared with 1976. Of this total, 1·329 million sets were UK produced, an increase of 2·8 per cent. A total of 1·035 million monochrome sets were delivered, an increase of 3·2 per cent. Slightly over half of these were UK produced, an increase of 11·6 per cent.

BREMA point out that although deliveries have improved there has been no matching increase in consumer purchases. As a result, distributor and importer stocks are substantially higher than a year ago.

Though setmakers have had a slightly better year, many are still operating at a loss on their TV side, as recent figures from Decca and Rank show. Meanwhile Japanese colour receiver exports worldwide fell 15·8 per cent last year, from 5·25 to 4·42 million sets. The decline was mainly due to a 28 per cent drop in exports to the USA following an agreement to curtail exports to the US from last July.

VIEWDATA CONFIDENCE

The PO is showing confidence in the future of its Viewdata service, which is to start a year earlier than originally planned. Up to £5 million is to be spent immediately on setting up ten Viewdata centres in London, Birmingham and Norwich, and there will be a further £18 million to extend and develop the service, with centres planned for Cardiff, Leeds, Manchester and Edinburgh. The London boroughs of Bexleyheath, Hammersmith, Hounslow, Redbridge, Sutton, Waltham Forest and Lewisham will be the first to receive the service, which is due to start in June. The PO and TV industry are at present collaborating with 150 companies and organisations in providing information for the service. 1,500 viewers will take part in the initial trial, using specially built receivers incorporating Viewdata facilities. All major UK setmakers are taking part in this operation. It's estimated that rental terms for such receivers will be about £18 a month, or about 50 per cent more than current standard set rentals. The Viewdata subscriber must also pay for his calls to the central computer. The charge is expected to range from a fraction of a penny to up to 50p for each page called up, depending on the cost of preparing the information. The PO has already earmarked £3 million towards the trial.

COLOUR TRANSPORTABLE FROM PHILIPS

Philips have become the second UK setmaker to offer a 14in. colour transportable TV set. Their Model 825 is fitted with the solid-state KT2 chassis. There are eight push-button programme selectors, and sockets for headphones and an extension speaker – these will mute the internal speaker if required. There's a loop aerial for use in good signal areas, plus the usual aerial socket. The trade price is around £195.

In addition, Philips have announced a 14in. version of their recently introduced UK made 12in. monochrome portable.

NEW GEC PORTABLES

A new chassis is used in the latest GEC monochrome portables, Models M1201H and M1501H, which have replaced the previous 3133/3135. The ingenious "transistor pump" circuit to provide a regulated supply has gone, replaced by a conventional series regulator circuit. The varicap tuner is followed by an i.f. strip consisting of a BF199 followed by a TBA1441 i.c. The new U version of the TBA120 provides the intercarrier sound channel, followed by a TCA830S audio i.c. The sync separator, line oscillator and field oscillator are all within the SN76546 i.c., while the line output stage features a BU407, which is rapidly establishing itself as the standard line output transistor for small screen portables. As with several other recent portables, the e.h.t. rectifier is encapsulated within the line output transformer.

TV GAMES WAR HOTS UP

Shock news from the well known TV games firm Videomaster is that the directors have called in a Receiver. It's understood that the firm intends to keep trading.

With programmable games about to be imported at prices similar to those of the present generation of TV games there's likely to be fierce competition in this field.

NEW AVO DIGITAL MULTIMETER

The new digital multimeter introduced by Avo, Model DA116, features a liquid crystal display giving long battery life, large 13mm high characters, a wide field of view and easily recognisable symbols, and has been designed for both servicing and laboratory work. Internally, the instrument employs the latest l.s.i. techology, with a single i.c. used for the analogue to digital conversion. All ranges except the 10A range, for which a separate socket is provided, are fuse protected. A.C. and d.c. voltages from 200mV to 1kV f.s.d. and current measurements from 200μA to 10A f.s.d. can be made, and an e.h.t. probe is to follow. There's a high-speed Ohms range, intended to speed up continuity testing, along with six normal resistance ranges which give high accuracy measurements up to 20MΩ. The response time on the high-speed Ohms range is reduced by a factor of ten. Another new feature is the semiconductor junction test range, which indicates the voltage drop across the junction for a nominal current of 0·5mA.

The new Avo DA116 digital multimeter.

SERVICE BRIEFS

Philips point out that if it's necessary to replace the e.h.t. tripler in the Pye 725/731/735/737/741 series chassis, C563 (0·1μF) should be checked in case it has gone short-circuit. It's the capacitor at the earthy side of the e.h.t. overwinding, used to generate the 1kV supply for the c.r.t. first anode presets. For replacement purposes, type OT121 or BT151/800R thyristors should be used in the power supply circuit in the Philips/Pye G11 chassis.

TRANSMITTER NEWS

There is increased transmitter power at two relay stations, **Pontardawe** (West Glamorgan) and **Campbeltown** (Scotland), to extend the coverage area.

The **Chisbury** (Wiltshire) relay station has come into operation on channels 55 (BBC-1), 59 (Southern Television) and 62 (BBC-2). Vertically polarised group C/D receiving aerials should be used.

THE RANK COLOUR TRANSPORTABLE

There are some interesting technical features in the new Rank colour transportable Model BC6004. The decoder uses the Philips two-chip package, TDA2560/TDA2522, plus the well known TBA530 matrixing i.c. which drives class B RGB output stages – these are described elsewhere in this issue. The TDA2590, an up-dated TBA920, takes care of the sync and line oscillator functions, while a TDA1170 is used for field deflection. The BU208 line output stage is interesting in employing a transductor for e.h.t. regulation: we'll have more to say on this in a later issue. There's a conventional diode modulator for EW raster correction. The i.f. strip consists of a BF199 followed by a TDA440, while a TDA1035 takes care of the intercarrier sound channel and audio output. The 370DLB22 tube requires no convergence circuitry.

LETTERS

THORN 1600 CHASSIS

I have experienced the same trouble with one of these sets reported in the January *Your Problems Solved* – no e.h.t., with low voltages in the line driver and output stages but no transistor problems. Unloading the line output stage was tried, and on disconnecting the line scan coils the h.t. voltage was restored and the 32V shunt regulator operated correctly – but the e.h.t. was only 8kV. A further test revealed low line drive. The cause was the bias resistor R138 (470kΩ) in the line driver stage – it had changed value. Replacing the resistor and the line scan coils restored the set to normal operation. The line output transistor seemed to be overheating during the fault condition incidentally. – **M. W. Colton,** *Woking, Surrey.*

Editorial comment: R138 seems to be becoming a trouble spot on these sets. See Les Lawry-Johns last month, page 322.

SERVICING HAZARD

In the March *Service Notebook* the problem of the c.r.t. heater going open-circuit was mentioned. There's a remedy for this however, and I've had an 80 per cent success rate with it. The procedure (pulse welding) is as follows. Remove the c.r.t. base and short the heater pins to restore heater chain continuity. Connect pin 8 (heater) of the c.r.t. to chassis and connect a long lead to the other heater pin (1). Switch the set on and wait until the line output stage comes into operation. Touch the lead connected to pin 1 to the top cap of the line output valve until the tube heater lights. Finally remove the leads and replace the tube base. The heaters should then operate normally. – **TV Engineer,** *Dublin.*

Servicing the B & O 3500/4000/5000/6000 Chassis

James Brice, B.Sc. (Eng.)

WHEN this chassis was first introduced it was something of a departure from the previous form for Bang and Olufsen. Gone were the double line output stages (one for line scan and the other for e.h.t.), eating some hundreds of watts – and also PL509s. In fact this chassis, which has been fitted to a larger range of models than B and O had hitherto marketed, brought them into the era of the completely solid-state TV receiver, with the advantage of cooler running, lower power consumption and higher reliability – improvements which will be obvious to all those familiar with its predecessor, the Beovision 3400 hybrid 110° chassis.

To cheer up the engineer, B and O adopted circuitry similar to that used by other contemporary European setmakers, with a thyristor regulated power supply, a decoder using Philips i.c.s, and the ubiquitous BU208 line output stage with diode EW modulator. The chassis is also constructed so that everything that matters from a servicing point of view is either on an easily removable panel or on the replaceable line output panel.

Circuit Features

The h.t. supply, which in many modern sets is the most formidable part of the whole box of tricks, consists of a thyristor half-wave rectifier followed by an active filter. The latter looks at first glance like an ordinary series regulator, but in this case is there to remove the 50Hz ripple without the need for a large electrolytic capacitor. Complicating the power supply is a chunk of protection ciruitry which closes the power supply down when anything potentially nasty happens. Operation of this circuit causes a "pumping" effect: the receiver tries to start up, but on sensing an overload closes down, only to try to start again after a moment. This behaviour soon becomes familiar to anyone servicing these sets.

The i.f. strip is a model of simplicity, with the i.f. gain, vision demodulation and a.g.c. and a.f.c. being carried out by just two i.c.s (MC1349P and TCA270). The i.f. board also carries the multiband varicap tuner.

The audio circuit is worth a moment's attention. The output stage consists of two high-power Darlington pair devices in push-pull. The arrangement will be familiar to those who also service B and O hi-fi equipment. Not only does the output stage use these strange devices: it also runs with a high standing current, in other words in class A, which is unusual in a solid-state audio TV output circuit. B and O may have designed it thus for the superior sound quality some attribute to this mode of operation, but it does also provide a sink for the current from the width modulator circuit.

The decoder uses the well-known TBA560AQ luminance/chrominance signal processing i.c., TBA540Q reference oscillator i.c., and a less well-known i.c., the TAA630T, for chrominance signal demodulation. The general arrangement is similar to most decoders of this generation, so no more need be added.

The most unusual part of the set is the c.r.t. drive circuitry. The RGB output stages have two power transistors each, a common-emitter stage operating as a normal video amplifier, and an emitter-follower which operates on the positive-going edges of transients, where the common-emitter stage is ineffective because of the time-constant of the stray and tube capacitance and the collector load resistance. These stages (See Fig. 1) drive the c.r.t. grids, since the cathodes have to be free for the auto grey-scale correction system. This arrangement is too complex for its operation to be covered in any detail here, though a brief outline of its principles of operation is necessary in order to explain why the grey-scale adjustment is done the way it is.

During the field flyback blanking period the tube is cut off. Each gun passes a few microamperes of current however, and these currents charge three separate capacitors. The voltage thus developed across each capacitor sets the basic voltage on the individual cathodes during the subsequent scan period. Any drift in the tube's characteristics will result in a change of the current flowing during the sampling period when each gun is "cut off". As a result, the grey scale will be corrected.

Adjustment of the grey scale is described in detail later. The c.r.t. first anode voltages have to be adjusted in the normal manner, but as the auto grey-scale circuit will try to cancel these adjustments they have to be done with a meter monitoring the correction voltage, and set up so that the auto grey-scale is in the middle of its range of operation and is thus best able to cope with any drift in the gun cut-off points – yes, on these sets you can adjust the first anode voltages without looking at the tube!

The sync separator and line oscillator is the fairly well-known TBA950. This and the line output stage are straightforward and look familiar – as they should since much the same circuitry is used in a large number of solid-state chassis using 110° delta gun tubes.

As mentioned at the outset, there's a single BU208 in the line output stage. There's also the usual double-diode EW/width modulator, and an e.h.t. tripler.

The field oscillator consists of the three transistors 5TR1, 2 and 3 in a rather quaint arrangement. This drives an ingenious field output circuit which manages to produce a 28V peak-to-peak output from a 25V supply rail. The output stage consists of a straightforward complimentary pair of transistors: the trick is the combination of 5TR8 and 5TR13 with 5D5 and 5C27. During the forward field scan 5C27 charges from the supply via 5D5 and 5R71. The positive-going edge at the start of the field flyback pulse switches 5TR13 on however. The previously earthy end of 5C27 is now connected to the 25V rail, and because of the 25V already stored in 5C27 the cathode end of 5D5 is reverse biased and the supply to the field output stage becomes the sum of the two voltages, approximately 50V. Thus the supply to the field output stage becomes 50V during the flyback period and a peak flyback voltage of 28V is easily achieved. See Fig. 2.

Setting Up Adjustments

There are a number of odd points in the routine setting up that either differ from other receivers or need a little care to ensure trouble free operation.

First and foremost is the correct setting of the h.t. rail and the overload cutout.

Adjustment of the h.t. voltage presents no big problems.

BARGAIN PACKS

Aluminium Coax. plugs	10 for £1
BR101	4 for £1
TBA 120A	2 for £1
SN76115N (Equiv. MC1310)	£1
Decca "Bradford" triplers	each, £2.50
Large screen CTV type 25KV	5 for £10
BD131	3 for £1
DY51 e.h.t. Rec.	2 for £1
100 mixed diodes, 1N4148 etc.	£1.50
100 mixed diodes including zener, power and bridge types	£3.30
E.H.T. bases (EY87/DY87 etc.)	10 for £1
Spark gaps	10 for £1
100 miniature reed switches	£3.20
20mm antisurge fuses, 800 MA, 1A 1.25 A, 1.6 A, 2 A, 2.5 A, 3.15 A. Your selection	12 for £1 100 for £7
470µF 25V modern type	5 for £1.00
Outdoor triplexers Band I, II & UHF with cable clamp	each, 50p 3 for £1
100 mixed transistors, new and marked including AF117, BC148, BF194, BC183, etc.	£3.95
200 new and marked, mixed transistors including 2N3055, AC128, BFY50, BD131, etc.	£6.95
Hardware pack, includes BA nuts, bolts, nylon, posi drive, self tappers, "P" clips, cable markers, clamps, fuse holders, etc.	£1 per lb
300 mixed $\frac{1}{4}$ and $\frac{1}{2}$ W resistors	£1.50
200 mixed 1 and 2 W resistors	£1.50
40 Germanium diodes	£1
300 mixed modern caps, includes most types	£3.30

MANUFACTURER'S SURPLUS

New Thorn transistor tuners with aerial socket and leads: 4 pushbutton type	£2.50
White Ceramic TV Resistors. 20Ω 16W, 135Ω 15W, 86Ω 11W, 105Ω 10W,	20p each 7 for £1
Set of 4 knobs, black with chrome caps to fit P/8 tuner (fit most small diam. shafts)	60p
Thorn "950" bottom panels, new complete with i.f.'s, switch etc.	£2.50
Thorn 3,000 focus units complete with metrosil	£1
Recon transistor UHF tuners (KBVC3 etc.)	£1.50
ITT CVC5 power panels, new but 5 resistors never fitted	£1.50
Pye "697" line and power panels, damaged, or some components missing but invaluable for spares	£2
Pye mono mains droppers with fusible link, 147Ω & 260Ω	each, 50p 3 for £1
Pye 11U contrast controls with centre tap	10 for £1
TV knobs pack, mostly Thorn & ITT, 20 assorted knobs including pushbutton, chrome and control types	£1
25 mixed pots and presets	£1.50

SURPLUS COMPONENTS

FIT THE RIGHT PART!

100 mixed electrolytics	£2.20
300 mixed printed circuit mounting components for various TVs, resistors, capacitors, etc.	£1.50
300 printed circuit resistors $\frac{1}{4}$ to 4W	£1
100 high wattage TV resistors wirewound, etc.	£2.20
TH3 thermistors	10 for £1
20 assorted TV VDRS and thermistors	£1.20
200 unmarked transistors, lots of interesting types, power, UHF. etc (60p for samples)	£4.50
100 mixed miniature ceramic and plate capacitors	£1.50
5Ω Convergence Pots with knob	8 for £1
20 Assorted TV Presets	£1
Thorn 3,000 series scan coils complete with leads, sockets, purity adjusters and static controls. Brand new and boxed	£7.25

AVOID LETHAL SHOCKS

Specially designed EHT probe removes high voltage charges from tubes,caps etc. Heavily insulated complete with lead and earth connector — each, 60p

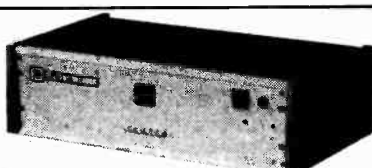
Try our **BARGAIN PARCELS** full of components, surplus electronic equipment, resistors, capacitors, transistors and ex equipment panels etc. — 7lb – £4.95, 14lb – £7.95

De Luxe Fibreglass Board Etching Kits includes 150 sq.in. f/g copper clad board, 1lb ferric chloride, 1 dalo etch resist pen, abrasive cleaner, 2 mini drill bits, etch tray and instructions, only — £5.30

SEND 40p P & P ON ALL ABOVE ITEMS. MINIMUM ORDER £1. SEND CHEQUES AND POSTAL ORDERS WITH ORDER TO: **SENTINEL SUPPLY, DEPT. T/V,** 149A BROOKMILL ROAD, LONDON S.E.8. (MAIL ORDER ADDRESS ONLY). CALLERS ONLY BY APPOINTMENT. **TRADE ENQUIRIES FOR QUANTITY PRICES WELCOME. SURPLUS STOCKS PURCHASED FOR CASH.**

Television

TELETEXT DECODER



All the kits for this project are now available from CATRONICS LTD all backed by Catronics exclusive FOUR STAR SERVICE

SPECIAL PRICE COMPLETE KIT **£220** *+ £2 P. & P.*

ALL THESE SPECIAL PRICES INCLUDE VAT

Catronics Guaranteed kits contain all components required for the specific unit, INCLUDING A REPRINT OF THE ORIGINAL ARTICLE, plus the PCB

POWER SUPPLY – £25.00 (+ £1 p & p)

INPUT LOGIC – £25.40 MEMORY CARD – £33.10

DISPLAY CARD – £32.65 MOTHERBOARD ETC. – £33.80

I.F. CARD (with ready wound coils) – £36.00

MODULATOR (pre aligned and tested) – £15.00

CABINET (with cable & mains switch) – £24.00 (+ £1.25 p & p)

Add min. 30p for post and packing.

Components also available SEPARATELY, as follows:

BYZ13 – 60p; BYZ88 zeners – 13p; 1A Bridge Rectifier – 40p; 7805 – £1.50; 7812 – £1.50; 10,000 mfd 16V capacitor – £2.75; Mains Transformer – £6.25 (+ £1.00 p & p); Heatsink – 30p ea; Illuminated Mains Switch – £1.15; Fuse and Holder – 52p; 3 Pole Thumbwheel Switch – £7.00; Push Button Switch Assy – £4.60; 32 way Edge Connector – £2.25 ea; 47KΩ 20T Cermet Pot – £1.10 ea; ELC1043 Tuner – £6.95; 1K 20T Cermet Pot – £1.20; BC212L – 15p; BSX20 – 21p; CA3046 – 94p; SL439 – £1.25; SN76660 – 85p; TDA440 – £3.40; ZTK33B – 98p; LM710-14 – 58p; SFE6.0MA – 98p; SW150 – £3.30; 4mm former + core, can & base – 25p; 74S262 – £14.50; 2102 – £2.25; OA91 – 9p; Set of Ready-wound coils – £2.95.

See our Price List for details of other components, including 7400 series. I.C.s.

ALL THESE PRICES INCLUDE VAT

Please add minimum 30p P. & P.

Catronics

CATRONICS LTD. (Dept. 865), COMMUNICATIONS HOUSE, 20 WALLINGTON SQUARE, WALLINGTON, SURREY SM6 8RG. Telephone: 01-669 6700.

Technical Training in Radio, Television and Electronics

Start training TODAY and make sure you are qualified to take advantage of the many opportunities open to trained people. ICS can further your technical knowledge and provide the specialist training so essential to success.

ICS, the world's most experienced home study college has helped thousands of people to move up into higher paid jobs – and they can do the same for you.

Fill in the coupon below and find out how!

There is a wide range of courses to choose from, including:

City and Guilds Certificates:-

Telecommunications Technicians,
Radio, TV and Electronics Technicians,
Electrical Installation Work,
Technical Communications,
Radio Amateur,
MPT General Radio Communications Certificate.

Diploma Courses:-

Electronic Engineering,
Electrical Engineering,
Computer Engineering,
Radio, TV, Audio Engineering, Servicing and Maintenance. (inc. Colour TV)
New Self-Build Radio Courses with Free Kits.

Colour TV Servicing

Technicians trained in TV Servicing are in constant demand. Learn all the techniques you need to service Colour and Mono TV sets through new home study courses which are approved by a leading manufacturer.

The ICS Guarantee

If you are studying for an examination, ICS will guarantee coaching until you are successful – at no extra cost.

POST OR PHONE TODAY FOR FREE BOOKLET.

I am interested in...

Name...

Address...

.... Phone No:.................................

ICS International Correspondence Schools, Dept. 285T, Intertext House, LONDON SW8 4UJ. Tel 622 9911 (all hours)

The h.t. has to be set to 169V with control 6R39 which is located towards the bottom of the right-hand (line output) panel. This is measured conveniently at test point 34, near the middle of that panel, and should be done at minimum brightness and contrast and using a meter of trustworthy accuracy.

At several points in the service information the h.t. voltage is shown as 172V, but B and O now recommend 169V – apparently to impose less strain on the line output stage and make spurious operation of the overload cutout less likely. If only three volts can make a difference, it underlines the necessity for an accurate meter when setting the h.t. voltage: B and O specify that the h.t. should be adjusted with an accuracy of 2%.

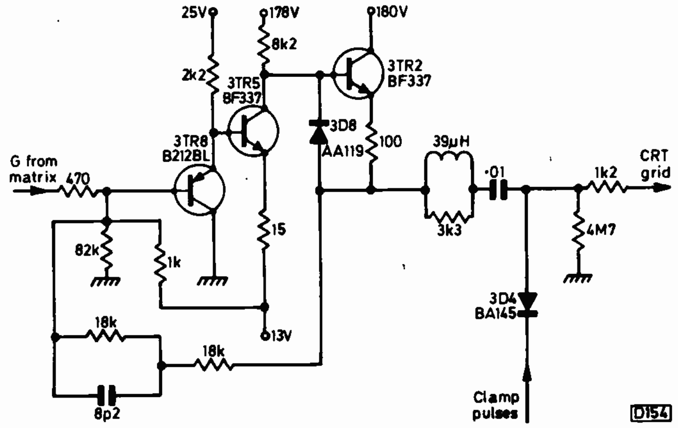


Fig. 1 (above): One of the RGB circuits (G). The output stages are unusual in having two power transistors each, a common-emitter stage and an emitter-follower (3TR2 above) which provides drive on the positive edges of transients.

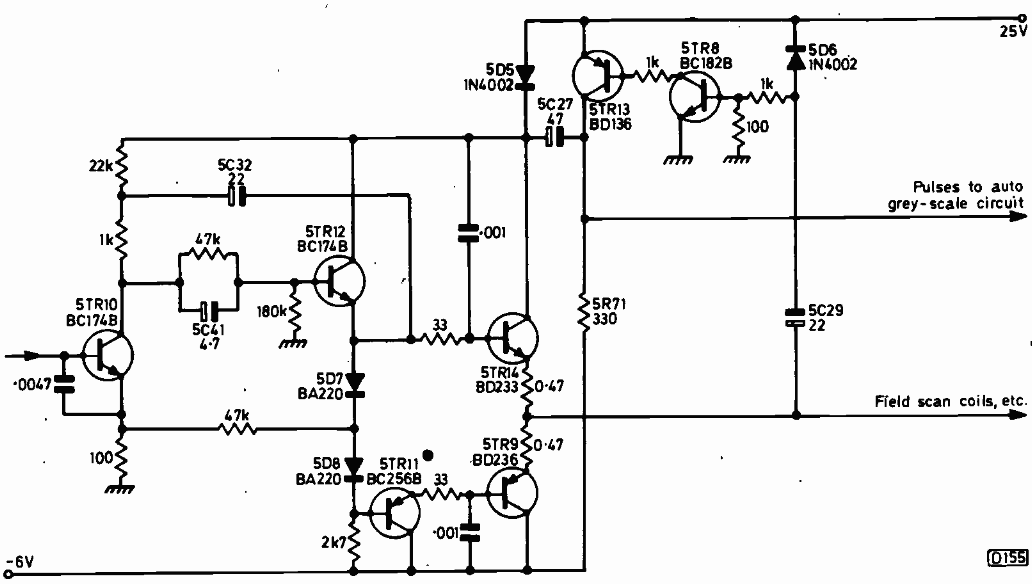


Fig. 2 (left): The field driver and output stages. An ingenious arrangement (5TR8/5TR13/5C27/5D5) provides an increased supply during the flyback, so that a 28V peak-to-peak output is obtained from a 25V supply rail.

The overload cutout is adjusted after the h.t. rail, with the meter still on TP34 but with the contrast and brightness at maximum. Remove plug P13 from the bottom left-hand corner of the line output panel and adjust 6R33 (near the h.t. control 6R39) so that the h.t. just begins to fall, but before the point at which the picture starts "pumping".

As explained before, the adjustment of the grey scale is a little different in so much as a valve voltmeter with an input impedence in excess of 10MΩ on a reading of approximately 8V is required. The first anode preset potentiometers, which are on the c.r.t. base panel, are adjusted to give 8V at the appropriate test points in the auto grey-scale correction circuit.

The top potentiometer (blue) is adjusted for 8V at 2TP13 on the decoder panel. Similarly the middle and bottom potentiometers (green and red respectively) are adjusted for 8V at 2TP12 and 2TP11. The adjustment needs a little care, since a small movement causes a large change in voltage at the test point, also this voltage can go negative – so if a digital meter is being used, avoid setting any of the test points at –8V by mistake.

This should have taken care of the grey scale adjustment at low brightness. The grey scale for the highlights can be adjusted by 2R99 and 2R101, which are ordinary green and blue drive controls.

Convergence is simplified in comparison with the previous 3400 series chassis, and does not require the degree of patience that the latter requires to achieve optimum convergence. It's not always possible to equal the convergence accuracy of the 3400 however, since that chassis seemed to have a control to eliminate every possible form of misconvergence.

On the smaller screen models, the convergence box is clipped inside the back of the set and can be unclipped and held in the hand whilst looking at the screen.

The 4000, 5000 and the 6000 models have the convergence box hidden behind the front panel on the bottom right-hand side of the receiver. Access, in the case of the 6000, is by pushing the panel at the bottom right-hand side of the front of the set. This springs out to reveal the tuning controls. To remove this unit to get at the convergence controls, a small orange catch at the bottom of the sliding drawer has to be pushed downwards with a screwdriver or similar tool. With the 4000 and 5000 receivers, the clip-on cover over the tuning controls has to be removed to reveal a convergence drawer. This is released by a similar catch to that in the 6000.

Stock Faults

Although an acknowledged improvement in reliability over the 3400 series chassis, a few stock faults have nevertheless emerged.

One, not exactly a stock fault, was a noticeable lack of contrast on the first of these receivers to appear in this country. This was especially noticeable if a side by side comparison was made with one of its hybrid predecessors. To improve this situation several resistors were changed in value. Although most sets have since been modified, it's worth checking these if an early specimen comes along with a dim picture which cannot be put down to a tired tube. The changes are 2R50 from 56kΩ to 39kΩ, 2R96 from 820Ω to 1kΩ, 2R115 from 100kΩ to 82kΩ and 1R19 from 1kΩ to

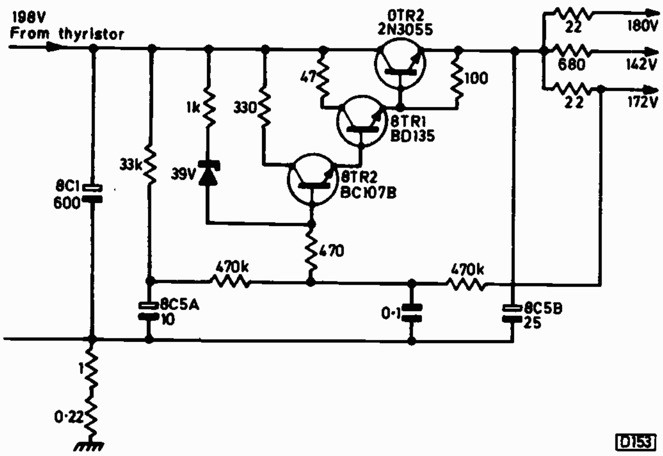


Fig. 3: The active filter circuit. The 0·22Ω resistor is normally shorted out by P13.

820Ω. If these modifications are carried out, the d.c. levels of the video amplifier stages will have to be readjusted in accordance with the service manual.

The power supply design has benefitted from the experience of others, and has not been plagued by thyristor failure, picture bounce and the like, as were some of the original thyristor controlled power supplies. A short-circuit thyristor does very occasionally blow the mains fuse, but a power supply fault which causes lack of h.t. but leaves the h.t. fuse intact is the reservoir capacitor 8C1 going open-circuit, often intermittently. On the face of it this would not cause complete loss of h.t., but as the cathode of the thyristor is no longer decoupled to chassis the pulses on its gate can no longer produce sufficient current to make the thyristor conduct. It looks for all the world as if the thyristor's open-circuit therefore. A scope will show equal trigger pulses at the gate and the cathode.

A similar fault, though possibly easier to diagnose, is a lack of trigger pulses at the thyristor's gate due to 6R30 (56kΩ) going high in value. This resistor is part of the network (6R29, 6R30, 6D8 and 6C22) which produces a ramp waveform used by the h.t. control circuit as a reference. Correct operation gives a 34V peak-to-peak ramp waveform at the cathode of 6D9.

With the active smoothing circuit used, smoothing problems are no longer going to be a tired electrolytic. H.T. hum will almost certainly be a short-circuit 0TR2 (what else but a 2N3055) or one of the drivers 8TR1 and 8TR2 being similarly faulty. See Fig. 3.

Faults in the protection circuit can also cause the power supply to shut down. E.H.T. flashover can damage 6TR5, 6 and 7, and the result is no h.t. If the protection circuit is operating normally, the h.t. "pumps" in a characteristic manner. If adjusting the cut-out control correctly, as described earlier, doesn't prevent this then it's fair to assume that something apart from the power supply is at fault.

It can be a little difficult chasing a fault condition with an AVO when the h.t. and everything else is coming and going every few seconds! A first line of attack is to stand back and see or hear what's wrong during each fraction of a second when the set is operating. For instance, lack of sound or field collapse show immediately the area where the fault lies.

If this approach fails, the protection circuit may be disabled by removing the 470Ω resistor 6R34. This must be done with care to prevent avoidable damage to the rest of the receiver. Here a variable voltage transformer is a very useful tool.

Servicing the line output stage is no problem to the engineer familiar with the modern solid-state designs now found in nearly every colour TV set. There are a couple of quirks to which this particular output stage is prone however. One of these is 6C9, an 0·47μF capacitor, which occasionally goes open-circuit. This capacitor decouples pin 8 of the line output transformer, which happens to be the earthy end of the primary winding as well as the h.t. feed point. Thus when 6C9 goes open there's a noticeable lack of width which looks as if the h.t. rail is low when in fact it's correct. This underlines the necessity of checking the h.t. voltage whenever servicing this chassis. A digital voltmeter used to check the h.t. at test point 34 when 6C9 is open will give unpredictable readings because of the high-amplitude line pulses appearing on the h.t. at this point.

Another fault due to a capacitor going open-circuit can have expensive consequences though it's not immediately visible on the screen. The capacitor concerned is the line flyback tuning capacitor 0C1 (9·1nF). If its value drops, the flyback pulse becomes shorter but of greater amplitude and, as the e.h.t. is derived from this pulse, the result can be that 30-35kV is applied to the final anode of the c.r.t. In a particular case, one of these receivers was giving problems with corona discharge around the e.h.t. connector. This proved to be 0C1 faulty, resulting in the e.h.t. being around 35kV. In this case the line output stage survived, but it's a wise precaution to check the e.h.t. if replacing a blown tripler or BU208.

As may be expected, field collapse is usually due to failure of one or both of the field output transistors. Originally a BD138 and a BD135 were fitted, but for replacement a BD233 and a BD236 are recommended as they are more robust. Intermittent field collapse can be caused by the 2,000μF coupling capacitor 5C34 – certain types of capacitor used in this position are prone to internal dry-joints.

A curious field cramping across the top half of the picture, often intermittent, can sometimes be tracked down to the field driver transistor 5TR12. Before changing this however check the soldered joints to the mounting lugs of the field output transistor heatsinks. There are three per heatsink, and several are collector connections in addition to the normal connection to the centre leads of the output transistors. Dry-joints on these mounting lugs cause a similar cramping to that mentioned above.

The control panel assembly is a source of several faults. First, the inevitable problem of noisy and high-resistance contacts in the channel selection switches. In this case there's little that can be done as it's difficult, if not impossible, to strip the unit down. A squirt of aerosol contact cleaner sometimes works wonders however and may save the cost of a new pushbutton unit.

The channel selector also has incorporated a switch which mutes the sound whilst a pushbutton is depressed. The purpose of this is to mute any unpleasant noises when changing channels. Sadly, it has the habit of permanently killing the sound when, after a little wear, the switch contacts fail to open. Because of the difficulty of servicing this unit, the most cost effective course of action is to disconnect the switch by identifying the printed circuit connections to it and cutting them. Even after this modification the sound disturbance on changing channels is no worse than on receivers that do not have this refinement.

The latches holding the two spring-loaded drawers which carry the customer controls are also part of the control panel assembly. If one of the drawers refuses to stay in, a new control panel assembly is the only way to do a proper repair. This is an expensive cure for such a simple fault. ■

LONG-DISTANCE TELEVISION

ROGER BUNNEY

FOLLOWING the active conditions during January it's sad to have to report that February, at least up to the time of writing, has been depressing, with few signals of consequence. Though reception has been so poor, the weather has certainly been of interest, and several of our DX-TV friends were cut off by the heavy snowfalls. David Martin at Shaftesbury noted five feet of snow in the road outside his house while Hugh Cocks, farther to the west in Devon, was unable to get out for seven days.

One sign of improvement however has been an increasing m.u.f., with the long term possibility of enhanced F2 reception at low v.h.f. Brian Fitch reports that the sunspot count towards the end of January reached 118, which ties in with my reception of trans-Atlantic signals – mainly highway patrol communications and other c.w. effects – at up to 35MHz, as mentioned last month.

Month's Log

The TV log reflects the general poor state of affairs, with only MS entries. The Band I loggings were as follows:

3/2/78 DFF (East Germany) ch. E4.
6/2/78 CST (Czecholsovakia) R1.
7/2/78 DFF E4.
10/2/78 CST R1, TVP (Poland) R1.
11/2/78 ORF (Austria) E2a, SR (Sweden) E2.
14/2/78 SR E2.
20/2/78 NRK (Norway) E2.
21/2/78 RTVE (Spain) E2.
24/2/78 DFF E4.

Not exactly impressive!

More on Auroras

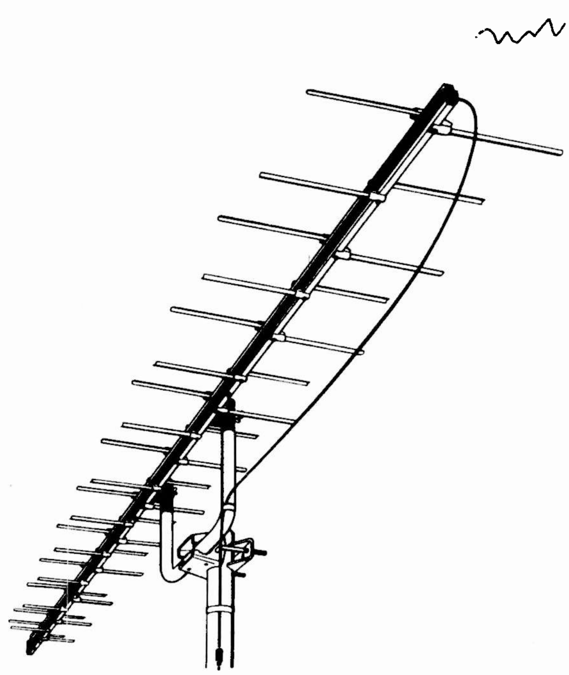
I've received from Radio Berlin International (East German Radio) information on auroral reception from their overseas journal. This is worth summarising. When the radiation of ionised particles from the sun is excessive, the earth's ionosphere is affected, particularly the belts around the two magnetic poles. As a result, reception of s.w. signals crossing these areas is blacked out. When the concentration of ionised gas in the upper atmosphere reaches a certain level the situation changes, higher than normal frequencies – up to about 200MHz – being reflected by the clouds of ionisation. For Auroral reception therefore both the receiving and transmitting aerials should be directed due north (northern hemisphere). Signals are reflected back irrespective of the transmitter's location either to the east or west of the reception point. The note of the signal is distinctive: rough, with a sleighbell sound, and fluttering. The effect on a TV screen is undulating horizontal bars.

Discone and V Aerials

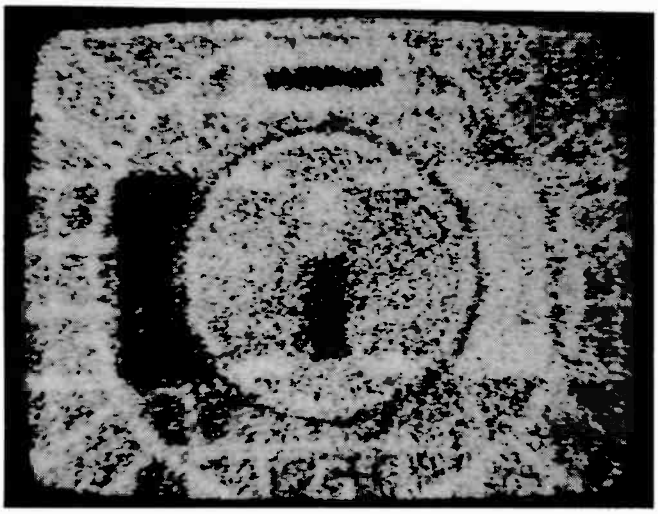
Derick Browne has written following comments in the January column. The discone aerial is in fact vertically polarised and he's willing to send measurements to anyone interested. The V aerial shown in the same column will receive in both directions, not one as illustrated. With the legs of the system shorter than three wavelengths, the best directivity and gain are with a smaller angle than determined by the lobes, i.e. leg 1 2·75dB 90°; leg 2 5·5dB 70°; leg 3 7dB 57°; leg 4 8dB 52°; leg 5 8·75dB 46°; leg 6 9·5dB 44°; leg 7 10·2dB 41°; leg 8 10·75dB 39°; leg 9 11·25dB 37°; leg 10 11·6dB 35°; leg 11 12dB 33°; leg 12 12·25dB 31°. An error of a few degrees causes a much larger loss in directivity and gain in a longer V aerial than it does in a shorter one.

New EBU List

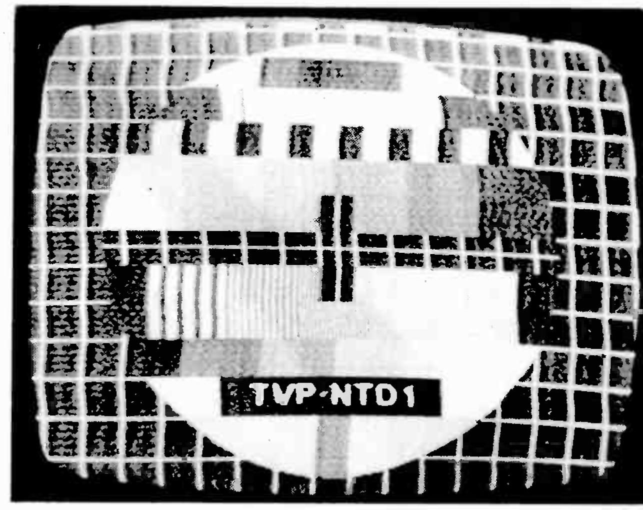
The EBU has published its 22nd "List of Television Stations". Unlike earlier editions, the new one comes in two



The Antiference TS21 Mk. 2 u.h.f. log-periodic array.



Test card G received on ch. E2 by Anthony Mann (Australia) from W. Malaysia at a distance of over 3,000 miles.



The PM5544 test pattern carrying a new Polish identification. Received by V. Petrzilka on ch. R25 at 180km.

Saudi Arabia ch. E6 station identification card. Photo courtesy Alan Latham.

The new NRK (Norway) colour test card. Copyright Norsk Rikskringkasting, photo courtesy HS Publications.

volumes. It's good value at 400 Belgian francs. Obtainable from the EBU Technical Centre, 32 Avenue Albert Lancaster, Bruxelles, Belgium.

The USSR section lists the radiation powers of various Band I transmitters: Tallinn (Eesti) ch. R2 19kW, R3 10kW; Leningrad R1,3 240kW; Moscow R1 240kW; Minsk R1 150kW; Kuldiga R1 50kW; Lvov R1 35kW; Kiev R2 150kW, R3 20kW, R4 150kW (the close adjacent-channel working is questioned!); Vilnius R2 50kW, R4 300kW; Krasnodar R1 50kW.

Station Listings

West Germany: Wuerzberg/Odenwald ch. E56 increased to 100kW e.r.p. (HR network).

France:

Ajaccio	FR3	E24	500kW
Niort	TF1	E28	1000kW
Boulogne	TF1	E29	100kW
Amiens	TF1	E41	500kW
Dunkerque	TF1	E42	200kW
Bastia	FR3	E44	500kW
Lyon-Mt. Pilat	TF1	E46	1000kW
Chartres	FR3	E53	250kW
Autun	FR3	E54	500kW
Lyon	TF1	E61	10kW
Abbeville	TF1	E63	250kW
Champagnole	FR3	E64	80kW
Nantes	TF1	E64	80kW

All transmissions horizontally polarised.

The Indian government has given the go ahead for a TV satellite in 1981, for a two year experiment. The satellite is to be designed and built in India. The ultimate aim is to have a series of smaller, low-power satellites to give regional TV exchanges.

From our Correspondents . . .

Ryn Muntjewerff (Holland) reports that the PM5544 pattern was noted on February 17th carrying the Swiss identification "+PTT-TSI/SSR-1". We must assume that this ch. E46 signal is a new transmitter under test since the time was during normal Swiss programme times (2037). Ryn has been fortunate in receiving trop signals from Northern Sweden at u.h.f. recently

Robin Crossley has recently returned from West

Germany. He had been living at Celle (Hanover), where the British Forces TV service started. Celle operates on ch. E51 at 94W, relaying UK programmes. The test pattern is the PM5544, with the identification "BFBS-Colour", and the UK system I is used. Other transmitters are linked by microwave to Celle. Apparently system B/G (West German) receivers can be used on system I by adding an 0·5MHz oscillator in series with the intercarrier sound feed, small transistor units being readily available for this purpose.

Aerial Notes

I've had quite a bit to say about aerials in recent columns, and one result has been a number of letters on aerial topics.

Brian Fitch (Seamer, near Scarborough) was recently given a redundant combined Band I/III array and feels that it could be useful for DX-TV purposes. The original dimensions are shown in Fig. 1(a) and suggested modifications in Fig. 1(b). These should give good wideband coverage of the ch. E2-4 vision frequencies, while the Band III section should give moderate operation over much of the band. Brian's location on the east coast should give him enhanced tropospheric reception from Scandinavia.

I mentioned the Fuba range of miniature, omnidirectional aerials recently. Audio Workshops tell me that these are intended for shipboard use. This accounts for the high price – the Band I version costs upwards of £140, without an amplifier. There are special accessories to prevent damage to the receiving system when used adjacent to a ship's transmitter.

The West German manufacturer Kathrein has introduced an active aerial (integral amplification) for caravan use. The aerial (type HD35) consists of a folded dipole for Band III and an eight-element wideband u.h.f. log-periodic array, the latter being encased in a protective plastic cover. Quoted gain figures are 0dB Band I, 18dB Band III and 25dB at u.h.f., with a typical noise figure of 6dB and maximum signal handling (assumed for one signal) of 98dBμV. The aerial is also available without the amplifier.

Aeranamics Electronics Ltd. of Peterhead, Scotland, are also active in the miniature aerial field. Their Ash 1 high-gain omnidirectional array, some 14in. in diameter and with integral amplification, is intended for marine use. Protection is provided by a shallow plastic case with a filling of high-density polyurathene foam. The more recent Ash 2 provides higher output and has a diameter of some 20in. The quoted amplifier gain is 27dB over the 40-860MHz spectrum, with a noise figure of 5·5dB. 24V d.c. is applied via the feeder. There's filtering to minimise cross modulation/overloading effects, and a preset sensitivity control to provide adjustment for weak signal/transmitter overloading problems. It occurred to me that the system would make a useful search array, but the price is £89 (Ash 1) or £102 (Ash 2) plus VAT.

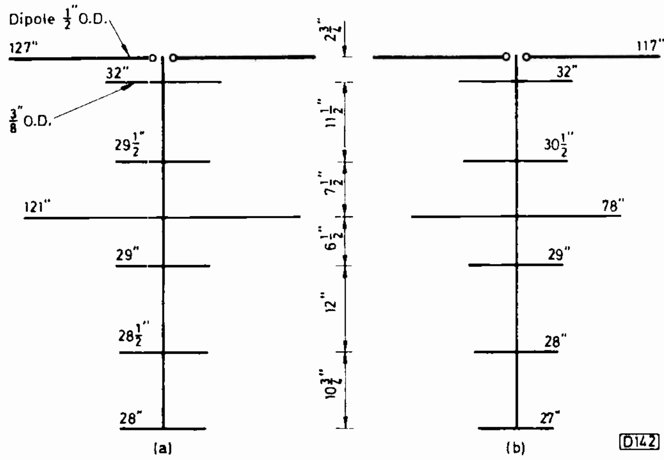


Fig. 1: Combined Band I/III Yagi array. (a) Original dimensions. (b) Suggested modified dimensions to give coverage of chs. E2-4 in Band I and chs. E5-8 in Band III. All element dimensions are overall lengths.

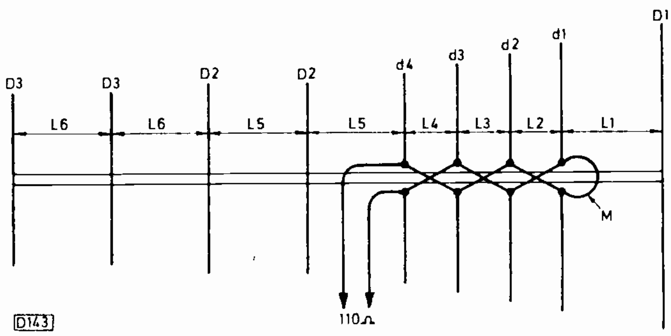


Fig. 2: The narrow band Swan aerial.

I'd be interested to hear from anyone who has used one of these active aerials. And maybe someone has some design data ...

Finally, Igor Hájek of Lancaster University has drawn our attention to an interesting aerial design which was featured in the December 1977 issue of the Czechoslovakian magazine *Amatérské*. The aerial is called the Swan and is apparently based on a design for an amateur two metre array described in the October 1969 issue of *QST*. It consists of a relatively narrow-band log-periodic system coupled to an extensive Yagi director chain (see Fig. 2). The gain of the original two metre (144MHz) array was claimed to be 18dB. The design as shown has an output impedance of 110Ω (balanced): this could be reduced to give better matching to standard 75Ω feeder by reducing the distance between director D1 and dipole d1 to half the distance given in the table. Connection can then be made via standard coaxial feeder – along the lines suggested in our recent discussion on balanced to unbalanced connections with log-periodic arrays. Alternatively direct connection could be made to a masthead amplifier acting as a matching device and preamplifier or a balance to unbalance ferrite transformer could be used.

Table 1: Swan aerial dimensions (mm)

Channel	Centre frequency	Element diameter	D1	D2	D3	d1	d2	d3	d4	l1	l2	l3	l4	l5	l6	Shorting lead M
A	67	12	2239	1926	1881	973	921	899	849	436	409	396	382	1092	1307	382
A	94	10	1598	1375	1343	694	657	641	606	311	292	282	273	779	933	273
B	98	8-9	1533	1319	1288	666	631	615	581	299	280	271	261	748	895	261
C	102	8-9	1473	1267	1237	640	606	591	559	287	269	260	252	718	860	252
D	106	8-9	1418	1219	1191	616	583	569	538	276	258	250	242	692	828	242

Service Notebook

G. R. Wilding

Tuner Troubles

A Decca hybrid colour set gave a fairly good picture which was marred however by constantly moving lines in the background. Our first thought was cross-modulation or some form of co-channel interference, but closer examination showed that the interference was linked with the sound since it completely disappeared at low volume levels. It seemed therefore that there was a microphonic valve, or that the a.f. signals were getting though to the luminance channel due to impaired decoupling.

On removing the back and sliding the chassis out we found that tapping the main chassis and the valves on it produced no effect, but that tapping the tuner unit resulted in greatly accentuated lines and even a few white streaks across the picture. There's a small paxolin panel containing the aerial feed-in connector, an r.f. gain control and a few associated components at the rear of the tuner. This was examined, but all connections and soldered joints were perfect. The only thing to do therefore was to remove the tuner lid and check on the internal soldering and component positions – there is always the possibility that one small component is so close to another or to chassis that vibration causes light contact.

These sets use either a Telefunken varicap tuner or a mechanical one. The set concerned was fitted with a mechanical one, and inspection showed that all soldered joints were perfect. Although the moving vanes of the tuning capacitor were earthed by a couple of strong thin springs clipped across the rotor shaft however, and by a flat contact at one end, the free end of the shaft was making only very doubtful contact with a curved earthing spring soldered to the tuner casing. While a few drops of switch cleaner followed by contact lubricant would ensure good contact to the clipped on springs, the end contact would certainly need bending in order to establish firm pressure.

This is easier said than done! The best way is to hold the spring gently still farther away from the fixed contact by means of screwdriver pressure at its base, then increase the contact pressure by bending the strip in the required direction. At the same time the contact faces must be kept parallel. Before attempting this we ran a strip of cloth moistened with switch cleaner between the contact areas. Then, on adjusting the spring and reassembling the tuner, all signs of microphony had gone.

The appearance of a test card transmission showed that the dynamic convergence was quite a bit out, while the width was excessive. Correcting the width by means of the slider at the right-hand bottom of the main chassis greatly improved the convergence, and with only a few slight adjustments an excellent picture was obtained. As with all colour sets then, before attempting to correct any convergence errors make sure that the width, height and e.h.t. are correct.

Tuner trouble of a different kind subsequently came our way in an ITT monochrome set fitted with the VC200 chassis. Two of the pushbuttons were perfect, one needed readjustment after every channel change, while the other was completely inoperative. On dismantling the tuner the spigot of the pushbutton which did not work was found to have its top section broken off, while the other defective spigot was cracked, making it impossible to obtain a correct fixed setting. ITT's stock number for these small alloy castings is 20931-17-13.

A similar ITT tuner required readjustment after each channel change whichever button was used, but this time it was found that one of the two plastic arms linking the tuning capacitor shaft with the push bar had almost broken away where it joins the latter. Replacing the defective arm would have involved almost complete tuner dismantling, but using the new quick-setting Araldite on the joint gave a hard positive bond which has proved to be reliable.

Brilliant Red Picture

A brilliant red picture on an ITT set fitted with the CVC5 chassis indicated very low c.r.t. red cathode voltage and low red output transistor collector voltage. This could have been due to leakage in the transistor, so voltage measurements were made to see whether this was the case or whether the fault lay earlier in the circuit. As Fig. 1 shows, the primary-colour channels in this chassis consist of an emitter-follower driving the output transistor, with a.c. coupling at the input and a feedback clamp. As anticipated, the low output transistor collector voltage was accompanied by increased base voltage, which is also the emitter voltage of the driver. The driver's base voltage was also high, so either the 2·2μF coupling capacitor C82 was leaky or there was a fault in the clamp circuit. If C82 was leaky however one would expect the collector voltage of the preceding transistor T10 to be low: this wasn't the case, ruling out C82 therefore.

The action of the clamp circuit is to establish a constant d.c. or black level at the end of each line – normally about –2·2V is present at the anode of the clamp diode. Clearly if the diode was open- or short-circuit this voltage would not be present and in either event the forward bias at the base of the driver transistor would be increased. The diode could

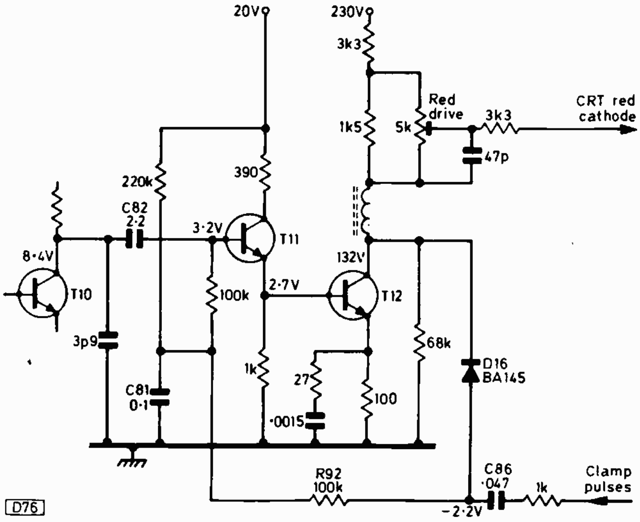


Fig. 1: R channel, ITT CVC5 chassis.

have been responsible for the fault therefore, but turned out on test to be perfect. The trouble in fact was that R92 was open-circuit, so that the negative voltage developed at the junction of D16/C86 was not communicated to C81 in the driver transistor's base bias circuit.

Poor Field Linearity

The trouble with a single-standard Rank colour set fitted with the A823A chassis was poor vertical linearity which couldn't be cured by adjusting the preset field linearity control. In view of the age of the set we decided to check the electrolytic capacitors in the field charging circuit (5C24 50μF and 5C25 25μF) since these often partially dry up after a few years' use to cause linearity problems. Once again replacement gave us a raster which could be adjusted for correct linearity with the preset linearity control.

Another electrolytic which partially dries up at times in these sets is the h.t. reservoir/smoothing electrolytic 8C9/8C10. When the loss of capacitance is fairly small there is usually a hum bar on the screen, often with impaired timebase locking: severe loss of capacitance on the other hand, especially in the reservoir capacitor section, can markedly reduce the h.t. and thus the picture size.

Weak Line Hold

The owner of a dual-standard monochrome set fitted with the STC/ITT VC51 chassis complained that the line hold locking position had gradually drifted to one end of the control's travel, and that hold was now invariably lost on changing channel. The first suspect was the PCF802 line oscillator valve, though this tends to give complete loss of line sync rather than a continual shift in the locking position. A new valve failed to improve matters so we considered adjusting the line oscillator coil. Since the drift had been present for some time however it seemed likely that a component, probably a resistor, was changing value. Thus coil adjustment would probably only postpone the cure unless the defective component was found.

On removing the base inspection cover we first checked the forward and reverse resistance of the two diodes in the flywheel sync discriminator circuit. The diodes gave normal readings so the next suspect was the 820kΩ resistor connected in series with the line hold control across the h.t. supply. This too turned out to be in order so we had a look at the circuit to see what other likely suspects there were. It was noticed that the cathode of the reactance triode section of the valve is biased by a potential divider, again across the h.t. supply, so a check was made on the cathode voltage which turned out to be above the correct figure of 7V. Now carbon resistors carrying a constant current tend to fall in value, so it seemed likely that the upper resistor R131 (47kΩ) in the potential divider network had changed value. On checking it we found a major reduction in value, and for good measure we decided to check the lower resistor R133 (1·2kΩ) in the network as well. This was found to be slightly down. Replacing both resistors restored line lock at the normal setting of the hold control.

Dead Set

The raster had suddenly vanished from an ASA hybrid colour set, quickly followed by loss of sound. Classic symptoms of a fault in the line output stage, followed by the h.t. fuse blowing or a fusible resistor going open-circuit. All the fuses were found to be intact however, but what we did find was that a replacement 2·2kΩ resistor feeding the screen grid of the PL509 line output valve had unsoldered itself and was lying on top of the main printed panel. This suggested either lack of drive, so that the PL509 had passed excessive anode and screen grid currents; an internal short or prolonged sparking over within the valve; or a leaky screen grid decoupler. There were no measurable shorts within the valve while the decoupler was o.k., so as no other signs of thermal damage could be seen the only thing to do was to replace the valve and the resistor and switch on.

The tube and valve heaters warmed up but the set remained dead. No h.t. In these ASA sets the vertically mounted wirewound resistors have particularly small contacts at the base, and quite often one or other of these becomes unsoldered by the heat being dissipated without any other fault being present. An unsoldered contact can easily be detected by seeing whether the resistor will give when lightly pushed each way in the direction of the contacts. In this case pushing the 4·7Ω surge limiter resistor in series with one a.c. feed to the mains bridge rectifier restored the sound, and clearly the excessive current previously flowing through the PL509 had contributed to its unsoldering. Since the connection point on the board is often charred, the only way of making a sound job of reconnection is first to extend the contacts with a little stiff wire.

On completing this repair and switching on we found that the screen grid winding of the PL509 started to overheat after a short period. There was no voltage at the anode of the PL509 or the cathode of the PY500A boost diode, explaining the PL509's excessive screen grid current. Since there was h.t. at the anode of the PY500A it was obvious that the valve had an internal disconnection. A replacement restored normal results.

Weak Field Hold

Weak field but normal line sync is a very common TV fault which can usually be cleared by changing the field oscillator valve and/or the interlace diode (solid-state field timebase circuits are much less prone to this fault). In quite a few cases however the cause may at first sight seem unconnected with the timebase or sync separator circuits: examples are incorrect working conditions in a video stage prior to the sync take off point, as a result of which the pulses are cramped and distorted; similarly i.f. drift or misalignment, which reduces the bandwidth so that the field sync pulses become rounded off and attenuated; or bad aerial siting.

We came across a rather unusual cause recently however. The set was a solid-state one fitted with the Pye 731 colour chassis. This uses (earlier versions) an SN76544 i.c. as sync separator and line and field oscillator. Our first move was to check diode D650 which is connected in series between the field frequency output from the i.c. (pin 15) and the first discrete transistor stage in the field timebase. This turned out to be in order, as did the other nearby diodes and electrolytics. The linearity was excellent and the height ample, so it seemed possible that the i.c. was at fault. As excessive ripple on a d.c. supply can seriously affect field timebase locking while leaving the line sync unaffected however, we decided to check the decoupling of the supply lines, including that to the i.f. strip. Paralleling near equivalents across each suspect brought no improvement – until we finally bridged C194 (68μF) which decouples the a.g.c. feed to the tuner. When tested, the original component was found to be of greatly reduced capacitance, a replacement providing a complete cure.

Transistors in TV Circuits

Part 1

S.W. Amos, C.Eng., B.Sc., M.I.E.E.

ALL the functions necessary in a colour television receiver (except the display of the picture itself) can be performed by bipolar transistors and some by field-effect transistors, and all solid-state receivers have been available for a number of years. In this series of articles, typical examples of circuits from television receivers will be analysed to show how the properties of transistors are exploited to perform the required operations. These can be analogue or linear, as in audio and video amplification where every change in input signal is required to bring about a corresponding change in output signal. In such applications the shape of the input-output characteristic is all important and negative feedback is often used to linearise it. Alternatively the transistor applications can be digital, as with a multivibrator. Here the transistors are at all times in one of two possible states and are switched rapidly from one to the other: in such circuits the shape of the input-output characteristic is of little relevance.

Bipolar Transistors

Bipolar transistors are basically current-operated devices, that's to say the output (collector) current is linearly related to the input (base) current over a wide range of operating conditions as shown in Fig. 1. To achieve linear amplification therefore it's essential to arrange the circuit so that the signal to be amplified is represented by the input current (not voltage). The relationship between collector current and input voltage is markedly non-linear, as Fig. 2 shows.

Circuit Configurations

The transistor can be connected in the common-emitter, common-base or common-collector arrangements, and all three methods of connection are used in practical circuits. For amplification, the most used arrangement is the common-emitter one shown in Fig. 3. A typical value for the input resistance is 2kΩ (for a mean emitter current of 1mA) whilst the output resistance for a silicon planar transistor is commonly around 1MΩ. The fact that the input resistance is low and the output resistance high is a reminder that the device is a current amplifier: i.e. if a number of such circuits is connected in cascade it's the current of each stage which is effectively transferred to the following stage. The current gain of the common-emitter amplifier is represented by $h$fe (sometimes by β) and practical values may lie between 20 and 500.

The common-emitter amplifier is also capable of considerable voltage gain, and the value can be calculated readily from the expression $gmRl$ where gm is the mutual conductance of the transistor and Rl is the effective value of the collector load resistance. For bipolar transistors gm is approximately equal to $40Ie$ where Ie is the mean value of the emitter current. Thus a transistor with a mean current of 1mA has a mutual conductance of approximately 40mA/V and, if the effective collector load resistance is 2kΩ, the voltage gain is 80. It should be remembered however that the relationship between collector current and base voltage is not linear (see Fig. 2), so the common-emitter amplifier is not suitable for voltage amplification in linear equipment unless measures (such as the use of negative feedback) are taken to linearise the input-output relationship. An alternative way of minimising the effects of the non-linearity is to confine the operation of the stage to very small amplitude signals.

For certain applications it's important to remember that the output signal from a common-emitter amplifier is inverted with respect to the input signal.

There are two properties of bipolar transistors to which attention must be paid to obtain a satisfactory performance.

Current Stabilisation

(1) The essential properties such as gain and input resistance depend on the value of the mean emitter current and, due to manufacturing spreads and temperature variations, the mean emitter current for a given base current may lie anywhere within a range of 3:1. Thus to obtain a consistent performance from mass-produced circuits it's essential to adopt some means of mean emitter current stabilisation.

An arrangement commonly used to achieve such stabilisation is embodied in the common-emitter amplifying circuit shown in Fig. 4. The potential divider R1, R2 stabilises the base voltage and any variations in emitter current, in flowing through Re, cause corresponding variations in emitter voltage which oppose the changes in emitter current: this is an example of direct-coupled negative feedback. Re also causes signal-frequency feedback, but this can be minimised – if not required – by decoupling Re with a low-reactance capacitor. In multistage direct-coupled equipment negative feedback can be used over a number of stages to stabilise the mean currents of all the transistors within the feedback loop. Some examples of such elegant systems of stabilisation are given later in this series.

The initial i.f., and sometimes the r.f., stages in receivers are usually automatic gain controlled. To achieve this the lower end of R2 in Fig. 4 is returned to a source of bias (the detector or a gating circuit) which ensures that the gain of the stage is reduced when a strong signal is received.

The a.g.c. signal may bias back the controlled stage to reduce the gain, a system known as *reverse control.* Alternatively the a.g.c. signal may bias the controlled stage forward, the increased collector current causing a reduction in collector voltage by virtue of a resistor included in the collector circuit for this purpose. This is known as *forward control:* it can be more effective than reverse control but requires a transistor specially designed for this application.

Internal Feedback Capacitance

(2) The internal collector-base capacitance of a bipolar transistor may be as low as a few picofarads. Nevertheless unless precautions are taken the positive feedback via this capacitance is sufficient to cause instability if the common-emitter circuit is used for high-gain r.f. amplification. The positive feedback can be neutralised by an equal amount of negative feedback, but this requires critical adjustments to

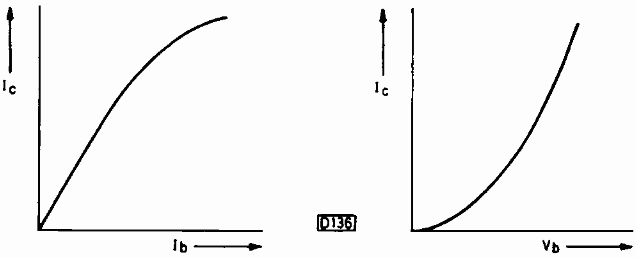


Fig. 1 (left): For a bipolar transistor, the collector current Ic is directly proportional to the base current Ib.

Fig. 2 (right): The relationship between Ic and the base voltage Vb is non-linear with bipolar transistors.

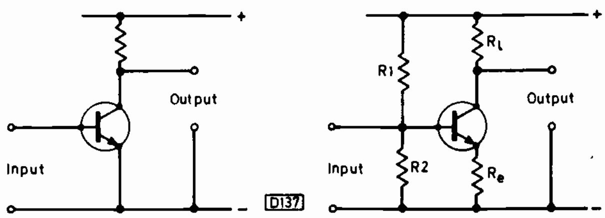


Fig. 3 (left): Basic form of common-emitter amplifier.

Fig. 4 (right): Mean collector current stabilisation by means of a potential divider R1, R2 and emitter resistor Re.

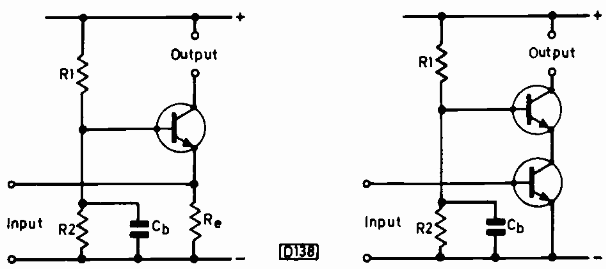


Fig. 5 (left): Common-base amplifier, with mean collector current stabilisation as in Fig. 4.

Fig. 6 (right): The cascode amplifier – a combination of common-base and common-emitter stages.

neutralising capacitors (a nuisance in mass production) and a more common method of achieving stability in i.f. amplifiers is to limit the gain of the stage to a value at which the positive feedback is insufficient to cause oscillation.

One way of limiting the gain of a common-emitter stage is to give the stage a very low load resistance, such as the input of a common-base amplifier. The combination of the two is known as a cascode circuit.

Common-base Amplifier

The basic form of the common-base amplifier is shown in Fig. 5 and includes R1, R2 and *R*e for d.c. stabilisation as in Fig. 4. It has a very low input resistance – commonly around 25Ω – and the output resistance is higher than that of the common-emitter amplifier. These properties make it suitable for current amplification, but the current gain is slightly less than unity. The voltage gain can be considerable and is approximately equal to that of the common-emitter amplifier. Again the input-output voltage relationship is non-linear, but this may not be serious if signals of very small amplitude are to be amplified. Thus common-base amplifiers are sometimes used in microphone head amplifiers. The common-base amplifier differs from the common-emitter amplifier in that there is no signal inversion: the output signal is in phase with the input signal.

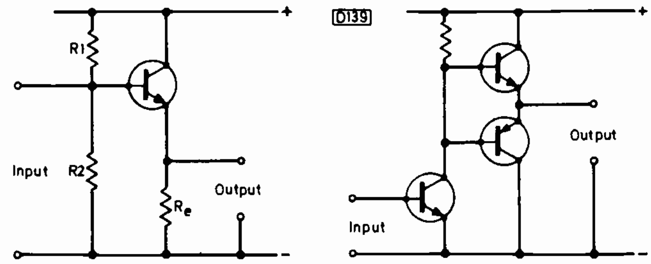


Fig. 7 (left): Emitter-follower circuit, with d.c. stabilising components R1, R2 and Re.

Fig. 8 (right): Skeleton circuit showing the use of a pair of complementary transistors to provide push-pull operation.

The common-base amplifier can also be used for stable r.f. amplification.

As shown in Fig. 4, the base is decoupled by *C*b. Thus the collector-base capacitance (which is troublesome in the common-emitter amplifier when used at r.f.) now appears in parallel with the output of the amplifier where it contributes to the tuning of the output circuit.

The two transistors in a cascode circuit can be conveniently connected in series across the supply as indicated in Fig. 6, the upper transistor being the common-base stage and the lower one the common-emitter stage.

Emitter-follower Circuit

The third basic circuit configuration for a bipolar transistor is the common-collector arrangement more commonly known as the emitter-follower. Its outstanding properties are a high input resistance and a low output resistance, and it is commonly used at the input to an amplifier to give a high input resistance or at the output to give a low output resistance. The ratio of the input to the output resistance suggests that this circuit arrangement should be used for voltage amplification, but the voltage gain is slightly less than unity so that signals applied to the base emerge with negligible change in amplitude from the emitter – the emitter follows the base.

The basic form of the emitter-follower circuit is shown in Fig. 7 which also includes the d.c. stabilising components R1, R2 and *R*e. The emitter-follower has considerable current gain: it is equal to that of the common-emitter amplifier, i.e. approximately *h*fe, and this circuit is often used to give high current gain where no signal inversion is required between the input and output signals.

Complementary Types

One of the most useful properties of the bipolar transistor is that there are two complementary types. This gives considerable flexibility in circuit design and makes possible some very simple push-pull circuits. For example, a positive-going signal applied to the base of an npn transistor increases the emitter current but the same signal applied to the base of a pnp transistor decreases the emitter current. Thus a complementary pair, fed with the same input signal, operate naturally in push-pull. A push-pull stage can thus be constructed by connecting pnp and npn transistors in parallel as shown in the skeleton circuit shown in Fig. 8.

Class A, B and C Operation

The circuit arrangement used in Figs. 4, 5 and 7 for the stabilisation of mean collector current can be used only with stages operating in class A, for which the mean emitter current does not fluctuate during operation. It must not be assumed that all the stages in linear equipment necessarily operate in class A however. Examples of class B and class C operation can be found in receiver design. For instance the output transistors in Fig. 8 can be biased back almost to the point of collector-current cut off so that they operate in class B. Amplification is still linear: indeed most transistor a.f. output stages and many field output stages consist of a pair of complementary transistors operating in class B push-pull.

Oscillator Circuits

Oscillator circuits often operate in class C, taking a burst of base current and of collector current during a small fraction of each cycle and remaining cut off for the remainder of the cycle. The bias which keeps the transistor cut off is usually provided automatically by a capacitor *Cb* included in the base circuit – as shown in the typical Hartley circuit (Fig. 9). The capacitor is charged by the burst of base current, and *Rb* is made large so that little of the charge on *Cb* leaks away during the periods when the transistor is non-conductive. To a first degree of approximation therefore, the voltage across *Cb* remains constant.

In the Colpitts oscillator the centre tap of the frequency-determining circuit is achieved by the use of two equal value capacitors connected in series across the inductor as shown in Fig. 10. Unfortunately the circuit is often so drawn that it is difficult to determine which if any of the many capacitors present are the two fundamental ones. Thus much time can be lost before the circuit is recognised as a Colpitts oscillator.

Digital Circuits

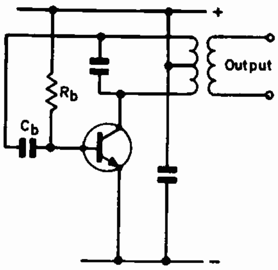
Bipolar transistors are well suited to use in digital circuits, where they are switched between the following two states: (a) cut off, i.e. with zero collector current (the "off" state); and (b) fully conducting, i.e. with zero collector-emitter voltage (the "on" state). These are the properties of an ideal switch, and a signal applied to the base of the transistor can change it from one state to the other very rapidly.

Dissipation in the transistor is the product of the current and the voltage: it's zero in both states therefore – in one because current is zero, and in the other because voltage is zero. In fact there is some dissipation in the "on" state, because the switching signal applied to the base has to supply appreciable voltage and current to hold the transistor in the fully-conducting condition.

Field-effect Transistors

The field-effect transistor, whether of the junction-gate or insulated-gate type, has properties quite dissimilar to those of the bipolar transistor. For example the input resistance is almost infinite: it takes no current therefore from the source feeding the gate with input signal, responding only to the voltage of the signal source. Field-effect transistors are therefore voltage-operated devices.

The high input resistance makes the field-effect transistor ideal for certain applications, e.g. following a capacitor microphone, crystal microphone or a gramophone pickup of the capacitor or crystal type – the common-source circuit is commonly used for this purpose. The common-source circuit on its own is unsuitable for use as an r.f. or i.f. amplifier however because of instability caused by the gate-drain capacitance. But a cascode composed of a common-



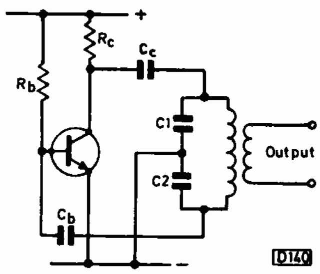
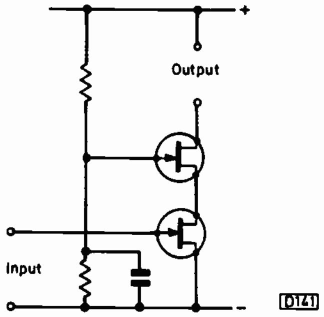


Fig. 9 (left): The Hartley oscillator circuit. It operates in class C, with bias provided by Rb and Cb.

Fig. 10 (right): Colpitts oscillator circuit: the two fundamental capacitors which provide the positive feedback are C1 and C2.



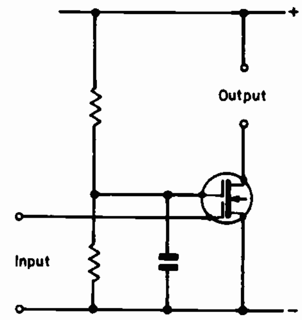


Fig. 11 (left): Simplified cascode circuit consisting of a common-source amplifier feeding a common-gate amplifier, using junction-gate field-effect transistors.

Fig. 12 (right): A dual insulated-gate f.e.t. used as a cascode circuit – equivalent to Fig. 11.

source amplifier feeding a common-gate amplifier, as shown in Fig. 11, is stable.

An interesting feature of this circuit is that there is no external connection to the inter-transistor drain-source link: it's possible therefore to achieve the same results from a dual-gate field-effect transistor, as shown in Fig. 12. The similarity of this circuit to that using an r.f. tetrode or pentode valve is striking, and dual-gate field-effect transistors are sometimes referred to as tetrodes.

The relationship between input voltage and output current for a field-effect transistor is far from linear (it is similar to that shown in Fig. 2), and to minimise distortion arising from the curvature of the characteristic such transistors are normally used in the early stages of equipment where signal levels are small.

In some of its applications the field-effect transistor is best regarded as a voltage-controlled variable resistor. The resistance of the channel, i.e. the drain-source path, can be made any value within wide limits by suitable choice of gate bias voltage: moreover, the resistance of the path remains substantially constant for alternating signals of small amplitude. Thus the field-effect transistor is very suitable for use as the control element in remotely-controlled faders and a.g.c. circuits.

Field-effect transistors make near ideal switches. In the "off" state they take zero current, and in the "on" state there is negligible voltage drop across them. They have the advantage over bipolar transistors that they can be made very much smaller physically, and that there is no dissipation in the input circuit in the "on" state.

Summary of Transistor Properties

The following parts in this series of articles will illustrate typical applications of transistors in television receivers. It's useful to summarise first the principal transistor properties that are exploited.

In general bipolar transistors are used for current amplification and field-effect transistors for voltage amplification. It's a simple step to see how bipolar transistors can be used as current-to-voltage converters and field-effect transistors as voltage-to-current converters.

Where gain control is required bipolar transistors can be used and there is a choice of forward or reverse control. Control of gain is also possible using dual-gate field-effect transistors – by applying the signal to one gate and the control voltage to the other.

For a low input resistance a common-base or common-emitter stage is a natural choice, and where a high input resistance is wanted an emitter-follower, or a field-effect transistor as common-source or source-follower, can be used. A low output resistance calls for an emitter-follower or a source-follower.

Signal inversion is provided by common-emitter or common-source amplifiers.

For circuits requiring a controllable resistance, bipolar or field-effect transistors can be used, the control signal being applied to the base or gate.

In certain transistor applications the input circuit is required to operate as a diode which rectifies the input signal. A bipolar transistor or junction-gate field-effect transistor is suitable. At least one circuit application makes use of the collector-base diode, and here a bipolar transistor is essential.

Some oscillator circuits rely on the collector-base capacitance for their operation, and here a bipolar transistor is called for. The base-emitter and collector-emitter internal capacitances of a bipolar transistor can be used as the two fundamental capacitors of a v.h.f. Colpitts oscillator.

There are numerous instances where a switching action is required, i.e. a circuit element is required to be a short-circuit or an open-circuit. A control signal determines which of these states is taken up by the element. Bipolar or field-effect transistors can be used for these switching applications, the control signal being applied to the base or gate terminal.

The TBA120T and TBA120U I.C.s

Phosphor

SINCE I described the TBA120 and TBA120S intercarrier sound i.c.s in the April 1975 issue two new variants have appeared, with sufficient differences to warrant a further short article. Both the new types have symmetrical eight-stage limiting amplifiers and coincidence detectors of the same sort as the earlier i.c.s, and offer d.c. volume control.

The similarity to the earlier types ends here. The newer ones each have an a.f. input before the d.c. volume control stage, intended for playback from a VTR, and an uncontrolled a.f. output for feeding a VTR or possibly a hi-fi system through suitable isolation. D.C. volume control is effected by the application of a voltage to pin 5, the maximum output being obtained when pin 5 is at 4·8V. This voltage is generated internally at pin 4, which can supply up to 5mA if so required. If d.c. volume control is not wanted, pin 5 is connected directly to pin 4.

Supply voltage variation from 10-18V does not affect the a.f. output, which compares with that of the TBA120S when operated at 15V, and with this goes supply line hum rejection of typically 35dB on the controlled a.f. output.

A.M. suppression reaches a broad maximum at 20mV input, being specified as 50dB minimum at only 500μV input for 30% modulation at 1kHz. Limiting starts at a maximum of 60μV input.

Now for the differences between the T and U variants. The T version is designed to operate with Murata or equivalent ceramic filters, while the U version is for an *LC* quadrature circuit with either an *LC* or ceramic filter input circuit. Beside being arranged for use with a standard SFC ceramic filter in place of the quadrature coil, the T's input impedance is 800Ω in parallel with 5pF, matching the SFE type filter with no need for other external input components. If a ceramic input filter is used with the U, a terminating resistor must be employed as the input looks like 40kΩ in parallel with 4·5pF, with a wide tolerance on the resistive component. The makers suggest the circuit shown in Fig. 1, and give the block diagram shown in Fig. 2. ■

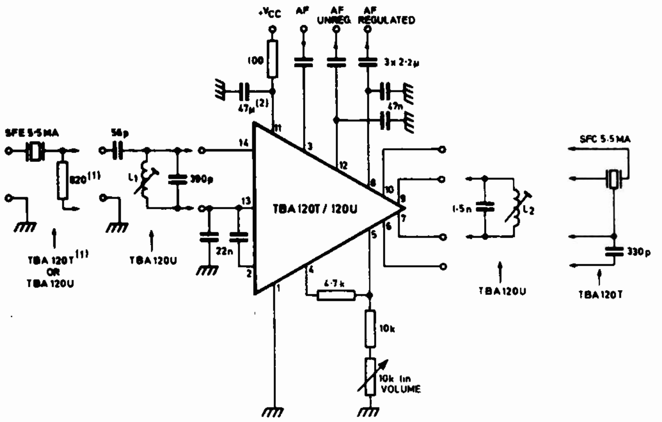


Fig. 1: Suggested circuit. Notes: (1) The 820Ω input circuit resistor is not required with the TBA120T. (2) Omitting the 47µF capacitor connected to pin 11 alters the volume control range.

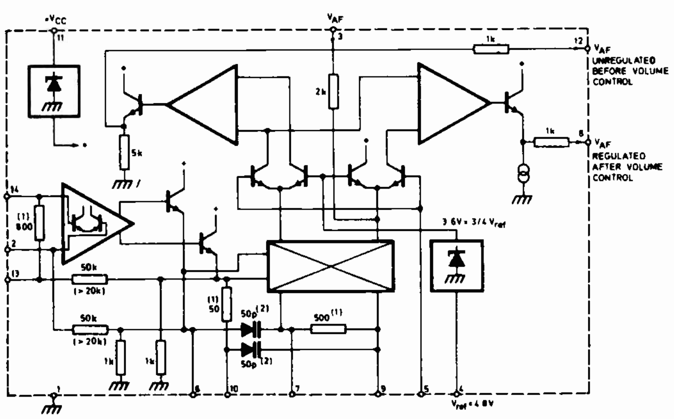


Fig. 2: Block diagram. Notes: (1) TBA120T only. (2) TBA120U only.

Servicing Saba Colour Receivers

Solid-state Chassis H

Part 4

P. C. Murchison

LAST month we saw how the ultrasonic remote control version of the receiver worked, and looked at the fault conditions to be found in that part of the set. In this part we are going to cover the i.f. and luminance circuits, ending next month with the colour circuits. Although most of these circuits are straightforward in operation, there are some interesting variations to be seen and quite a few servicing hints to be passed on.

So without further ado we'll quickly mention the i.f. strip and then plunge on into the mysteries of the luminance channel, with a view to making some sense of the unusual circuitry employed here. We've tried to make things a bit easier to understand by showing the various stages inside the i.c.s in block form, a policy we feel ought to be adopted as standard on all circuit diagrams.

After leaving the varicap tuner unit the i.f. signal passes into a four-stage transistor i.f. unit which is a solder-in printed circuit board mounted vertically on the main signal board on the left-hand side of the set. We've never experienced any faults on this unit, and feel that the best cure for any trouble is to replace the unit as a whole rather than trying to effect a repair. The vision detector is incorporated in the i.f. unit, and it's from here that the video signal passes via an emitter-follower to the TBA500P luminance signal processing i.c.

The Luminance channel

The emitter-follower transistor acts as an impedance matching device driving pin 2 of the i.c. (see Fig. 12). Once inside the i.c. the video signal is subjected to several stages of current amplification before emerging at pin 4 to feed the luminance delay line L351. The signal then passes to pin 8 of the i.c., minus the chroma information which is extracted by the 4·43MHz trap between R386 and R348. This trap is interesting since it operates only when a colour transmission is being received. Thus the full video bandwidth passes through on a monochrome transmission when there is no chrominance component to filter out. L356 and C357 form a series resonant (4·43MHz) tuned circuit to short out the chroma part of the bandwidth, whilst at the same time C356 forms a parallel resonant circuit with L356 to emphasize the frequencies above 4·43MHz, so improving the h.f. video response.

This series-parallel tuned circuit is switched into circuit when there is a colour transmission by transistor T352. This is in turn controlled by the colour-killer voltage which is derived from the chroma section of the set. When a colour transmission is being received, 8·5V from the colour killer is applied to R396 which in turn feeds the base of T352, turning it hard on so that its collector potential drops to zero volts. The collector of T352 is connected to the cathode of D353 via R393, and as T352's collector voltage drops to almost 0V the diode conducts connecting the lower end of the tuned circuit to chassis via the 12V rail decoupling capacitor C354. In this way the tuned circuit is switched into action.

Should the signal being received revert to monochrome however, the killer supplies no voltage to T352's base, the transistor cuts off and its collector voltage rises to 12V. The 12V is in turn applied via R393 to the cathode of D353 and since there's no potential difference between its anode and cathode the diode cuts off. Under these conditions the resonant circuit has no effect and the full luminance channel bandwidth passes through to pin 8 of the i.c.

The line and field flyback blanking pulses are also fed into pin 8 of the i.c. The luminance signal is thus blanked and then subjected to further amplification before emerging at pin 10 for feeding to the matrix i.c. Contrast and brightness control and beam limiting are also carried out within the TBA500.

Inside the TBA500, an "electronic potentiometer" circuit consisting of twelve transistors exercises linear control of the gain of the luminance channel. This is where contrast control is effected, the control itself being linked via D349 to pin 5. The voltage tapped from the control is used to increase or decrease the gain of the luminance channel.

This is not the whole story however, as the beam limiting action is also controlled at pin 5, excessive c.r.t. beam current causing a reduction in contrast.

The operation of the beam limiter circuit is based on the widely used principle of two currents flowing in opposite directions through a fully conductive diode. The diode concerned is D351, whose cathode is connected to the 12V supply while its anode is connected via R362 and R696 to the 270V h.t. rail. It's normally forward biased therefore, a bleed current flowing via the 12V supply, the diode and the two resistors to h.t. The c.r.t.'s cathode current flows through the diode in the opposite direction – via the tripler, the e.h.t. overwinding, R362, D351 and the impedance of the 12V supply. So long as the c.r.t.'s cathode current is below the 2mA bleed current, D351 remains conductive. Should the c.r.t.'s cathode current exceed 2mA however D351 ceases to conduct and the current then flows to chassis via R361, P354, P352, R366 and R364. In consequence the voltage at the slider of the contrast control moves negatively, reducing the gain in the TBA500P and hence the beam current. The colour saturation is also reduced since, as we shall see later, the contrast and saturation control circuits are linked. In this way the c.r.t. and the power supply are protected against overload. The time-constant of R361 and C347 (5·6msec) is such that short-term peak currents do not initiate the beam limiting action. D350 is incorporated to provide protection against the effects of c.r.t. flashovers – preventing damage to the two tantalum electrolytics C346 and C347.

This circuitry, also the colour-killer switch system, can be responsible for some interesting faults. Before going on to faults in this part of the circuit however we must consider the service switch and the a.g.c. system, both being associated with this i.c.

Pin 6 of the i.c. is connected via R351 to the service switch which, as shown, is usually connected to chassis. For setting up however there's a "raster" position of the switch, when R351 is connected to 12·8V instead. This interrupts the luminance signal path. The "raster" position of the switch is used for checking colour purity – turn down the

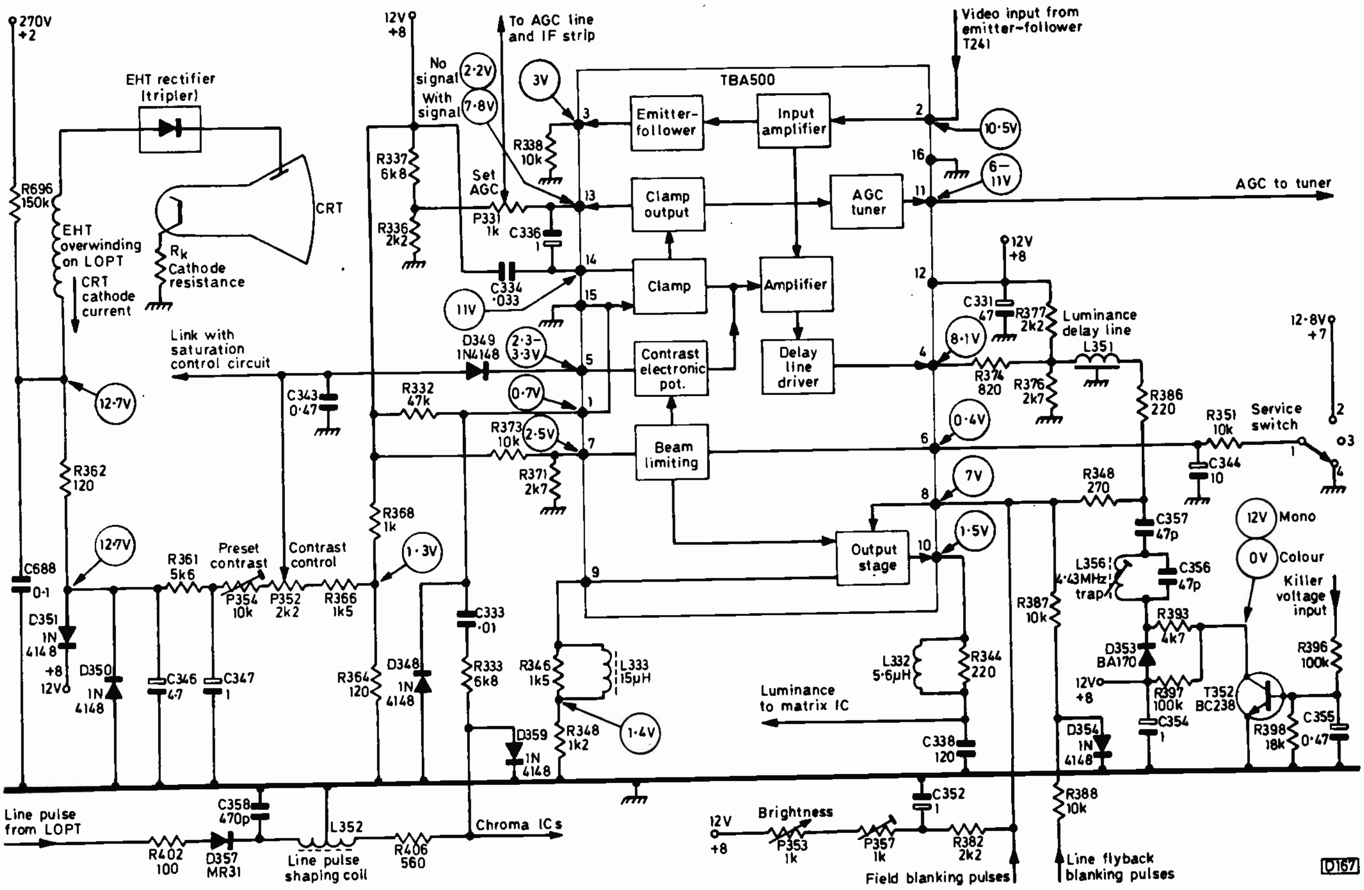


Fig. 12: Luminance signal processing is carried out by a TBA500 i.c., which also provides the a.g.c. potentials.

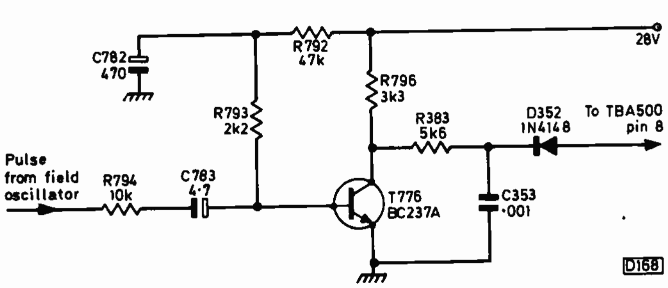


Fig. 13: The field flyback blanking pulse circuit.

blue and green c.r.t. first anode controls and examine the red raster then present. It's worth noting that the TBA500N requires a negative voltage at pin 6 to block the luminance channel. The two types of i.c. are not interchangeable therefore.

The i.c. provides an a.g.c. output at pin 13 to control the gain of the i.f. strip and an a.g.c. output at pin 11 to control the tuner. The a.g.c. system is a gated one, sampling the video signal black level (the back porch). A gating pulse is required therefore and is fed in at pin 1. The way in which the pulse is obtained – delayed to coincide with the back porch of the sync pulse – is interesting. Diode D357 is normally conductive, damping the tuned circuit L352/C358. A negative-going line flyback pulse is applied to the anode of D357 however, cutting it off. When this happens, the oscillatory circuit is shocked into oscillation, producing a delayed, negative-going pulse which is fed via R406, R333 and C333 to pin 1 of the i.c. The following positive-going half cycle of oscillation is short-circuited to chassis by D359. Note that pnp transistors are used in the tuner, 11·5V at pin 11 corresponding with maximum gain (forward a.g.c.).

The obvious fault to look at first is failure of the TBA500P i.c. itself. This does occur, though only very rarely. The i.c. is d.c. coupled to the TBA530 matrix i.c., so when it fails the result is usually a very bright raster with flyback lines. The set then automatically switches itself off when the protection circuit operates, because the beam current will have exceeded the normal "safe" level. Luminance channel faults often cause this effect, with the protection circuit coming into operation to save the day.

Other components which can cause this effect are C354 (12V decoupling) which goes leaky and D352 (Fig. 13) in the field flyback blanking pulse circuit – it tends to exhibit a poor back-to-front ratio.

The luminance delay line L351 is an extremely delicate component which sometimes goes open-circuit with the resulting loss of video.

Another nasty fault occurs in the beam limiting circuit, where R696 goes open-circuit. The voltage at pin 5 of the i.c. is then reduced to less than a volt, turning the internal electronic potentiometer down. C346 has been known to go leaky, usually causing a very pale picture – R696 going open-circuit usually causes complete loss of luminance.

Another electrolytic capacitor that's inclined to leak is C331. This pulls the 12V rail down with the resultant loss of luminance.

Sometimes we get the complaint that the picture gradually gets darker as the receiver warms up. Close examination will reveal that field flyback lines are clearly visible on the picture, indicating that all is not well with the field flyback blanking circuit. T776 is the culprit here. It's situated on the timebase panel, in the centre at the top. The voltage at its collector should be 28·5–30V under normal working conditions, but drops drastically when the transistor fails.

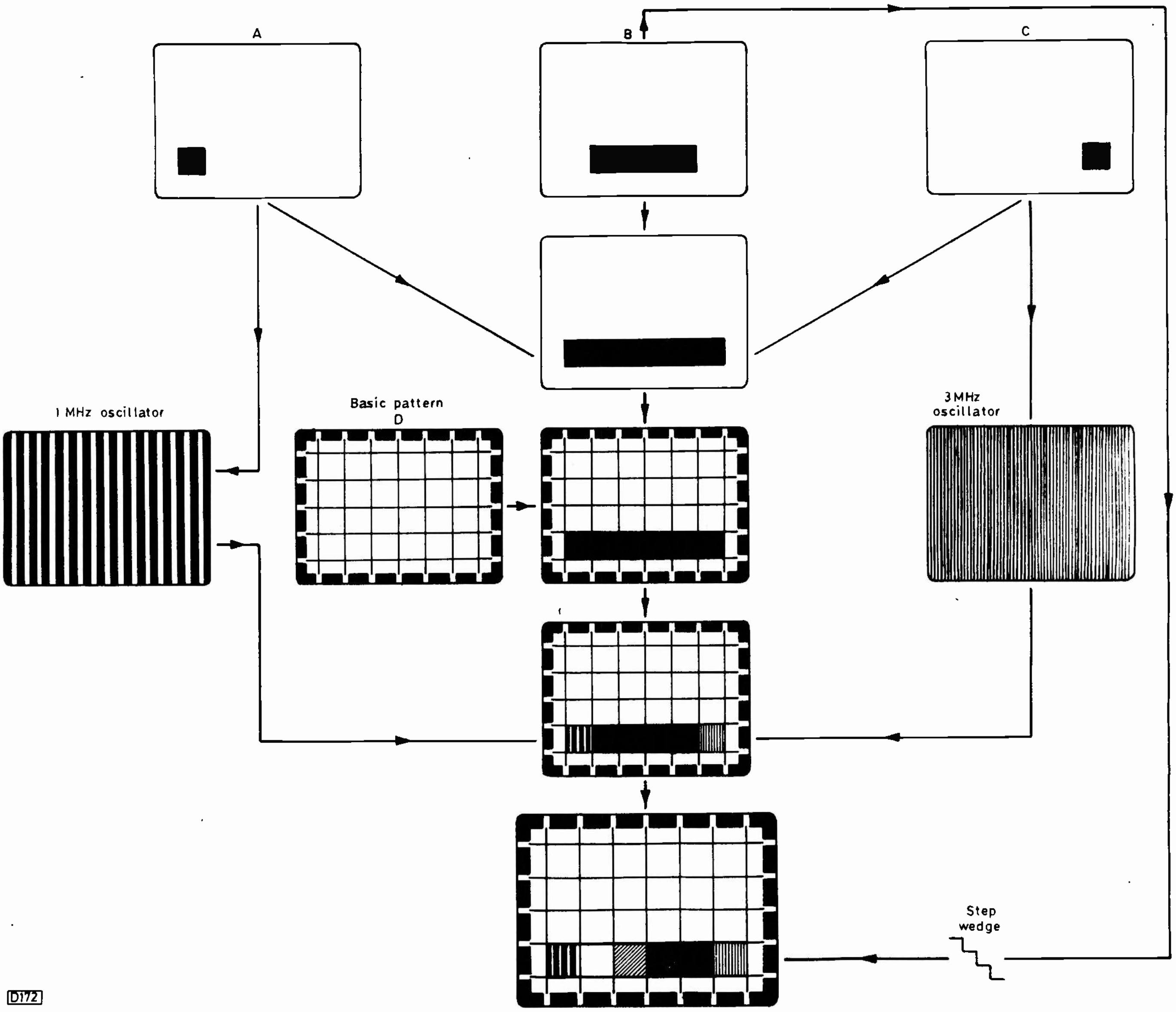


Fig. 3: How the complete pattern is built up.

★ Components list

Resistors:

R1	10kΩ
R2	2·7kΩ
R3	220Ω
R4	6·8kΩ
R5	390Ω
R6	6·8kΩ
R7	2·2kΩ
R8	15kΩ
R9	5·6kΩ
R10	4·7kΩ
R11	47kΩ
R12	1kΩ
R13	18kΩ
R14	5·6kΩ
R15	22kΩ
R16	12kΩ
R17	2·7kΩ
R18	5·6kΩ
R19	10kΩ
R20	2·7kΩ
R21	100Ω
R22	390Ω
R23	390Ω
R24	1·5kΩ
R25	390Ω
R26	A.O.T. (330 Ω approx.)
R27	390Ω
R28	330Ω
R29	180Ω
R30	1·8kΩ
R31	330Ω
R32	56Ω

All ¼ W, 5%

VR1	4·7kΩ
VR2-VR10	10kΩ Subminiature horizontal types

Capacitors:

C1	2200μF 16V
C2	100μF 6V tantalum bead
C3	·0022μF ceramic plate
C4	22pF ceramic plate
C5	·47μF polyester
C6	·001μF ceramic plate
C7	·47μF polyester
C8	18pF ceramic plate
C9	·33μF polyester
C10	470pF ceramic plate
C11	·0022μF ceramic plate
C12	·0047μF ceramic plate
C13	·47μF polyester
C14	·47μF polyester
C15	·0022 ceramic plate
C16	100pF ceramic plate
C17	·47μF polyester
C18	·0022μF ceramic plate
C19	·47μF polyester
C20	·0033μF ceramic plate
C21	·0022μF ceramic plate
C22	10μF 16V tantalum bead
C23	10μF 16V tantalum bead
C24	·0015μF ceramic plate
C25	·0033μF ceramic plate
C26	56pF ceramic plate
C27	·0033μF ceramic plate
C28	·0022μF ceramic plate
C29	·0022μF ceramic plate
C30	10μF 16V tantalum bead

Polyester capacitors are Siemens types.

Semiconductors:

20 of	74121
7 of	7400
2 of	7490
1 of	7413
1 of	7401
1 of	7404
1 of	2NA134
1 of	7805
D1, 2	OA91
Bridge	BY164

Miscellaneous:

XL1	2·5625MHz crystal
T1	9V, 2A RS 207-510
Case	Marshalls RB4
FS1	1A anti-surge
PCB	D048
Heatsink	Redpoint TV4 (for 7805)
UHF modulator	Manor Supplies
UHF coaxial socket	
Mains switch with indicator	

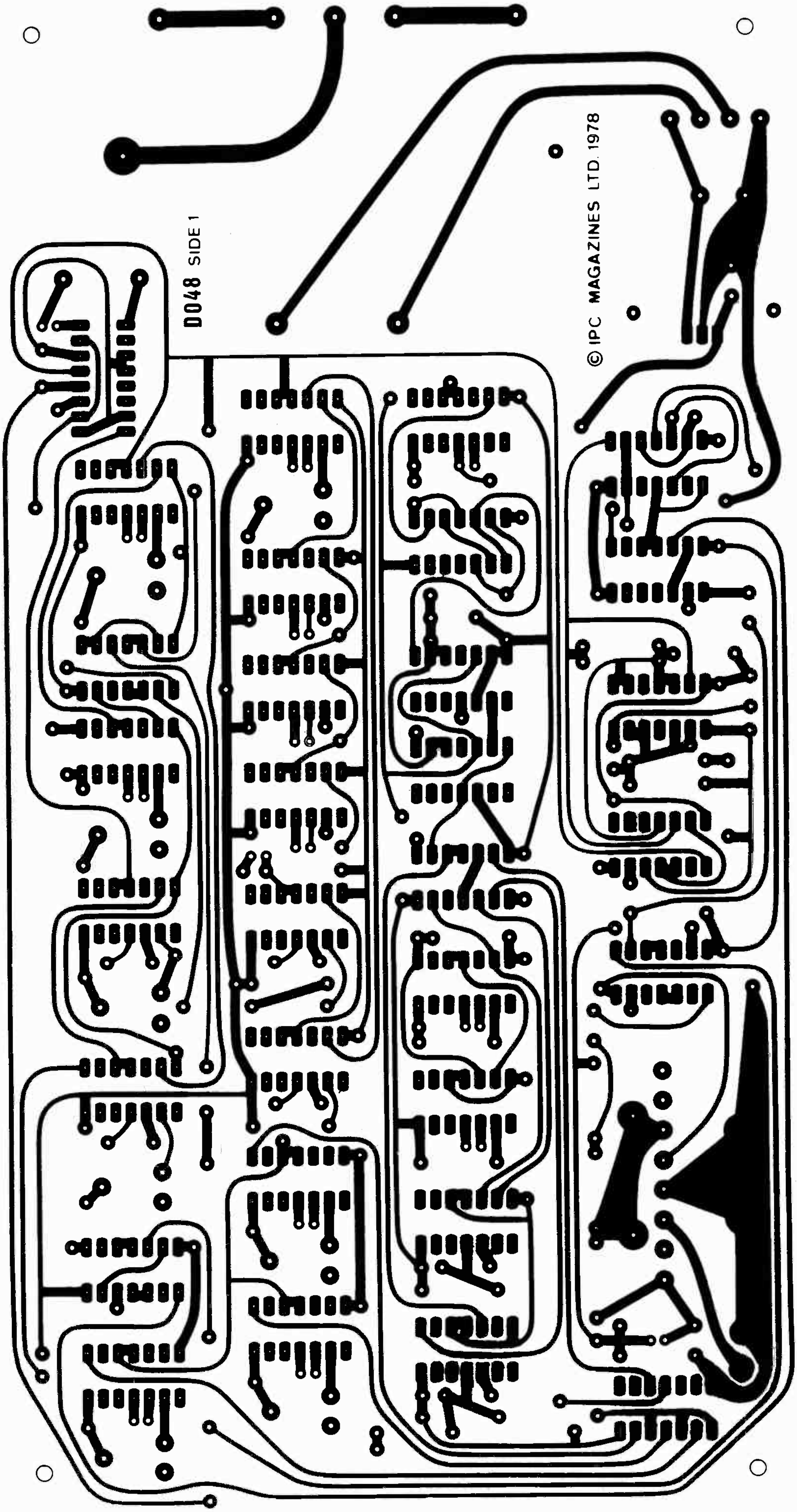


Fig. 4: Underside print pattern. Note that this is a double sided p.c.b. The top side will be shown next month. Scale 1:1.

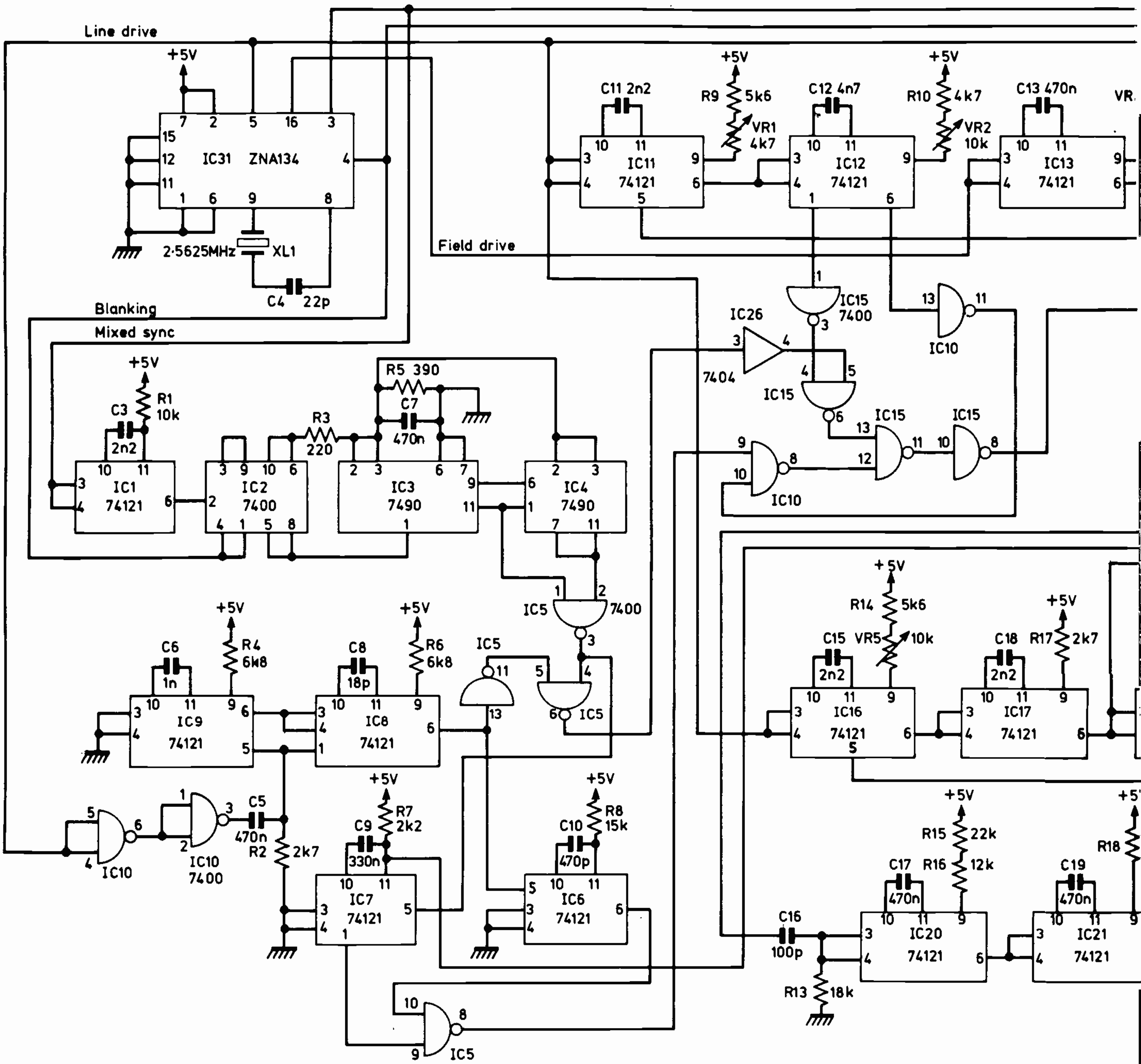


Fig. 5: Complete circuit diagra

Only four steps are included in the step wedge, but additional i.c.s could be employed to increase the number or alternatively a circuit design similar to previous *Television* articles could be employed.

Crosshatch

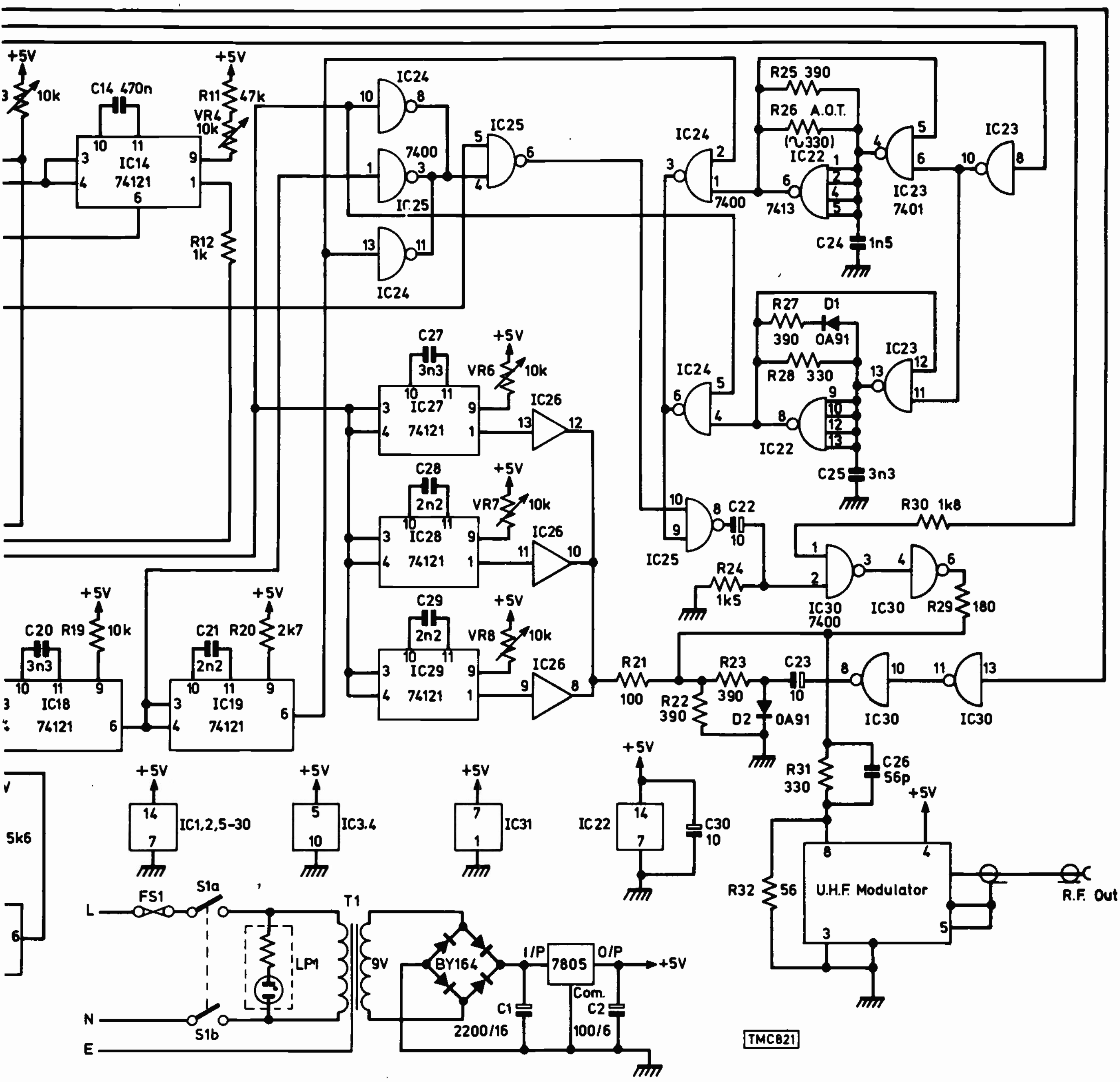
The horizonal grill lines are formed by a novel yet not original circuit using the monostable IC1 and the quad nand-gate IC2 fed with mixed blanking and mixed sync signals to produce a field output without the odd half line (this would introduce erratic operation of the horizontal line generator, causing a jittery pattern). IC3 and IC4 are decade counters feeding part of IC5, giving an output of horizontal lines at pin 3.

Vertical grill lines are produced by monostables IC8 and IC9 which are strapped as a multivibrator and locked to the line drive obtained via half of IC10. The pulse width is determined by R6/C8, and the exact number of lines by R4/C6. If some adjustment is required, R4 can be altered. Vertical and horizontal lines are combined in IC5 to produce a complete crosshatch pattern at pin 6.

The horizontal grill lines from pin 3 of IC5 are also fed to monostable IC7, resulting in broad horizontal bands with the width set by R7/C9. Similarly the vertical line waveform from the grill generator IC8 pin 6 is fed to IC6 to produce broad stripes with R8/C10 as the time-constant. Both patterns of stripes are combined in IC5 to give at pin 8 an output of black squares on a white background (see Fig. 1).

Combining Border and Grill

To combine the two patterns a "hole" must be made in the border pattern and the edges of the grill signal clipped so that both can be superimposed exactly. This is done in ICs 11 to 14. These generate a rectangle which is adjustable for



n of the test pattern generator.

horizontal position by VR1, horizontal width by VR2, vertical position by VR3, and vertical duration by VR4. Fig. 1 shows diagrammatically the method that's employed. IC11 and IC12 produce a pulse locked to the line drive, and IC13 and IC14 produce the field frequency locked pulse which ensures that IC11/12 cannot be switched 'on' during the period of the gap at the top and bottom of the raster.

The rectangle output from pin 1 of IC12 is fed to pin 1 of IC15 and inverted, then passed to pin 4 where it gates the edges of the crosshatch signal arriving at pin 5 from invertor IC26. Likewise the rectangle from pin 6 of IC12 is fed to pin 13 of IC10, inverted, then used to gate out the centre of the border pattern, giving a black and white castellated border at pin 8. Chopped border and grill are fed to pins 12 and 13 of IC15 producing a complete pattern of crosshatch with castellated border at pin 11. The remaining part of IC15 inverts the signal, producing the basic pattern at pin 8.

Insert Signals

Fig. 3 demonstrates how the gating waveforms for the insert signals are generated. Another chain of monostables produces three small rectangles, A, B and C.

A and C are intended for frequency gratings, while B is intended for the step wedge. Horizontal centring of the whole group is by adjustment of VR5; R26 can be varied to move it vertically, although the value given should, as previously mentioned, ensure that it lies slightly below the centre line.

First it's necessary to make a hole in the grill/border pattern. Rectangles A, B and C are combined in IC24, at pins 10 and 13, also pin 1 of IC25, with all outputs strapped together. They are applied to IC25 pin 4 whilst the grill/border goes to pin 5. The result at pin 6 is a complete pattern with a central segment missing.

CONCLUDED NEXT MONTH

Faults Analysed

Robin D. Smith

Smoking Set

We were called out to see a single-standard hybrid GEC colour receiver with the complaint no picture, set smoking. On inspection, it was noticed that various components beneath the PL509 line output valve had burnt out. These were removed and tested, but we could find no basic fault. The wirewound cathode resistor R52 (see Fig. 1) had been touching the screen grid decoupler C50 (0·1μF) which had burnt out, presumably due to the heat from R52. Anyway, we replaced these components and rebuilt the PL509 base and switched on.

Still no picture, but this time we noticed that R536 in the beam limiter circuit was getting very hot while C529 was disintegrating. The obvious thing to do was to check the PL509's cathode voltage, which turned out to be 80V instead of about 2·7V. It was obvious why C529 was disintegrating: it's rated at 6·4V! We next measured the current through R52. This was zero, although R52 was in order. So there had to be a fault in the cut-out, which was found to be open-circuit. Replacing the cut-out and C529 restored a normal picture.

Lack of Width, Poor Picture

The fault with a Pye hybrid colour set fitted with the 693 chassis was lack of width with a generally poor picture. My colleague got misled by this. The e.h.t. was 15kV, the h.t. 185V instead of 285V and the negative control grid voltage at pin 8 of the PL509 –50V instead of –90V. On this basis he assumed that there was a short-circuit in the line output stage (not uncommon on these sets) and after spending some time checking various capacitors, resistors and valves and finding nothing faulty he put the set to one side.

Having an hour to spare I decided to take a look myself. I've always found that the best policy is to ignore what's already been tried and look at the set in a different light. I confirmed his voltage readings, but as the valves in the line output stage weren't overheating I decided that the line output stage wasn't passing excessive current. So I turned my attention to the fact that the h.t. was down by 100V. The h.t. circuit is simple enough: a half-wave rectifier D49, reservoir capacitor C306, choke L42 and smoothing capacitor C315.

There was approximately 250V a.c. at the anode of D49 and 185V d.c. at its cathode, so it seemed likely that the reservoir capacitor was open-circuit and thus not developing adequate output. Shunting another 200μF capacitor across C306 restored the h.t. to 285V and correct width to the picture. Replacing C306 and C315 (double electrolytic) produced a good picture.

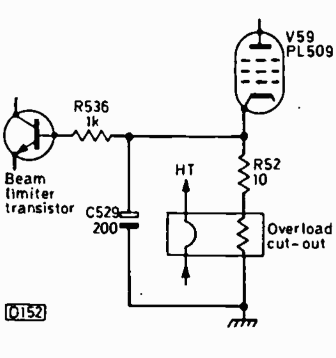


Fig. 1: An overload cut-out is incorporated in the PL509's cathode circuit in GEC hybrid single-standard colour sets. Excessive cathode current opens the cut-out to remove the h.t. from the line output stage.

GEC C2110 Series

The GEC 90° solid-state chassis (C2110 series) has been in production for some five years. I've sold several hundred of these sets and have found them to be very reliable. They are of modular construction and the panels are all very accessible for servicing. A *Which* report a couple of years ago voted the set as the best buy for performance, safety and reliability: for once I fully agreed with them and I'm still convinced that you need to go a long way to beat them at the price. I have had one at home for over four years and have had only two minor faults.

The two basic stock faults are failure of the thyristor h.t. rectifier (SCR701), and failure of the line output transistor (TR51, BU208). I would have liked to have seen a better protection circuit in the event of the line output transistor going short-circuit, but the designers seem to be happy with the 47V zener diode D51 (see Fig. 2) going short-circuit. In the event of TR51 failing, GEC suggest that the complete heatsink assembly is changed, due to the importance of the flyback tuning capacitor C52 (0·0052μF). I agree with this, having tried rebuilding the panel without success.

The power supply unit can be tested simply by disconnecting the output plug PL17 and connecting a 100W light bulb across the reservoir capacitor C702. With the set h.t. control P701 set at about midway the voltage across the load should be about 220V.

The line drive can be checked by removing PL27 and connecting a meter on the 10V a.c. range across PL27. A reading of approximately 4V a.c. should be obtained.

I always set the set h.t. control P701 to give a reading of 39-40V across C601, i.e. at the emitter of the line output transistor. GEC suggest adjusting for approximately 42-43V at this point, but in my opinion this reduces the life of either the thyristor SCR701 or the line output transistor TR51. 42-43V is too close to the breakdown voltage of the 47V zener diode D51 for my liking.

The only major fault I've had with one of these sets was when a customer had a go himself. He had bought the set last summer and stated that he'd noticed the tripler arcing. He had removed it and taken it to the local tarmacadam depot and dipped it in hot pitch. Upon refitting it, the set exploded. . . .

I did a post-mortem, having always been interested in the work of the pathologist. The following faults were found without even bothering to switch on. (1) E.H.T. tripler disintegrated. (2) Line output transistor short-circuit. (3) Protection zener diode D51 short-circuit. (4) 40V rectifier D601 short-circuit. (5) Both R607 and R608 (1MΩ) on the earthy side of the e.h.t. overwinding low resistance. (6) Mains fuse FS1 missing, with a 2in. wire nail in its place. (7) The fuseholder broken. (8) The fusible resistor R60 in the h.t. line had come unsoldered and had had thick wire wrapped around it. (9) The thyristor short-circuit. (10) The live side of the on/off switch shorted out.

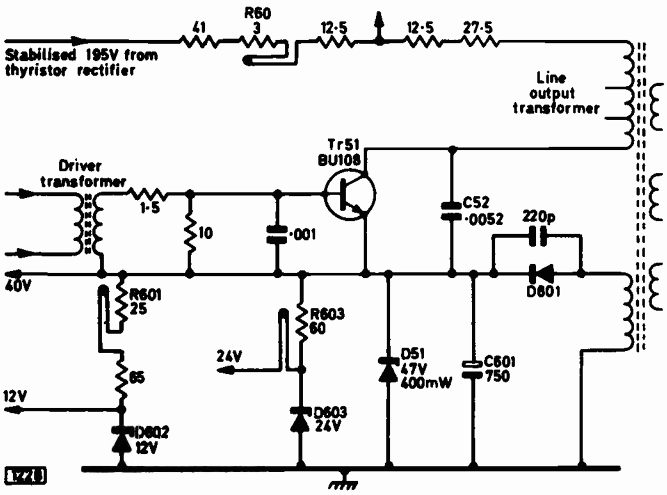


Fig. 2: Basic elements of the line output stage used in GEC solid-state colour receivers. The line output transistor sits on a 40V rail which is obtained from a rectifier fed from a winding on the line output transformer. D51 provides protection by going short-circuit when the 40V rail rises to 47V under excess load conditions. The usual cause of this is a defective flyback tuning capacitor (C52).

After replacing all these components I switched the set on and luckily it worked perfectly first time. After setting it up I left it to soak test for several hours and there was no further trouble. When the customer came I gave him a lecture and warned that I would not handle the set again if I found it had been tampered with. To make the point stick, I presented him with a £25 bill for labour for a job that took me about two hours, and explained exactly why I felt the charge justified. He paid up, with a red face, but seemed happy that he'd got his set back in working order.

There are a couple of other points worth noting about these sets. First, the audio i.c. is supplied from a 24V line derived from the 40V rail at the emitter of the line output transistor. The line is, or should be, stabilised by a 24V zener diode (D603). The zener can go short-circuit to cause no sound, or can be responsible for distorted sound when it fails to stabilise the supply. You don't normally expect to look in the line output stage in the event of such faults occurring. Secondly, excessive or low brightness can be due to the resistors in series with the c.r.t. first anode preset potentiometers. The usual offender is R507 (300kΩ) going high to give excessive brightness. Oh, and in the event of weak field sync check C452 (4·7μF) which decouples the emitter of the field sync pulse amplifier transistor TR451.

For further information on these sets, see the September 1976 *Television.*

RGB Loads Open-circuit

We had an interesting fault the other day on the decoder panel of a Bush colour receiver fitted with the A823B chassis. All three fusible resistors in the collector circuits of the RGB output transistors – the load resistors – had fused. I could see no reason why this should happen, so I resoldered them and switched on. Up came a good picture with correct colours. It was slightly over scanned however. The h.t. was checked and found to be high at 220V. After resetting it to 205V the set was run on test for several hours and then returned to the customer.

The conclusion I came to was that the high h.t. had tripped the overvoltage protection circuit and that the customer, not realising what had happened, had failed to switch the set off. Result, increased current through the RGB transistor collector load resistors, which had eventually fused. When the set is switched off the overvoltage trip remakes automatically of course and hence the set works when switched on again. The overvoltage circuit is normally set to trip should the h.t. rise above 220-225V.

A Theory Puzzle

A question that was sometimes asked in the City and Guilds Final TV Theory paper was "why is the screen grid feed resistor of the line output valve rated at around 5W when by Ohm's Law a 1W resistor would suffice?" It's a pet question I ask fellow engineers – and some of the answers I get are quite surprising.

If the h.t. line is say 250V, the screen grid voltage 220V and the feed resistor 2kΩ, then by Ohm's Law the dissipation is $W = V^2/R = 30^2/2{,}000 = 0{\cdot}45$W. So why 5W? My view is as follows.

The screen grid resistor is fed from the mains via a solid-state rectifier, so that there's a voltage present at the screen grid as soon as the set is switched on. The anode voltage of the line output valve will not be present however because the boost diode, which is in series with the line output valve, takes some time to start conducting. The boost diode must have high insulation between its cathode and heater, typical voltages on the valve being cathode approximately 800V (pulsed) and heater 100V. Because of this large voltage difference, the heater-cathode spacing is large and the time required to heat the cathode sufficiently to produce a space charge is long. Thus the boost diode is the last valve in the set (except for the e.h.t. rectifier of course) to come on. Now a pentode valve's cathode current is the sum of its anode and screen grid currents. So before the boost diode conducts, the total line output valve cathode current flows through the screen grid feed resistor which has to be rated to cope with it. Once anode current is developed, the screen grid current falls and the valve settles down – all being well.

Note that the boost diode is always the first or second valve in the series heater chain, in order to keep the potential difference between the heater and cathode as low as possible. I don't like to contemplate what would happen if it was last in the heater chain and went heater-cathode short-circuit.

Unusual BBC Test Cards

Keith Hamer and Garry Smith

TO most viewers the test card is something to assist in picking out faults after the service engineer has spent a long time repairing the glowing box in the corner of the room. Captions are just as boring, but a detailed look at the BBC output in this field will show that engineers and caption designers have a sense of humour. From time to time they come up with unusual ideas, and indeed at Christmas time each year it's interesting to see what colourful creation has been concocted to introduce the next programme.

In this short article we will look at one or two examples. There have been many more, but it isn't always possible to whip the camera out in time.

Globes and Clocks

From almost time immemorial BBC-1 has been obsessed by a globe caption which rotates day in day out. Actually the globe is a very good symbol for the BBC, since its programmes are sold to all parts of the world while many European television DXers can catch some good viewing free of charge. This is a sore point with some BBC officials, so we had better change the subject!

In the 1960s, programmes were preceded at the start of transmission with the globe caption and some special guitar music – a different piece for each day of the week, with a rather sombre tune reserved for Sundays. At the beginning of the 70s these rather quaint melodies were discontinued, except for spasmodic airings. A pity really, but that's progress!

The original globe zapped round at a fair rate, but the latest version is more sedate. The globe caption shown in Fig. 1 was transmitted on November 15th, 1970, to commemorate the first year of colour television on BBC-1. Hence the candle-shaped "1". The globe itself was not the usual one, but instead a more colourful type. Upon close inspection it would appear that it had been taken from the previous year's Christmas special.

The globes are normally approximately nine inches in diameter and illuminated from within. A curved mirror is positioned behind the globe to give the "iced cake" effect!

For a short period in 1972 the customary "this is BBC-1" announcement was replaced by a short jingle based on the musical notes of two Bs and a C (very musical, these BBC chappies!) which had been swiped from BBC test card music tapes. For the benefit of any BBC test card music fanatics, these musical "signals" have gone for good, and so have the jazzed-up versions previously mentioned.

The caption designers have a beanfeast at Christmas, particularly with the globe caption. 1977 was no exception, as Fig. 2 shows. The steadily rotating earth was substituted by a Christmas pudding, complete with white sauce and a sprig of holly atop! It was used for only three days, but no doubt caused some amusement to some viewers.

Although globe captions change for special events (including a rotating football for the 1970 World Cup events in Mexico), clock captions tend to remain formal looking. Occasionally the caption designers let their hair down at Christmas however as Fig. 3 shows, but this appears to be a rather rare event. The photograph was taken in 1973, and BBC Midlands haven't repeated the idea.

BBC clock captions are usually very accurate, although regional centres may be ± 1 second. Occasionally something goes wrong with the caption and a totally incorrect time is shown; this is extremely rare however.

The second clock photograph (Fig. 4) shows a caption which suddenly appeared on BBC-2 during January 1975. It didn't last long, and within a week BBC-2 had reverted to the normal caption.

Test Card F

The story of UK test cards was related in the February 1978 issue of *Television*. Yet more information about BBC test cards can be obtained from the BBC Monograph No. 69, which was first published in 1967. Test cards used throughout the world are featured in our book, *Guide To World-Wide Television Test Cards*, which is available through bookshops.

The two remaining photographs featured in this article show the very familiar Test Card F, but with somewhat unusual centre pictures.

The first photograph (Fig. 5) was taken in 1974, off BBC-1's "Nationwide", in which aerial erectors were under investigation and examples of poor installations were given. Test Card F has been interfered with in this fashion on several occasions. Digressing for a moment, when the SABC/SAUK Television Service began in South Africa two top comedians tore through the electronically generated PM5544 test pattern, something which had to be seen to be believed!

Returning to Test Card F however, the final photograph (Fig. 6) may at first sight appear to be as normal but on close inspection it will be noticed that the dream of many a television service engineer has been enacted by someone at the BBC Television Centre in London. For ten years Carol has been sitting there with her toy and blackboard. And now, finally, the game of noughts and crosses has been completed!! The photograph was taken on Christmas Eve, 1977, and it's open to conjecture as to whether the engineers in charge had been at the orange squash bottle. The two extra crosses were transmitted for only five minutes, so we were fortunate to capture the event on film!

Whatever will happen next? Will Carol's toy be exchanged for a cuddly gorilla off the Generation Game?? We will probably have to wait until next Christmas.

Whilst on the subject of BBC test cards it's perhaps worth recording that the SMPTE test card has been used during trade test transmissions, though only on rare occasions. As with the colour test card G (or PM5544 electronic test pattern), a modified version was used without any identification.

BBC test card music is carefully selected and produced by the Foreign Recordings Unit in Broadcasting House. Each of the numerous tapes is used for approximately one year, though some last a lot longer. To keep service engineers (and others!) happy a wide selection of music is transmitted, ranging from Eine Kleine Nacht Musik to Down By The Riverside! Most of the music is not available commercially, and special copyright laws apply. Back in the days of test card C two tapes were produced, copies of which were distributed to the various regional centres.

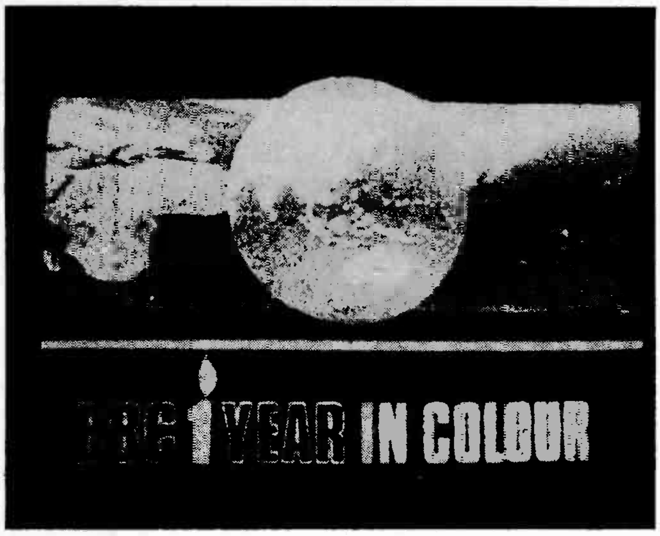


Fig. 1: Special globe caption to commemorate the completion of one year of colour on BBC-1.

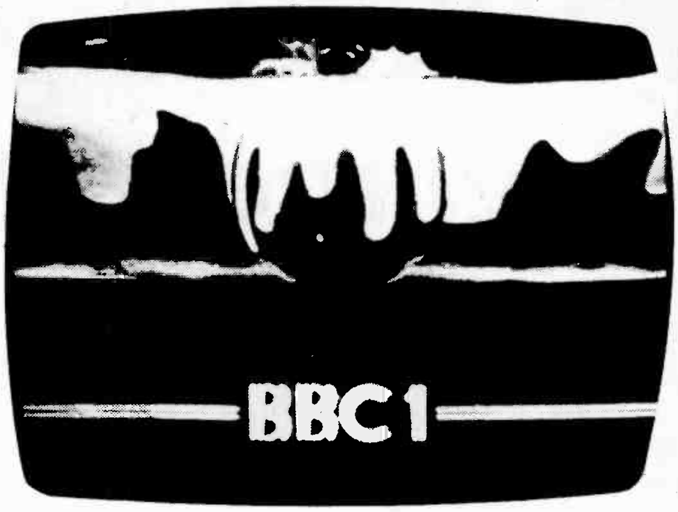


Fig. 2: The rather unusual Christmas pudding caption which was used for three days in 1977.

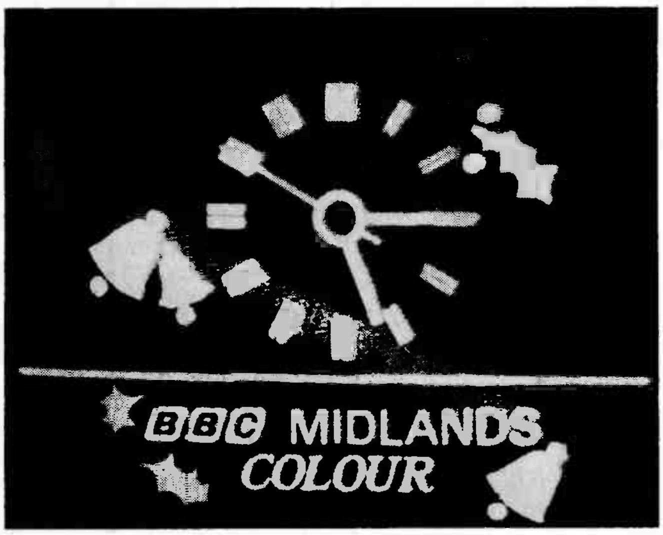


Fig. 3: BBC Midlands Christmas clock caption, 1973. The London Television Centre clock caption is occasionally dressed up.

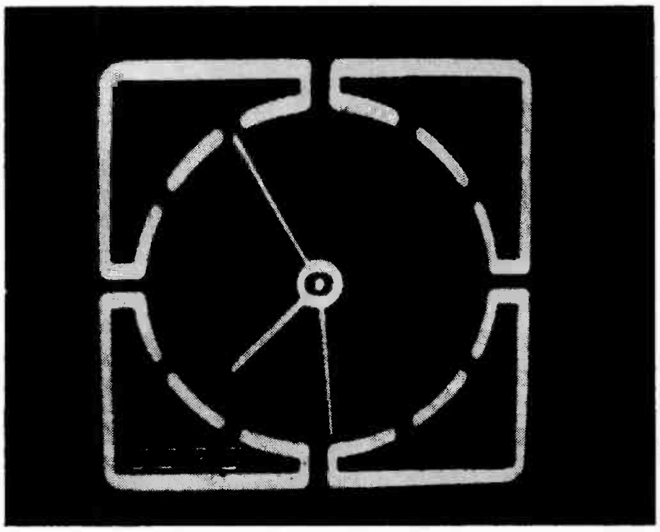


Fig. 4: A BBC-2 clock which broke with the normal BBC tradition and was used for a short period in 1975.

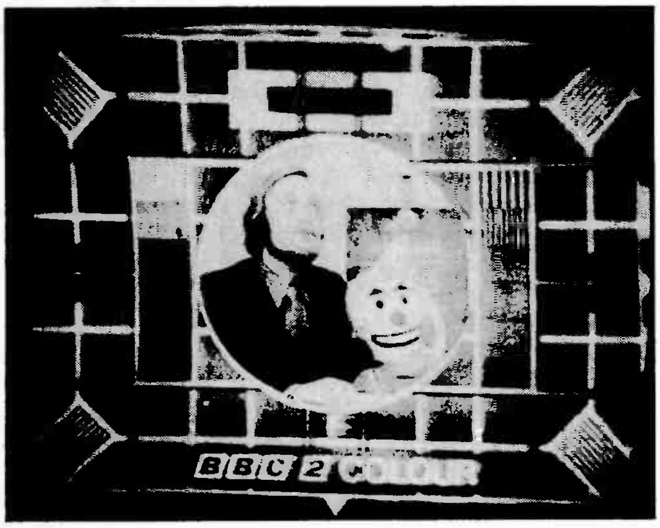


Fig. 5: The BBC-2 test card F was transmitted on BBC-1 during the programme Nationwide.

Fig. 6: A slightly modified test card F, with two electronically superimposed crosses to complete the game!

These two tapes outlived test cards C and D and were eventually pensioned off in 1970. One included 12th Street Rag.

We would like to invite readers with memories of unusual captions or test cards used by the BBC to write to the authors. If any photographs are available, we'd be delighted to receive them. Also if any readers were naughty enough to record test card C music, please contact us!

TV Servicing: Beginners Start Here...

Part 8

S. Simon

Resistor Troubles

A RESISTOR is a conductor which is deliberately made to be a less efficient conductor than most others. With the exception of some specialised varieties which we have previously mentioned, such as thermistors and VDRs, an efficient resistor will offer the same opposition to the movement of electrons under such varying conditions as increasing heat, persistent heat, differing stress (potential difference between the two ends) and age.

Bearing in mind our prime interest, which is how these things affect us from a servicing point of view, we need not consider selection of materials for manufacture or methods of construction. We are concerned about what types are used in various applications, what fault symptoms result when they become defective, and whether replacements can be of a different type in order to improve the reliability and perhaps the performance.

It may be said that the designer knows best, and that the original specification should be rigidly adhered to. This is true as far as safety components are concerned, where resistors are purposely designed to fail under certain fault conditions so that other parts of the circuit are protected and fire hazards etc. reduced. It should be remembered however that designers also have to be cost conscious, and it cannot be disputed that the vast majority of TV receivers still in use would have been, and would continue to be, far more reliable if the ratings of a few resistors had been just a little more generous or robust. Note that we said a few.

The majority of resistors used give no trouble at all, and continue to function and maintain their value far beyond the life of the receiver in which they are used. Generally speaking, the resistors which give trouble are those which are called upon to dissipate a considerable amount of heat or are used between two points of considerable potential difference. Let's consider a couple of well known types of receiver and pinpoint the common failures, thus combining general information with specific servicing hints.

Thorn 1500 Power Supply Circuits

So far we have referred mainly to the Thorn 1500 series of monochrome receivers in our explanations and diagrams, so it's reasonable to continue with this chassis though we may in a few cases be repeating what has already been said.

Wirewound resistors are used to drop the mains voltage to that required by the heater and h.t. lines. Some h.t. dropper resistors are of the type fitted with circuit-breaking springs. The spring is secured by solder, so that in the event of the resistor overheating due to excessive current flow, the solder securing the spring melts and the supply is then divorced from the faulty circuit.

By far the most common resistor to fail with no contributory cause is R111 (see Fig. 1), this being the centre section of the top horizontal multisection dropper unit. It's wirewound on a ceramic former, and it would appear that the wire is chemically attacked, particularly in areas of high humidity. Its failure renders the receiver inoperative due to the heater circuit being broken. Confirm its failure by proving that the supply voltage is present at the 1·6A fuse F1, then at both sides of W7, but at only one end of R111. Replace as necessary, preferably with a totally enclosed and adequately rated dropper section of between 140 and 160Ω.

Common Failures

Less common is failure of R116. This is the 20Ω surge limiting section on the h.t. side. The receiver is again rendered inoperative, due to the absence of h.t., but the heaters continue to glow. If it's found open-circuit check whether rectifier diode W8 is short-circuit – though this defect would normally blow the supply fuse F1. A surge limiter leads a hard life however, and a sudden extra current demand could cause it to fail before the fuse. It's prudent therefore to check for possible h.t. shorts as a contributory factor.

The spring-open wirewound resistor R124 (80Ω) is wired in series with the h.t.1 supply smoothing resistor R125 (the latter is part of the dropper). The h.t.1 line supplies the line output stage. R125 very rarely gives trouble, but R124, which is situated above the PCL805 valve, may often be found open when the fault is sound normal but "no picture, no raster". The spring will be found to have sprung as it were, and there is usually good reason for this although it may not be immediately apparent. Resoldering the contact may restore normal conditions but the resistor may overheat and open its spring again in a short time. An observer watching the screen immediately before this happens could well report that "the picture collapsed to a vertical white line down the centre and then went off".

Normally one of three things can cause this to happen, but of course there are many other possibilities in addition to these few probabilities. The first probability is an intermittent short in the PL504 line output valve. This is the most common cause of R124 overheating. The same effect occurs when the PL504 is deprived of its drive, due to the 30FL2 having stopped oscillating on its own account or because of a component failure in this stage (see Fig. 1, February). The third cause is where a short-circuit is present across the supply line via the PY800 or PY801 efficiency diode (see Fig. 1, January). This could be due to the PY801 valve itself being defective, but more often the capacitor C113 shorts to present the valve with an immense overload. This however is not an intermittent short, and should present no problems as with the set switched off an ohmmeter check from the top cap (cathode) of the PY801 to chassis will immediately reveal the short. Incidentally, the replacement capacitor must be of the high working voltage

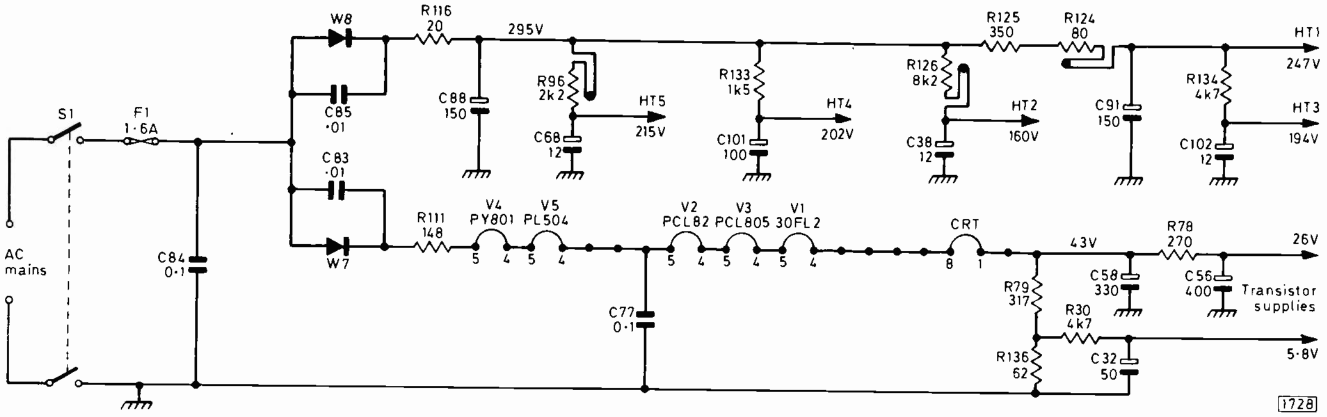


Fig. 1: Power supply circuitry, Thorn 1500 chassis. The HT1 rail supplies the line output stage, HT2 supplies the video output transistor, HT3 supplies the line oscillator and sync separator, HT4 supplies the field timebase and HT5 the audio valve. The low-voltage circuits are supplied from the 26V line. R79 is the left-hand section of the centre, top dropper resistor. When it goes open-circuit, as it sometimes does, the 26V line rises to about 50V with damage to transistors in the i.f. strip if the set is left switched on. The 5·8V supply provides bias for the video driver stage.

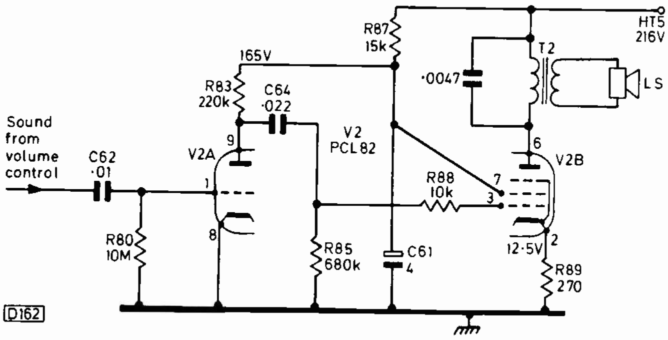


Fig. 2: Audio circuit, Thorn 1500 chassis.

disc type and not the tubular ceramic type as the latter are less suitable for pulse working (remember that the line flyback pulses are present at this point). According to the model, the capacitor may be a 180pF or 220pF, 8kV.

R96 is another wirewound resistor which may be found open (sprung) in later models or completely open-circuit in earlier sets (no safety spring). This is the supply resistor to the PCL82 audio output valve. If R96 is found open (no sound, no supply to pins 6 and 7 of the PCL82 valve base) there are three items to check. The PCL82 itself, its cathode resistor R89 (270Ω), and the 0·022μF coupling capacitor C64 which often becomes a short, thus damaging the first two items and possibly R87 (15kΩ). C61 can short to pull down the voltage at pin 7, and this is another point to check. See Fig. 2.

It can be seen then that an open-circuit resistor may be only the tip of a large iceberg, originating say in a shorted capacitor and resulting in damage to the valve and more than one resistor which in consequence have to carry excessive current until the supply resistor opens or perhaps the fuse fails (less common in this particular case).

Carbon Resistor Faults

Carbon resistors are cheaper to produce and are more suitable in situations where the ability to pass a heavy current is not called for. Probably over ninety per cent are content to soldier on year after year without a vestige of complaint. There are many situations however where resistors fitted by the makers are underrated and give trouble with unfailing regularity. For example, if a 1500 series receiver is troubled by poor sync, i.e. the picture cannot be locked vertically or horizontally, one can be pretty certain that R44 which feeds the sync separator valve's screen grid has given up the ghost and has become virtually open-circuit. All that's required is that a more robust 47kΩ resistor be fitted, say a 1W type. If necessary, fit it on the print side of the panel. If this resistor is suspected, a voltmeter check will confirm or disprove the suspicion. With about 200V h.t. at one side of R44, there should be 40V or so at the other. Absence of this voltage on the valve side (right) of the resistor is confirmation that the resistor is at fault. Presence of some 40V means you carry on looking elsewhere as the resistor is holding up at least for the present.

The 1500's Field Timebase

Another trouble spot is associated with the field timebase (Fig. 3). In a previous issue we spoke about the PCL805's cathode bias resistor R103 (300Ω) having a tendency to change value. The effect of this is to alter the height and vertical linearity as it rises in value, eventually causing field collapse (white horizontal line) and possible damage to the associated decoupling electrolytic capacitor C79. C79 is sometimes damaged because the voltage across it rises above its designed rating as the resistor goes high in value. Checking R103 is an essential routine whenever height troubles are experienced with these sets, although there are several other probabilities of course.

R103 can also fall in value – and C79 can dry out and become ineffective. In either case the valve's bias is reduced and the effect is poor vertical linearity – bottom cramping.

Above the PCL805 there are two 18kΩ resistors, R101 and R102. These are often overlooked during fault tracing efforts to find the cause of total field collapse or faulty field hold problems. In fact they're often responsible for these conditions and the reason is easy to understand since in order for the oscillator to function part of the output at the anode of V3B is fed back to the grid of V3A. This feedback is taken from the junction of these two resistors, then passing via C75 and C70. If R101 goes high, there is excessive feedback. If R102 goes high (more common) there is no feedback. So these must be included whenever checks are necessary on the field timebase of these receivers. The two resistors form a potential divider to set the amplitude of the feedback waveform.

In the case of R103, a 2W resistor should be used for replacement purposes and the value should be kept as near as possible to 300Ω (up to 330Ω). In the cases of R101 and R102 use 1W resistors or 0·4W metal film resistors.

Just for the record, the top and main linearity preset controls R104 and R106 are sometimes responsible for field collapse: they tend to become open-circuit at one end of their tracks, thus failing to provide a d.c. return path to chassis for the pentode's control grid. In consequence C73 acquires a heavy negative charge which biases off the pentode section of the valve, preventing it passing current – no voltage drop across R103. This defect should cause no heartache however since if the meter is switched to the low-voltage range and applied to pin 9, positive probe to chassis, the scan will be restored due to the internal resistance of the meter "unblocking" the grid and providing a path to chassis.

Poor Picture Quality

Another trouble spot is the two carbon resistors R40 and R41 (2·2kΩ and 5·1kΩ respectively) which form the collector load of the video output transistor VT9. It should be routine to check the value of these in the event of poor picture quality. If necessary, they should be replaced with more robust resistors of the same value – or with a single 7W wirewound resistor of value between 7kΩ and 8·2kΩ.

The GEC 2038 Series

From what we have been saying about the resistors used in the 1500 chassis the impression that we are criticising Thorn models may have been gained. This is far from the case. What we have been trying to do is to outline the role of resistors and the faults which are produced when they fail. Continuing with this theme, we'll consider another popular series of monochrome receivers which are still in wide use. We'll refer specifically to the Sobell 1038 and GEC 2038 models so as to avoid confusion, but the remarks will apply to many other sets using the same basic chassis.

Power Supply Circuits

The mains dropper is divided into two main parts, with the mains input to the centre (see Fig. 4). The part which supplies the valve heaters is toward the rear of the set and has three sections (R150/1/2) of 70, 63 and 188Ω, the lower values providing tappings for operation on supply mains of less than 240V. This heater part of the dropper very rarely gives trouble. When a section does fail, the valves and tube heaters cannot function of course.

It's the front three sections (R147/8/9) which are the trouble spot. These have values of 10, 15 and 19Ω respectively. It's extremely common for the receiver to cease functioning but with the heaters continuing to glow. The h.t. supply circuit is through R147/8/9, thence through the thermistor TH2 to the h.t. rectifier SR1. Whilst the thermistor is sometimes at fault, deteriorating to a point where the ends no longer contact, it's the wirewound sections that give most trouble. Peculiarly, it's the middle one of the three that fails most often, although the other two do fail – with the same effect of course.

Confirming the defect is simple enough. The fact that the valves are glowing means that the mains supply is at the centre tag of the dropper, and an a.c. voltmeter will read full scale here (with respect to chassis). A neon screwdriver will give full glow at this point provided the chassis is not live due to incorrect mains plug wiring (at all times first prove that the chassis is not live).

If the sections are intact, all tags will give the same glow at the h.t. end. If one tag shows no glow or a much reduced glow, you've found the fault. There is little point in fitting a shunt replacement across the defective section since one of the others will fail, producing the same symptoms, at a later date. It's better to fit a 33Ω dropper section from the mains tag to the final (thermistor) tag, making sound mechanical joints bearing in mind the considerable dissipation of heat on any soldered connections.

Moving over to the other end of the chassis, on the front end will be found a "wigwam" made up of two vertical wirewound resistors and two supply wires reaching to the apex. One of these wirewounds (R144) feeds the PCL805 field output stage and has a value of 330Ω. The other (R143) feeds the line oscillator, video and i.f. stages, and has a value of 150Ω.

No HT3 Supply

It's this latter component that can cause a good deal of trouble when it fails (as fail it does on occasions). The point is that this is the feed to the line oscillator stage. If the line oscillator cannot function, there is no line drive to the PL504 line output valve. We've already seen that the absence of drive causes considerable overheating, with the probability of damage to the PL504 and PY800 (efficiency diode) valves. Since these valves are supplied from the h.t.2 line (direct from the smoothing choke), they will continue to draw excess current until (a) the already frail dropper receives the coup dé grace, (b) the supply fuse fails, or (c) the PY800 collapses. Unless the set is switched off of course.

The point is that all these things can happen and be rectified one by one, leaving the original cause unrectified until the overheating is noticed. In fact it's not difficult to check this probable fault condition since the h.t. supply to the i.f. stages runs along a long strip of the print at the rear of the panel, adjacent to the EF183 and EF184 valves, and this line will be dead if the 150Ω wirewound is open-circuit.

The Carbon Resistors

Now to the carbon resistors used in this chassis. A very common fault is distorted sound. One of the chief culprits promoting this condition is the 18kΩ resistor R92 (see Fig. 5). This progressively falls in value until the increasing current also affects R93 (5·6kΩ or 5K6 if you like it better that way) which in turn falls in value to produce a virtual h.t. short. We don't wish to labour this point since it's so well known and the items referred to have probably already received attention. Suffice it to say that the resistors are in the front left corner of the panel, associated with the EH90 valve.

When dealing with this type of component replacement in this make of receiver it's important to appreciate that there are print connections both above and below the panel, and that one must be very careful not to damage the print when removing a defective item or fitting the new one. The alternative is to leave the existing connections and carefully solder to them.

Another carbon resistor which regularly fails is R132 (1·2MΩ) which is wired in the boost line supply to the height control. It's situated on the rear right side. As it rises in value, the height of the picture decreases to a point where it cannot be corrected with the height control. A 1MΩ 1W resistor brings lasting peace to this area. You will notice that carbon resistors sometimes fall and sometimes rise in value.

Lack of Contrast

Inability to advance the contrast sufficiently to produce

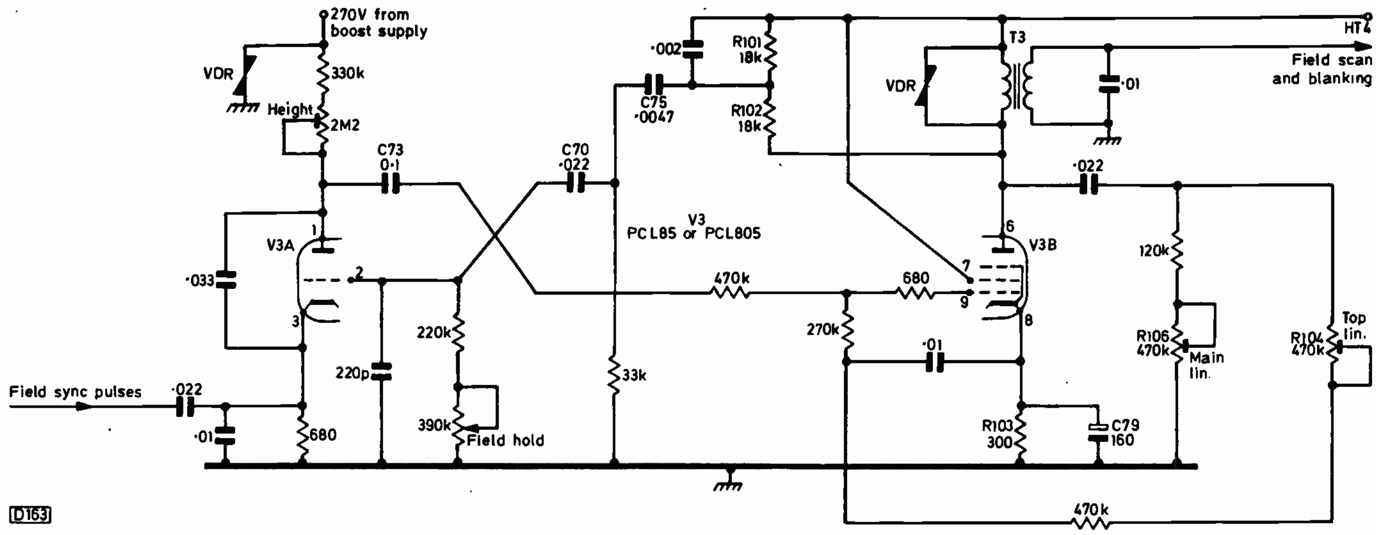


Fig. 3: Field timebase circuit, Thorn 1500 chassis.

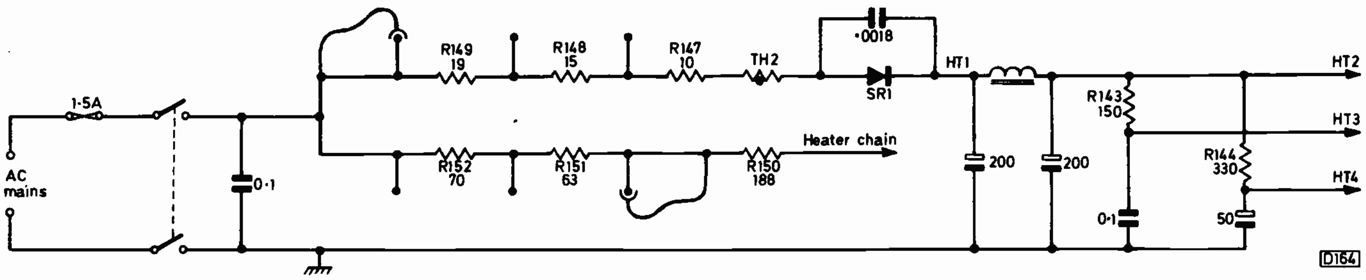


Fig. 4: Power supply circuit, GEC 2038 series.

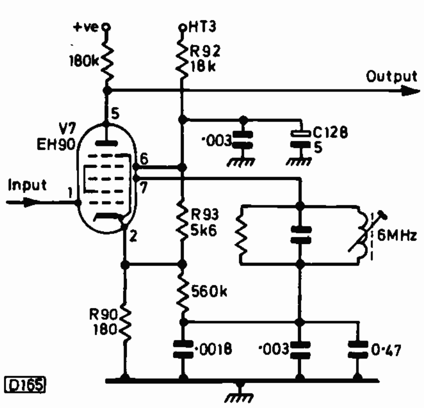


Fig. 5 (left): The EH90 acts as an audio amplifier on 405 lines and as the f.m. sound detector on 625 lines. A weak spot is the resistor chain feeding pin 6.

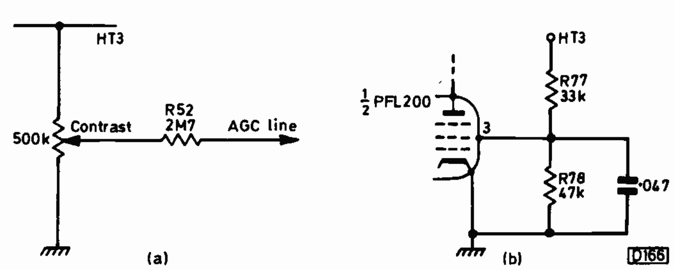


Fig. 6: High-value resistors in series with the slider of the contrast control are a common cause of lack of contrast in sets using valve i.f. strips. (a) Contrast control circuit used in the GEC 2038 series. (b) A common cause of weak or no sync in sets using a pentode sync separator is the resistor(s) feeding the screen grid: R77/R78 are the offenders in the GEC 2038 series.

an acceptable black level with correct highlights should direct attention to R52, a 2·7MΩ resistor which is situated off the front left side between a connecting socket and a tag panel (not on the panel). This resistor goes high, thus rendering the contrast control ineffective. See Fig. 6(a).

Weak/no Sync

Just to the right of the PFL200 video amplifier/sync separator valve are two small resistors, R77 and R78. They feed the screen grid of the sync separator section of the PFL200, so a fault here gives the fault condition "no sync", i.e. the picture cannot be locked either horizontally or vertically. R77 is a 33kΩ resistor and tends either to go high or to fall in value thus damaging R78 (47kΩ). It's not unusual to find both in a charred condition. See Fig. 6(b). Replace, making R77 a 1W type.

Lack of Width

It's also not unusual to find the preset width control defective. Whilst it's then necessary to replace this item, it's also essential to check the value of R133 (470kΩ) which is in series with it. This resistor can fall in value, thus damaging the control (marked set boost).

Incidentally a similar condition can arise in the Thorn 1500 chassis where the relevant resistor is R130. In early versions it was 330kΩ but was later changed to 680kΩ with the width control becoming 2·2MΩ (2M2) instead of the earlier 1MΩ.

Summary

From these few notes it can be seen that resistors are an important factor in servicing, and one which should be thoroughly understood so that the correct replacements can be made, such replacements not necessarily being the same as those fitted by the makers.

NEXT MONTH: CAPACITOR TROUBLES

Battery back-up modification for the Philips N1700 VCR

Angus Robertson

ONE rather useful facility lacking on the latest N1700 videocassette recorder from Philips is a battery back-up power supply for the digital clock/timer. This was included as standard on the N1502, but for some reason (probably economic) it's been omitted from the otherwise updated N1700. Fig. 1 shows the modifications necessary to install a battery to operate the clock and timer during loss of mains power. Since the clock is operated from the 50Hz mains supply, an oscillator is required to keep the clock going during power loss. A simple multivibrator using a couple of CMOS gates is added and is normally driven by the 50Hz mains input. When this input fails, the multivibrator runs free, providing impulses for the clock i.c. This part of the circuit is added by breaking the connection between the connecting board and the clock board (a ribbon cable).

Power during loss of the mains supply comes from a 9V battery, with D1 and D2 providing isolation between the two supplies. This part of the circuit is also inserted by breaking the ribbon cable core between the connecting board and clock board. Since operation of the LED displays would cause a rather heavy power load on the battery, R1 and D3 ensure that if power is lost pin 32 on the clock i.c. is taken to ground, thus inhibiting the display. While operating off the reduced 9V battery supply, the clock i.c. and oscillator take about 7mA which should provide roughly twenty five hours' operation from a PP3, or over a hundred hours from a PP6.

VR1 allows the oscillator frequency to be aligned to exactly 50Hz, the use of Lissajous patterns probably being the easiest method. When doing so, however, unplug the clock plug from the connector board so that the oscillator is operating from the 9V supply. Absolute accuracy is not really necessary, since the intention of the circuit is to keep the clock going during power cuts which rarely last more than a couple of hours. Whether the recording starts 30s early or late is not really important, providing that it does actually start – which of course it didn't during the power cuts last Autumn, although the mains power had invariably been reconnected by early evening.

One important point should be remembered. Although the N1502 clock was battery operated only if actually set to start a recording, this modification operates the clock during any power loss, including pulling the mains plug out, packing the recorder up and warehousing it. Provided the battery lasts, the clock remains activated, but the battery will eventually leak. On the other hand, for a videocassette recorder left connected to the mains day in, day out, this facility is rather useful since the clock will not require resetting even if the mains is accidently unplugged. If the recorder is to be left unplugged for any length of time, the battery can be disconnected, or a switch can be added. ■

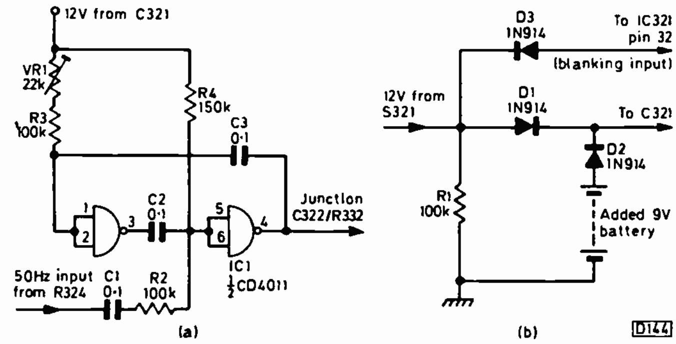


Fig. 1: Modification to the clock board on the Philips N1700 VCR to provide battery back-up should the mains supply fail. (a) CMOS multivibrator. Add between R324 and the junction R332/C322. To power the i.c., connect pin 14 to C321 and pin 7 to chassis. (b) Battery connections. Add between S321 and C321. See Circuit C in the service manual.

VCR Notes

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

Tape Speed

The article which recently appeared on tape speed reduction for the N1500 VCR (see February issue) was submitted for publication in the summer of 1977. Since then a lot of my time has been occupied by moving house. Just before Christmas however, I took delivery of an N1700 video head. This was fitted to the modified video recorder described in the earlier article. The field-skipping circuit fitted to the recording amplifier was disconnected and the test card recorded.

After rewinding, the picture, of better quality than was obtained on the old one hour system, was observed. There was some doubt as to whether the existing tracking arrangements would function correctly using slant heads. It was found that the tracking control was very much easier to adjust however. There's a band where the picture is present and a further band where only noise is obtained.

It was also observed that the still frame would not function. When one thinks about this it's obvious why this is so. The new system involves scanning the tape with a head at one angle, followed by the other head at a different angle. If one tries to scan a stationary tape one is scanning a track which is at only one angle. First it scans at the correct angle, then at the wrong angle. The second track therefore is reproduced as noise. It might be possible to resolve half a field by blanking out the noise. The result would appear somewhat dimmer than a fully interlaced still field. I've not yet tried this, and it's probable that extra circuitry would be needed to provide continuity of the line sync pulses during the blank field.

There has been some comment in the correspondence columns on the practicality of professional conversion of N1502 VCRs into N1700 VCRs. An advertisement has appeared in *Exchange and Mart* by Telescan, 28 Howwood, Park Street, St. Albans, Herts, who offer this service. The work is guaranteed – according to the advertisement – for one year. I should imagine that this would make the job very costly however.

As there's not an exact 2:1 speed ratio between the two standards, the result obtained by my conversion is not compatible with the N1700. It would be worthwhile however for anyone with access to an N1700 to try a cassette recorded on my system to see if any compatibility is obtained by the servos making up the speed difference. To be absolutely accurate, it would be necessary to get an engineering firm to turn down the capstan of the converted machine to 1312/1429ths of its present size. (The N1700 standard calls for a tape speed of 6·56 cm/s, whereas the N1500 speed is 14·29 cm/s.) I don't know, but I would expect that Telescan fit N1700 capstans into their converted N1502s. The N1502 capstan is incompatible with the N1500, therefore the N1700 capstan cannot be fitted to a converted N1500.

Induction Motors

Various remarks have also been made about the motors in the N1500 VCR. These are induction motors. Now an induction motor always rotates at a speed which is equal to the speed of the rotating magnetic field minus an amount which is known as the slip speed. This slip speed is necessary because it causes eddy currents to be generated in the rotor. It is these eddy currents that magnetise the rotor in such a manner that it rotates. The speed of the rotating magnetic field is found from the equation $f = np$, where f is the frequency Hz, n is the speed of rotation in rev/s and p is the number of pairs of poles. For 50Hz mains and two pole pairs the synchronous speed, that is the speed of the rotating magnetic field, can be only 1500 rev/min. Therefore, in order to obtain this particular speed for the rotating video head a small step-up ratio is necessary between the two relevant pulleys.

If the motor appears to lose power, this could be due to a reduction in the mains frequency or voltage or to lack of lubrication. When these points have been attended to, and if no improvement has been obtained, the fault must lie in the motor's rotor. One can go to the trouble and expense of replacing the motor of course, but the problem could be overcome by turning a small amount off the driven pulley so as to increase its speed. As the motors are far more powerful than is really needed, this somewhat crude procedure is entirely satisfactory.

Some Field Funnies

L. A. Ingram

Unusual field timebase faults are fortunately rare. You can come up against decidedly awkward problems however, as the following examples show.

The first set was a current GEC colour receiver still in stock but with the fault varying field scan amplitude. Gentle pressure on the centre of the field timebase subpanel would vary the height from about half an inch to almost full scan. It was noticed that the connections to the output transistors had been resoldered, presumably at the factory, so a dry-joint seemed likely. The panel was removed therefore and all joints examined with the aid of a magnifying glass, any suspect ones being resoldered. Result: perfect scan during a soak test of several hours, so the set was returned to stock.

A week later however similar symptoms were reported, though this time the fault was even more erratic. Use of the scope revealed that the trouble was somewhere in the output stage. This is the well known two-transistor circuit used in many hybrid and solid-state colour chassis. A gentle puff of freezer on the lower transistor TR455 caused complete scan collapse, so this transistor was replaced. All was well for about half an hour, then off it went again.

We consulted the circuit diagram, then checked or substituted every component between the supply rail and chassis. Each time we tested again however the fault returned after a short time. We then compared the panel with the layout shown in the manual and apart from the transposition of the connections to the output transistors, which were of different types, an extra diode was discovered neatly tucked away in the emitter circuit of the lower transistor (See Fig. 1). Replacing this cured the fault, but on checking the diode with an ohmmeter no amount of the hot and cold treatment would make the thing show a fault.

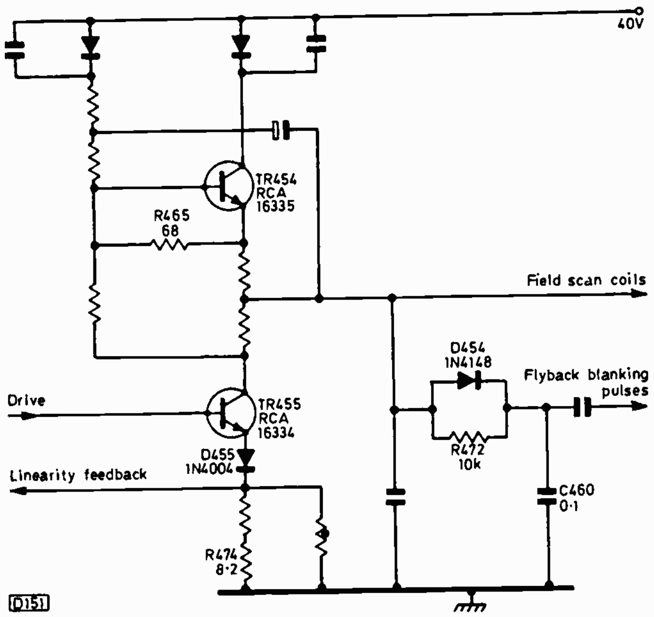


Fig. 1: Modifications introduced in the field output stage of the GEC 90° solid-state colour chassis (C2110 series). Diode D455 has been added because the driver transistor has been changed from a germanium (AC188) to a silicon (BC157) type.

The next set was a large-screen monochrome one fitted with the Rank A816 solid-state chassis. After repairs in the line timebase, it was found to have an annoying field jitter – just two or three lines in amplitude, more noticeable on some pictures than others. With the scan reduced by an inch from the top the jitter could not be seen, but when the height was opened out, there it was. For starters, we checked the voltage across 3C36 (2,500μF) which decouples the supply to the field timebase, and then connected a handy 470μF electrolytic across it. Much better: just jitter in one part of the lock. So 3C36 was whipped out and replaced – but the jitter was still there. Check the sync: spot on as per the manual, as indeed were all the other waveforms in the field timebase. Replaced the diode in series with the field sync pulse feed, then the two transistors in the field oscillator circuit, but still no joy. It was then fortunately time to go home and try to forget it.

Next morning, start again. Try the handy 470μF across 3C36. Again better results but still not quite right. We then tried connecting it from the positive side of 3C36 to the metal of the chassis frame – and it made no difference at all, which seemed rather strange. The negative side of 3C36 goes to a small area of print, and this does not go to the nearby tag on the chassis frame but is connected by a lead on the component side of the board to the area of print on the lower edge of the board where the field timebase components are earthed. This jumper lead was removed (it has crimped tag ends – why?) and replaced with 20 gauge wire. Results were nearly perfect. A duplicate lead was then added on the print side, and despite every test the offending jitter had gone.

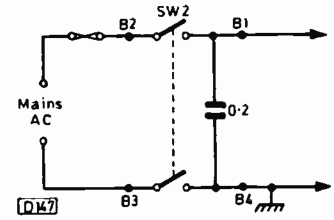
Later the same morning the apprentice passed over a set fitted with the Pye 169 chassis. The original complaint was varying field linearity, and when the set was switched on sure enough all the figures had their necks in their collars while their feet were somewhere under the bench. Without looking at the manual the lad had got from the cupboard we decided that R100 looked suspicious – because it was one which had not been disturbed and was so minute that it didn't look capable of doing anything for very long. Why do manufacturers sometimes use such small components, and what fractions of pennies are saved? With confidence we checked the resistor and, with considerable luck, it was found to be open-circuit. On replacement the scan was no longer non-linear – so far as could be seen! Only about a third of the raster was visible, even with the height control set to minimum, the rest being lost above and below the tube face.

Question: where did all this scan come from? The manual was consulted, and though it was for the 169 chassis the field timebase circuit was in fact found to be that in the later 173 chassis. R103 had been changed, and was of correct value (56kΩ) for the 169 chassis but not (820kΩ) for the 173 chassis. Replacement with the correct value restored sanity all round. The resistors, incidentally, are in the coupling circuit between the triode and the output pentode sections of the PCL805 valve.

While we were hoping for something more straight-forward, a hybrid Pye colour receiver appeared with the complaint "funny flashes of colour sparks" . . . The set had a history of occasional house calls over a twelve months' period for similar but rather inconclusive complaints. The varicap tuner had been changed some four months previously because of low gain, and the gain was obviously down once more. A new r.f. amplifier transistor cured that, and everything seemed normal. We left the set on soak for a while however and later what seemed to be mains borne interference could just be seen.

At first sight it was thought that someone nearby had switched on a vacuum cleaner or something similar, but as no other set was affected it had to be the set itself. The surge-limiting thermistor was examined but was o.k., then the on/off switch was tapped and prodded. There was no sign of overheating however, it ran cool, looked sound and measured o.k. on the meter. The vertical and horizontal scans did not vary by a whisker, but the h.t. rail was measured at a convenient point (PL11) on the colour-difference amplifier panel. It was correct, but when the scope was connected it showed lots of variation at this point.

Fig. 2: Mains switch circuit, Pye 693 chassis.



With the negative meter lead connected to the CDA panel metalwork the voltage on the h.t. reservoir capacitor was checked – and found to be around 450V! The meter must be wrong – but no there it was at a second try. Out came the circuit diagram, and we decided it had to be earthing somewhere and somehow. The on/off switch again came under suspicion, and a crocodile-clip lead was connected across B3 and B4 (Fig. 2) on the edge connector. No "funny colour flashes" now and, after the control was changed, all voltages made sense again.

The only moral I can offer following this tale of horrors is to use the manual – and make sure you have the right one! ■

Pulsed CRT Rejuvenator

At last the printed board details and component layout which were snowbound at the time our last issue was passed for press.

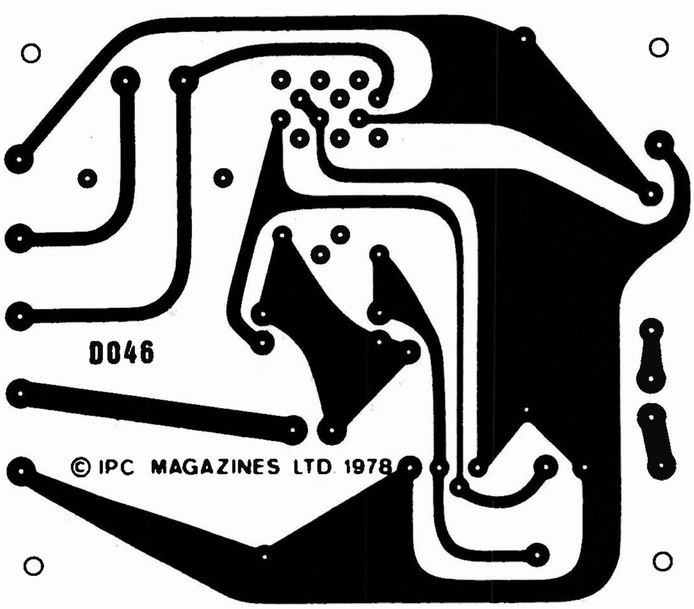
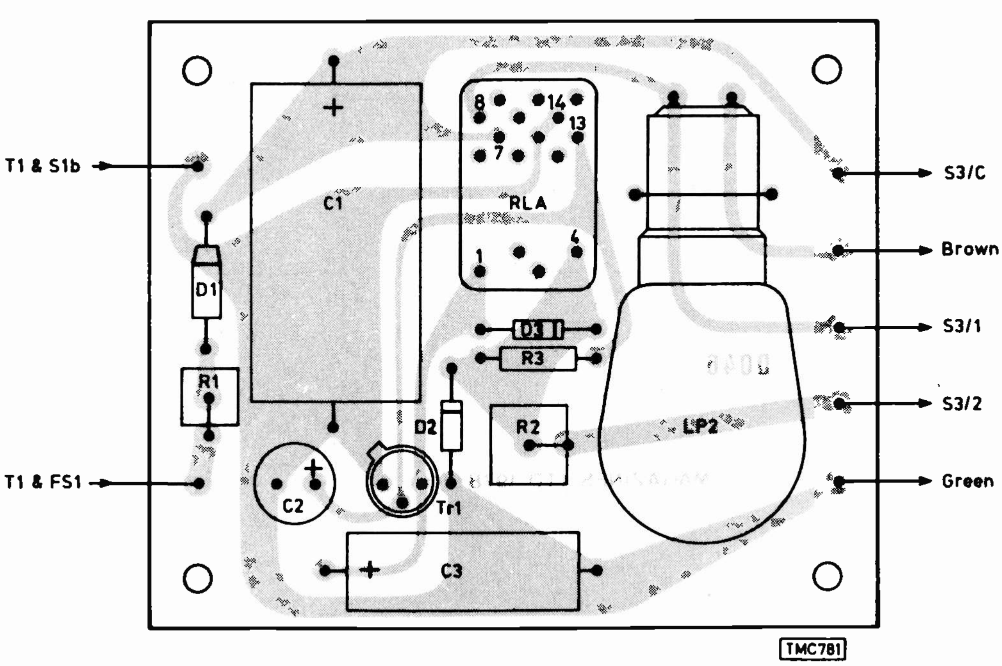


Fig. 2 (right): Printed board layout. Scale 1:1.

Fig. 3 (below): Component layout.



Transistor RGB Circuits

G. R. Wilding

LAST month we took a look at different approaches to monochrome receiver transistor video circuitry, ending up with the interesting luminance output stage used in the later Korting hybrid chassis. To complete the picture we'll consider one or two circuits which illustrate the techniques used in RGB output stages for colour c.r.t. cathode drive.

Matrixing of the colour-difference and luminance signals to produce the RGB signals is done in an i.c. in most modern sets. The i.c. may provide sufficient amplification to drive the output transistor directly, as in the case of the well known TBA530, or a two-transistor circuit may be needed following the i.c. There's considerable variety in the discrete transistor circuitry used, with either d.c. or clamped a.c. coupling and various cascode and complementary pnp/npn transistor combinations in use.

Class A Circuits

Since so many sets employ the TBA530, we'll start by taking a look at a typical RGB channel using this i.c. – our example, shown in Fig. 1, is the R channel used in the Philips G9 chassis.

Starting within the i.c., it will be seen that matrixing is carried out by the two series-connected transistors Tr1 and Tr2. The base of the former is fed with a negative-going R – Y colour-difference signal while the base of the latter is fed with the luminance signal. In consequence a negative-going R signal is produced at the junction of these transistors. This is fed to the base of one of the transistors, Tr3, in the following differential amplifier circuit (Tr3/4/5). Tr3's load resistor is the external component R291, but the output is actually taken from pin 10, i.e. from the base of Tr6, which provides a zener-type junction giving the level shift required for d.c. coupling to the base of the external output transistor T294. Capacitor C292 bypasses the zener junction to maintain the h.f. response.

A proportion of the output developed at the collector of T294 is tapped off via R302/R303 and is fed back to the other side of the differential amplifier in the i.c. via pin 9. The choice of external resistor values determines the amount of feedback, which in practice is made high to compensate for any thermal or electrical drift in the transistors or resistors or change in the supply voltage. Note that there is 6V at each side of R304, which in the other channels is made adjustable to act as a drive control. This bridge configuration ensures that adjusting these controls does not alter the black level. Note also that the signals at the bases of Tr3 and Tr4 are in phase – unlike the conventional antiphase inputs to a differential amplifier.

This arises because the signal at the base of Tr3 is inverted twice – by Tr3 and by the output transistor T294 – before being applied to the base of Tr4. The negative feedback reduces the gain as a result of the increased voltage developed across the common emitter circuit of the differential amplifier stage.

H.F. compensation in the output stage is provided by C297 which only partially decouples T294's emitter bias resistor R296. Overall frequency response compensation is provided by C308/R307 in the feedback loop.

Combined Matrix/Output Stage

In contrast, matrixing of the colour-difference and luminance signals in the Hitachi PAL-4 chassis is carried out in the RGB output stages. Fig. 2 shows the B output stage, and it will be seen that the B – Y signal is fed to the transistor's base while the Y signal is fed to its cathode, via the blue drive control. This chassis is fitted with the PIL tube, which has common grids and first anodes. The grids are connected directly to chassis, while the first anodes are fed from a potentiometer connected across an h.t. rail. In most colour sets the black level of each gun is set by means

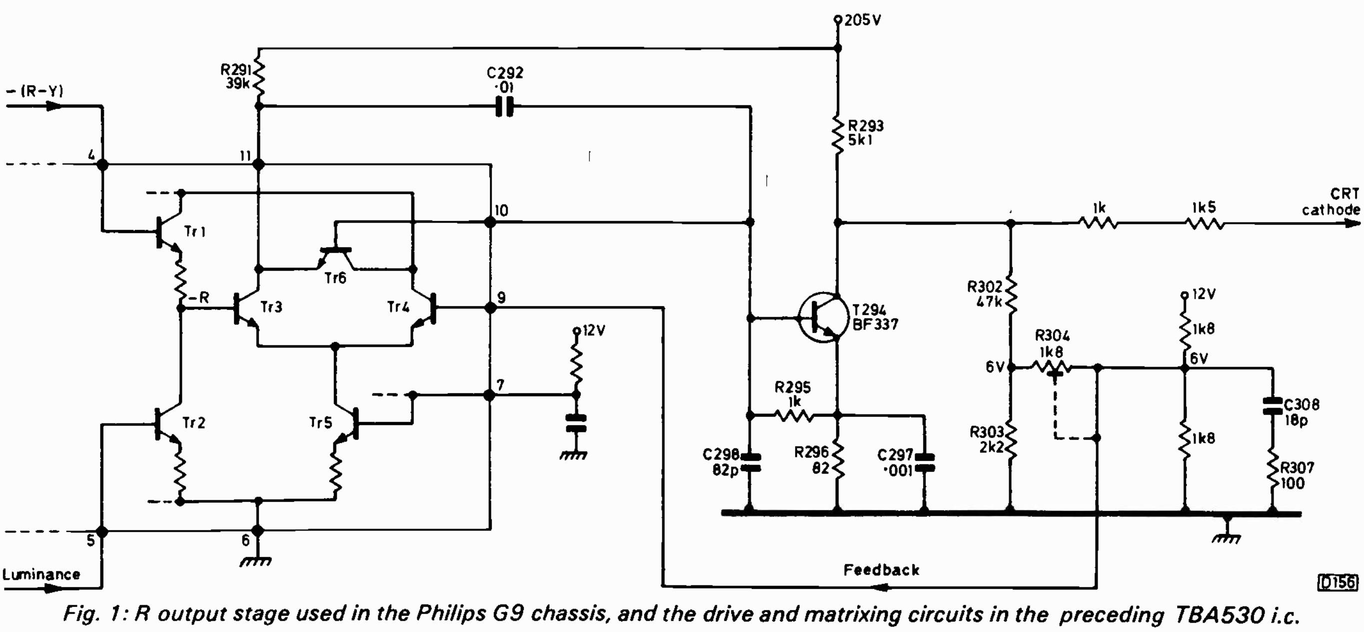


Fig. 1: R output stage used in the Philips G9 chassis, and the drive and matrixing circuits in the preceding TBA530 i.c.

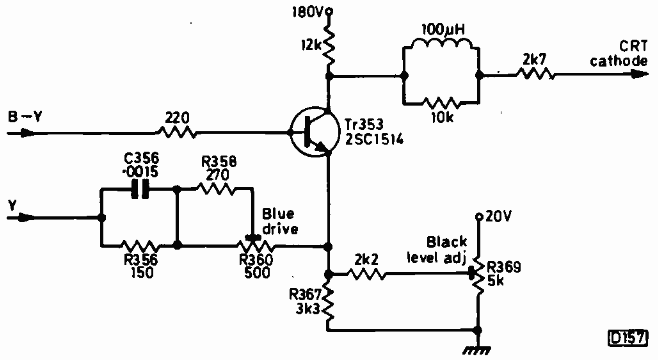


Fig. 2: B matrix/output stage used in the Hitachi PAL-4 chassis.

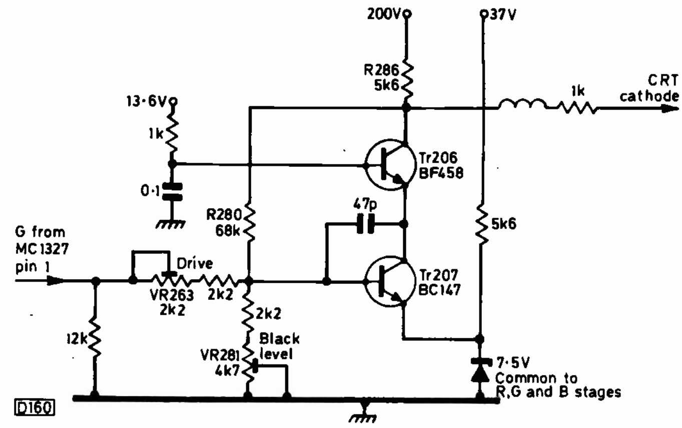


Fig. 5: Cascode G output stage used in the Decca 80 and 100 chassis.

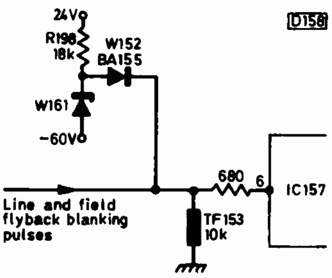


Fig. 3: The c.r.t. protection circuit used in the Thorn 4000 chassis to blank the tube in the event of line output stage failure works via the flyback blanking system.

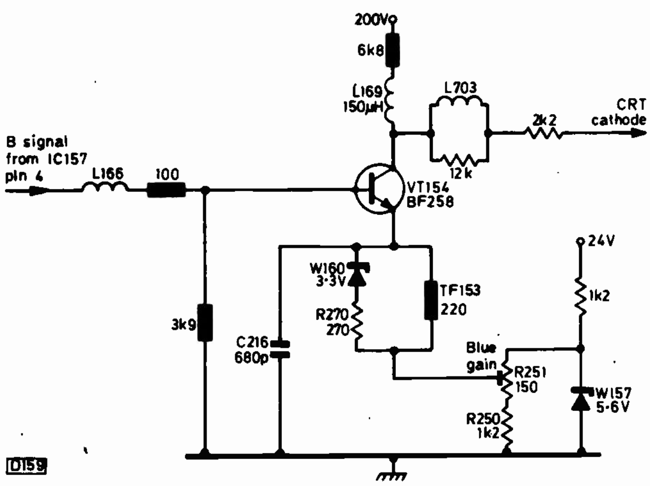


Fig. 4: B output stage in the Thorn 4000 chassis.

of the first anode controls, but in this case the black level is set by adjusting the emitter voltages of the output transistors. Beam limiting and brightness control are effected in the luminance channel. H.F. response shaping is provided by means of the network C356/R356 in the emitter circuit and the 100μH series peaking coil in the collector circuit.

The output transistor's emitter current flows via two paths, one via the basic emitter bias resistor R367, and secondly via R360/R358, R356 and the final video transistor in the luminance channel with its associated emitter and collector resistors – it's a pnp device, with its collector taken to chassis and its emitter linked to the three RGB output stages.

Thorn 4000 Chassis

There are some interesting aspects of the RGB output stages used in the Thorn 4000 chassis – including gamma correction. It's worth mentioning first however that as there are separate e.h.t. generator and line output circuits, both driven by the line driver stage in a manner analogous to the old 2000 chassis, failure of the line output stage could result in a damaging vertical white line down the screen unless protection is provided. To prevent this situation arising, the simple protection circuit shown in Fig. 3 is included in the feed circuit to pin 6 of the chrominance demodulator/matrix i.c. IC157. During normal operation, this pin is used to apply field and line flyback blanking to the signal. Zener diode W161 is normally biased on by a −60V supply obtained from the line output transformer, and in consequence W152 is reverse biased. In the event of failure of the line output stage however the −60V supply is removed, W161 no longer conducts and W152 is forward biased by the 24V supply. The voltage at pin 6 of the i.c. rises therefore, blanking the outputs from the i.c. TF153 is a thick-film resistor – this chassis makes wide use of these.

IC157 (SN76227N) provides RGB outputs of adequate amplitude to drive the single transistor RGB stages. Fig. 4 shows the B output stage, which is fed from pin 4 of the i.c. via the filter coil L166. The emitter is biased from a 5·6V supply which is stabilised by zener diode W157. The arrangement provides a method of adjusting the signal gain without altering the d.c. conditions and thus the black level of the picture.

The usual partial decoupling (C216) in the emitter circuit provides h.f. compensation, while the 150μH shunt peaking coil L169 increases the load at h.f. to compensate for the loss otherwise present due to the stray capacitance shunting the load. In addition, a series peaking coil L703 – to divide the stray shunt capacitance – is included on the c.r.t. base.

Gamma Correction

Gamma correction to increase the gain with a high-level video signal is provided in the emitter circuit by means of the zener diode W160 and its series resistor R270. When the emitter voltage rises above 3·3V W160 conducts, increasing the gain since R270 is now connected in parallel with TF153 thus reducing the total emitter circuit resistance. The circuit operates when peak beam current drive is applied to the c.r.t.

Cascode Circuit

Finally, a couple of two-transistor RGB output circuits. Fig. 5 shows the G cascode output circuit used in the current Decca 80 and 100 solid-state chassis. Despite the fact that the in-line gun c.r.t.s used in these chassis have separate connections to each of the three first anodes, the black level can be adjusted by altering the bias applied to the base of the lower transistor in each cascode pair (this is a factory preset adjustment however). As in the other circuits we have considered, the drive control is arranged to adjust the signal gain without altering the d.c. conditions and thus the black level. A low-voltage device is used in the lower position, serving mainly as an impedance matching stage. The gain is provided by the high-voltage transistor in the upper position. Overall negative feedback is provided by taking R280 to the collector of Tr206.

Class B Circuit

The circuit shown in Fig. 6 features a class B complementary-symmetry configuration and is used in the new Rank colour portable Model BC6004. Advantages of this circuit compared to the previous class A circuits are the low quiescent current and thus power consumption, and the good transient response – since the load capacitance is both charged and discharged via the transistors, reducing the time-constant of the load circuit.

The operation of this circuit is rather unusual. At low frequencies, T574 acts as a class A amplifier with R576 as its load. At higher frequencies T573 is driven in antiphase via C572, the stage then operating in class B. It will be noticed however that there is no discharge path for C572, and a fairly complex arrangement is used to discharge it at line frequency. A line flyback pulse is fed to the circuit via C583, switching diode D582 on. As a result, there is feedback from the output via D582, R583, R586, R584 and the i.c. to the input. T574 is switched on while T573 is switched off. D572 also switches on, discharging C572 via R511 – D511 switching off during this process.

A class AB video output circuit was described in the November 1976 issue of *Television* (page 43). It's interesting to note that this is employed in the RGB output stages in the Rediffusion Mk. III colour chassis. ■

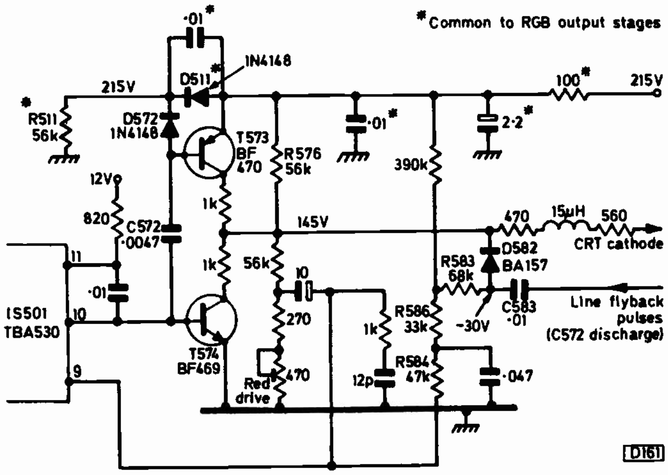


Fig. 6: Class B circuit used in the Rank colour transportable.

Plemi VHF Aerials

Hugh Cocks

WE RECENTLY tested some of the v.h.f. aerials made by the Dutch firm Plemi. The Band III aerial was the 12E512, which covers channels E5-12 (channels B6-13) with a quoted gain of 12·2dB. It has ten directors, a dipole and a double reflector. Despite the quoted lower limit of channel E5, a good measure of gain is available on channel F5 which lies about 12MHz below channel E5. Full gain is maintained right to the top end of the range.

The aerial elements are rather different from what we normally expect to see on a Band III aerial – being thin solid rods, though this in no way makes the aerial flimsy. The elements are fixed to the boom with plastic fixings, and a large wing nut is used to tighten each one on removal from the carton.

The aerial boom is square. Thus it can be clamped only vertically or horizontally using the special clamp provided – it's so often easy to clamp a Band III array with a circular boom in an unintentional slanted plane.

As one would expect with a multidirector array, the forward acceptance angle is quite sharp. This helps to reject unwanted signals.

The Band I aerial tested was a 4E2 which is a four-element channel E2 aerial with a quoted gain of 7dB. The aerial certainly performed well over its stated bandwidth (48-54MHz), but DX enthusiasts may wish to modify it to obtain a wideband response. This would be relatively easy. The dipole assembly is interesting: the tubing of the folded dipole is of different diameter on either side of the fold, no doubt a form of matching. The aerial rods are of standard Band I type, again mounted on a square boom.

We were rather unlucky with ours in that the neutral side of the folded dipole worked loose from the boom in a severe gale, causing "scratching" on the picture. All the nuts and bolts should be very strongly tightened before installation of the aerial therefore.

On both aerials the feeder cable is fixed to the inside of the lid, which contains a 75/300Ω balun transformer. The lid then snaps on to the dipole connections. Rather a large hole is left for the cable to emerge. We would recommend the usual water-proofing precautions therefore. Both aerials should be mounted with the connecting box on the lower side of the aerial to avoid the box filling with water. Having exposed the aerials to three months' weather however the dreaded moisture has not yet shown any sign of entry.

Both aerials compare very favourably with the few mass-produced v.h.f. aerials still available in the UK. For more information, write to Eastern Antennae, 87 Norwich Road, Ipswich. ■

Please note . . .

TV GAMES IN COLOUR

July/August 1977

Several readers wrote to ask advice on obtaining a satisfactory display, with correct sound, with this project. It was found that in some cases the mean d.c. voltage level at the base of the u.h.f. modulator driver transistor Tr1 was being held too negative by the games and modulator i.c.s: as a result, this transistor goes into saturation, providing a reduced and distorted output and hence a poor display. Connecting a 4·7kΩ resistor between the base of Tr1 and chassis should restore the d.c. conditions to normal and produce correct modulator operation.

LOG-PERIODIC AERIALS

The diameters of the smaller elements in the log-periodic aerial designs shown in Figs. 2-4 on pages 320-321 last month were incorrectly given as ¼in. instead of ⅛in.

Gate Crusher

Les Lawry-Johns

WHEN we featured a servicing article on the Waltham Model W125 large-screen monochrome receiver in the August 1977 issue we promised to report further on the set as its fault habits developed. We haven't come across many common faults so far, apart from the need with all of them to adjust the height control (which has a spindle protruding through the rear cover and so presents no trouble) after a short while in service. We have had some encounters however, one of which is worth relating . . .

The phone rang. It was Mr. Shuttlecock.

"That Waltham TV we got from you a few months ago is going funny. Can you call today?"

"What's it doing, Mr. Shuttlecock?"

"It keeps going dark and then coming up light again. My wife thinks it's something loose as nothing's been tightened up since we had it."

"How often does it do this Mr. Shuttlecock?"

"Oh it might be all right for hours, then it'll go right dark and come up again and stay all right for a few more hours."

"I'd better collect it and have it here for a while. I'll bring you another set."

So off we went and installed another set and brought the Waltham in for inspection. Needless to say it wouldn't play for us at all. Just stayed at the same brightness level for hours. Until we adjusted the front contrast control that is, then it started its pranks, the signal strength increasing dramatically to produce a very dark and over contrasted picture. So the trouble was not after all a variation of brilliance, rather one of varying a.g.c. Oh dear.

The triode section of the PCL84 (see Fig. 1) functions as an a.g.c. gate, sampling the voltage across the video amplifier's cathode resistor R122. This voltage is applied to the triode's cathode, the actual operating or conducting level of the triode being determined by the voltage applied to its grid by the contrast control R503 and the preset contrast control R130. The d.c. voltage at the anode controls the a.g.c. line, all other things being equal. Where to start? Change the PCL84 was the coward's way out and was promptly tried. With no success of course.

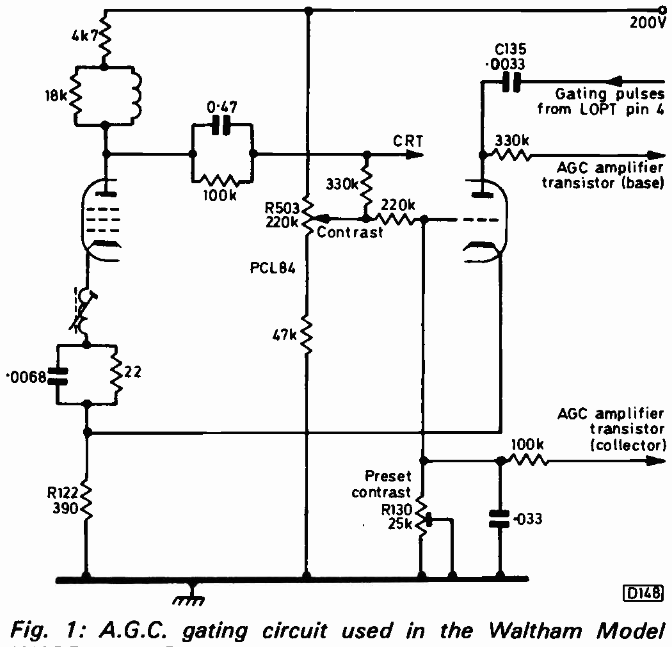


Fig. 1: A.G.C. gating circuit used in the Waltham Model W125 – the PCL84 triode is gated at its anode.

Some time was then spent chasing the variation of a.g.c. control voltage until we removed the aerial, something we should have done in the first place of course. It was then confirmed that the triode's grid voltage varied very occasionally, a cold check revealing that once in a while the resistance from the PCL84 triode's grid to chassis would suddenly change. All the resistors in this circuit are of high value except for the preset R130 which is only 25kΩ.

Our brilliant mind instantly grappled with this problem, and after due time we came to the conclusion that all was not well with the preset R130. Changing this brought about complete stabilisation of the contrast, and what could have been a very awkward job was polished off without too much trouble – except for the sound.

Now no persons living or dead had mentioned this. On test however, we noticed that the sound suddenly became "thin". Whilst it remained audible, it certainly weakened and lost bass. Due to the intermittent nature of the fault, it took us some time to arrive back at the 0·01μF coupling capacitor C215 which is by the side of the screened section to the left and slightly lower down from the PCL86 audio output valve. Replacing this brought back normal sound, which is very good in these receivers, in no small part due to the generous loudspeaker.

A Visit to King's Drive

So we were now in a position to return the set. It should be clearly understood that the Waltham W125, originating as it does from a land where there is no shortage of wood, is no lightweight. Having removed it from the estate car it was necessary to drop the tail gate before taking the set into the house, as the dog had decided to accompany me and given half a chance he would have hopped out for a sniff round. I then had to negotiate Mr. Shuttlecock's front gate, which is spring loaded. Having done this and arrived at his door we were a trifle puffed. In answer to our third ring Mr. Shuttlecock opened the front door and after an exchange of pleasantries led us into the room where the TV set lived.

Having fixed the set so that it displayed a rock steady picture we were subjected to an intensive interrogation by Mr. Shuttlecock as to what the exact trouble had been. We explained in some detail, none of which conveyed anything at all to him, but he was determined to extract the last detail. At last he appeared satisfied. We turned to pick up the loan set and depart when Mrs. Shuttlecock arrived.

"Ah, the television set is back", she cooed. "Now tell me Mr. Lousy-Jones, what exactly was wrong. I would like to know".

"Oh dear" I stammered. "I've just told your husband all about it." "Ah yes," she persisted. "You must tell me as he has such a bad memory you see".

So out came the old spiel again, Mr. Shuttlecock's head nodding in agreement. At last I was able to escape.

Picking up the loan set, I was obstructed by Mr. S busily rearranging furniture, mainly directly in my path.

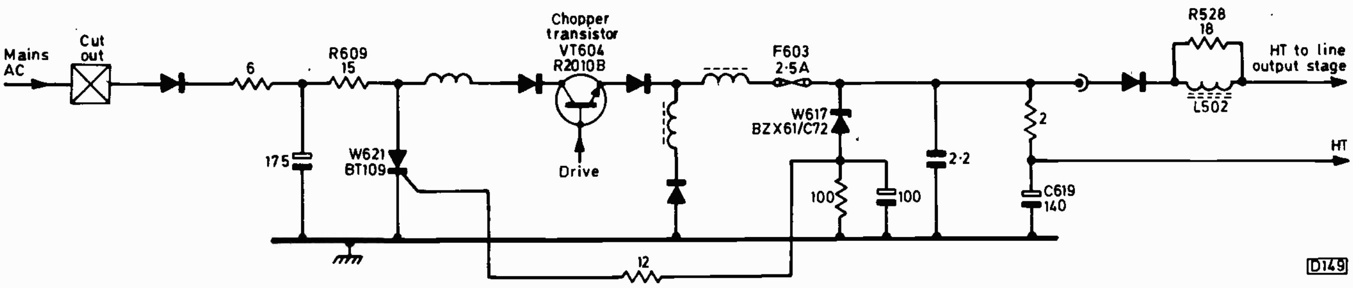


Fig. 2: Path from the mains input to the line output stage h.t. supply point in the Thorn 3500 chassis. Various problems included the core having fallen out of L502.

"Could you open the door?" I begged him.

"Ah yes, ah right, yes of course". He opened the front door and shot off down the path to open the gate. I followed and was about to pass through the gate when he let it go and shot toward the estate car.

The gate swung as I was passing through and combining with my forward movement dealt me a mortal blow in the groin.

"Ahhhhhhhhhh!" My scream rang the length of King's Drive and Queen's Walk. The pain was so intense that had the set not been mine I would have dropped it. As it was I waltzed around howling with pain and fear for the damage that might have been wrought.

"What on earth's the matter," enquired Mr. Shuttlecock. "The neighbours will think you've got a screw loose."

"You let the gate go and it's damaged me for life."

"Oh dear", commiserated Mr. S. "Your face is green, I'd better go and tell my wife what has happened." This was too much for me. Hopping in the front I drove off as fast as my legs would enable me to change gear.

Wanted by Five

On our return there was a batch of jobs "wanted by five o'clock." First was a UA3 unit audio. This unit has stereo v.h.f. radio as well as medium and long a.m. The complaint was not the usual one of one side dead or the unit totally out of action due to defective audio i.c.s – we'd been looking forward to the time when we would get one in without this chip trouble. Here it was.

Records played nicely and full output from the audio unit, but the radio reception was very poor both on a.m. and v.h.f. So we started by making an assumption, which of course turned out to be the wrong one. We ruled out the v.h.f. tuner and the stereo decoder, and concentrated on the supply voltages to the common i.f. stages, transistors etc. All proved to be in order, and signal injection didn't help much either. We then did what we should have done in the first place and studied the circuit diagram more closely. This showed that the detected a.m. output is also fed into the decoder i.c. Replacing this restored normal reception, which only goes to show that making assumptions (in this case that the only common ground was the mixer, i.f. and supply) can save time on some occasions but waste far more on others.

Cut Out Cuts Out

Back to TV for the second job, a Ferguson colour set fitted with the 3500 chassis. Cut out operates as soon as it's pressed. Correction. Cut out operates almost immediately. During the very brief operating period (say one second) R609 (see Fig. 2) heats. Remove the supply plug to the line timebase. No difference. Check chopper transistor R2010 (VT604). Dead short emitter to collector. Replace and check for shorts. When the line timebase supply plug is inserted a short or near short is recorded. Make a more direct reading on the line output transistor (R2008) and find this also a dead short. Nagging doubt creeps into usually blank mind. Let's make an assumption (not another one surely?).

If the chopper supply transistor shorted, the sudden voltage rise should cause W617 to conduct (it should conduct at 72V) and turn on the crowbar W621 which should cause the cut out to operate. Well apparently it was. Yes, but why the shorted line output transistor? Better check W617. Missing. Only the wire ends protruded from where it once was. Check the crowbar. This seemed to be in order.

As we were fitting a new 72V zener (W617 – BZX61/C72) we got to thinking. If the rise in voltage had caused the line output transistor to short, why hadn't the 2·5A fuse F603 failed? Removing it and taking off our glasses so as to be able to see properly we found it marked 5A. Ah....

So with a new chopper, new line output transistor and new zener, plus a 2·5A fuse of course, we felt brave enough to switch on. Buzz, loud sound hiss (no aerial), rustle of e.h.t., tube heaters alight. High pitched "tweaking" sound and we just knew the picture would be rippled.

Insert aerial. Colour o.k., sound o.k., picture rippled. Slap another electrolytic across C619. Better but not cleared. Check R528 (18Ω, wired across L502). Turned to dust. Replace, but hardly any difference. These components are in the supply line to the line output stage: R528 is inside sleeving, and is revealed when the beam limiter board is lifted. Bearing in mind that there had been a difference when R528 was fitted, we tried a capacitor of around 0·15μF across L502. Ripple cleared. Funny. Enter friend Ray.

"Can I take a set-top aerial to try over the flats Les?" he bawled.

"Of course. I say, why should a capacitor across L502 stop a ripple usually associated with lack of smoothing in the chopper line?"

"Cos the core's dropped out of L502 and it's not smoothing. I thought everyone knew that" said Ray.

"Of course, of course", I mumbled. "I was about to

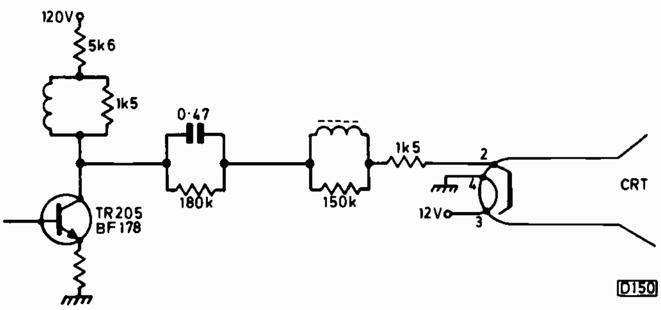


Fig. 3: C.R.T. cathode drive circuit used in the Indesit T12LGB monochrome portable.

check the presence, or rather the absence of – well where would it be?"

"Probably dropped out of the bottom on the way in", said Ray. "I'll send you one up later."

"And he did. And it did. And that's all there was to that one. Just between you and me, young Ray is not so hot on 1933 Ferranti radio sets.

Tube Tapping

Still demoralised and confused, we commenced to direct our considerable talent to an innocent Indesit T12LBG which just happened to be sitting there. The complaint was that the picture would vanish and leave an over bright raster. Switching on produced a normal speckled raster (no aerial) which suddenly became speckless (speckleless?) and over bright, suggesting that the supply was absent from the collector of the video output transistor.

Having located the video output stage (TR205, BF178) we found the collector voltage normal (about 60V), also that the speckles had returned denoting normal operation. Removing the fixing screws, we withdrew the chassis whereupon the fault condition returned. A quick stab of the meter revealed that the video stage was still working but alas so was the screen.

Feeling a trifle frustrated, we decided to attack the tube base voltages. Now these small tube bases always confuse me, and it takes some time for me to sort out which pin is which. The first anode was easy as it was at over 300V. The trouble was, I couldn't find the cathode's 60V. Blind panic began to take over. It wasn't surprising however because the screen was once again over bright. I made several assumptions (each of them wrong) before I calmed down and became merely irrational. I spoke to myself sternly: first positively identify the cathode pin.

This proved to be pin 2, with a 1·5kΩ resistor (Fig. 3) leading back to the video circuit, first via a choke wound on a 150kΩ resistor, then on to a 180kΩ resistor shunted by a capacitor, then to the collector of the BF178. I left a meter on the collector and another on the c.r.t. base socket which was now a normal 60V at pin 2. I'd just about given up hope of the fault returning when it did. Collector 60V, c.r.t. cathode 0V. Oh dear. It had been so long since I'd had a monochrome tube with a heater-cathode short that I had omitted to take this into consideration. Removing the tube base socket restored the 60V, putting it back produced 0V. I cursed loud and clear.

"Now what have you done" asked my angel, tender and considerate as always.

"I've spent some time trying to find out what's wrong with this, when all I had to do was tap the tube neck, like this, and it would have shown up right away" I moaned, tapping the tube neck. Immediately the short cleared and back came the speckles.

Tap it again and back comes the short. Tap tap. No short. Tap tap tap. No short. Test for hours, no fault.

In the meantime my adorable one was having her say as usual. "Instead of tapping it, why don't you slap a transformer in like you did on mum's."

"Because mum's isn't expected to work on a 12V battery, that's why."

"Perhaps they don't want to work it from a battery."

"Shut up and get that cat off the bench."

The decision as to whether or not to order a new tube was not necessary as the short has not recurred (so far).

Thinking back to Mr. Shuttlecock, the only comfort I gained from all this is that at last I understand what is meant by "gated pulses".

Your PROBLEMS solved

Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 386 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

THORN 3500 CHASSIS

When the set has been on for about half an hour a vertical, patterned white line appears on the right-hand edge of the screen, approximately 1¼in. from the edge of the raster, and remains there until the set is switched off. The picture quality is otherwise excellent, and the sound o.k. The line developed after a replacement power panel was fitted. On a blank raster, there's a shadow to the right of the patterned line. The line doesn't interfere with the locking, the linearity or the picture content.

The following components in the power supply can be responsible for this: the "efficiency diode" W616 in the chopper circuit; the choke in series with this diode (L602 – remove and replace with a wire link and ferrite bead); and C635 in the base circuit of the chopper driver transistor (remove or increase from 0·005μF to 0·01μF). If the tuner unit is of the mechanical type, fit an 0·47μF capacitor between its 12V supply point and chassis.

STC VC2 CHASSIS

There's loss of picture and sound on this set, on both systems. The raster is normal and the brightness controllable. The aerial is o.k. – tested on another set. The i.f. and video valves have been replaced, their load resistors checked, also the tuner a.g.c. clamp diode.

Loss of sound and vision on both systems means that the fault must be in the v.h.f. tuner or the first i.f. stage V5. If the voltage at pin 8 of V5 is incorrect, check its screen grid feed resistor R34. Eliminate a.g.c. problems by shorting out the i.f. a.g.c. clamp diode D9 as a test. If the problem persists, concentrate on the v.h.f. tuner unit, checking the voltages and mixer valve.

THORN 950 CHASSIS

There's a broad, woolly white band, rather bright and about 1in. wide, from the top to the bottom of the screen – down the centre. It's like a slight foldover, and is present on u.h.f. only.

The effect is not uncommon on this chassis. Replace the 1μF capacitor (C103) which decouples the screen grid of the line output valve. C47 (16μF) which decouples the supply to the flywheel sync d.c. amplifier valve is occasionally the culprit.

GEC S/S HYBRID COLOUR CHASSIS

On switching on there's sound but no raster, and after two or three minutes the thermal cutout operates. The picture sometimes appears if the set is switched off and on again, with the familiar line whistle being present. Retuning the line oscillator coil L501 seems to help but then the problem returns. I also find that it's sometimes necessary to retune after changing channels.

The cutout is in the cathode circuit of the PL509 line output valve and operates when there is a line drive or line output stage failure. A faulty e.h.t. tripler often operates the cutout. It seems more likely that the line oscillator is reluctant to start however. Check the voltage at the control grid of the line output valve: there should be –60V here (measured with a 20kΩ/V meter) if the line oscillator is working properly, even with the tripler and the anode cap of the PL509 disconnected. Suspect components in the line oscillator circuit are the feedback capacitor C509 (820pF), the tuning capacitor C507 (0.0022μF) and the cathode resistor R516 (680Ω). The tuning drift is sometimes caused by poor earthing of the spring contacts or dried grease on the moving parts. Great care is required when cleaning the tuner.

COMBI COLOUR

The trouble with this five-year old colour receiver is defective tuning. It's an imported set and the shop where it was purchased is no longer in business. There don't seem to be any agents now, so I'm rather stuck.

The push-button unit on these sets is not of very robust design and tends to wear out after some year's use. The usual problems are associated with the buttons, which tend to keep springing out or in bad cases fail to stay in at all. Another trouble is that the carbon coating of the tuning resistors varies in value, causing severe tuning drift. The sets are of German origin and spares are no longer available. You might be able to obtain a replacement unit from the manufacturers, Graetz of Pforzheim, West Germany. An easier solution however is to fit the five push-button plus a.f.c. switch unit which is available from Manor Supplies (see advertisement section). The six buttons of these units fit neatly through the holes in the Combi set, leaving a spare hole which can be blanked off with a strip of black insulation tape. Cut the brackets off the Combi unit and solder them on to the Manor Supplies unit (see Fig. 1). The replacement unit is devoid of the complication of band switching, so the wires from the band switches can be connected together as shown. Glue the plastic channel/Band indicators into position so that they display the legend 21.40.60 through the escutcheon windows.

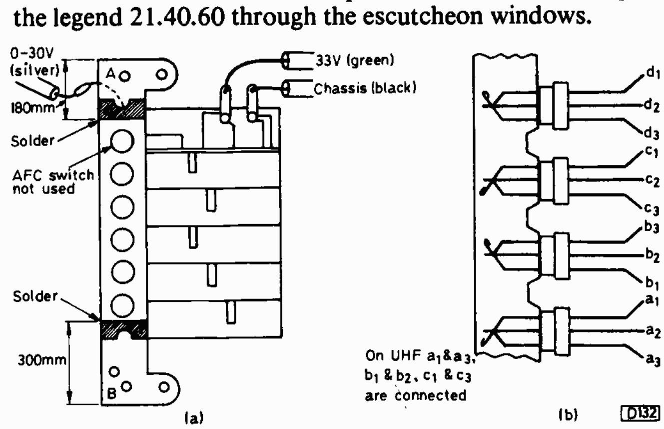


Fig. 1: Fitting a Manor Supplies push-button channel selector unit in a Combi colour receiver. (a) Cut the two fixing brackets A and B from the Combi unit and solder them on to the new unit in the positions shown. The five buttons and a.f.c. switch will then fit through the plastic front escutcheon, leaving the bottom hole unused – this can be blanked off. (b) The band switches on the rear of the Combi unit. Since u.h.f. only is required, disconnect all the wires, then connect a1, a3 and b2 together, and c1 and c3 together: a2 and c2 should be cut off short and sleeved – they are not used.

DECCA 30 CHASSIS

There's an odd field fault on this set. The picture is only about five inches high, across the centre of the screen, but it looks as if it's the middle section of the picture that's missing.

This reduced scan and foldover suggests that there's a defective capacitor in the field timebase. Check the charging capacitor C404, the coupling capacitor C403 and the feedback capacitor C411. Also check the pentode's screen grid feed/decoupling components, and make sure that its cathode bias resistor R413 is intact. We've known this effect to be caused by shorting turns in the field output transformer.

THORN 1500 CHASSIS

There is foldover, by about a third, at both sides of the raster, also a blank gap of about three quarters of an inch at each side of the screen. The picture can be locked, and all controls work except for the width control which has no effect. It seems as if the line timebase is running at twice the correct speed, because there's no black gap in the middle of the picture.

You will probably find that there is little voltage across the flywheel sync d.c. amplifier's load resistor R58, i.e. the voltage at the collector of VT10 is high. This means that the transistor is taking little current. This could be due to the transistor being faulty (possible), or its base voltage being low (probable). It's often the case that the filter capacitor C51 (1μF) goes short-circuit, thus pulling the base voltage down. Check this, and the discriminator diodes W3/4.

GEC C2110 SERIES

The trouble with this set is an excessively bright raster with flyback lines. I've tried one common cause, R507 in the c.r.t. first anode supply circuit, but a replacement makes no difference. The RGB output transistors have also been replaced. The brightness control (P52) has no effect on the raster.

Make sure that P52 is not open-circuit, and that R52 in series with it is of the correct value (2·2kΩ). Then check that the 12V supply to the chroma panel is present.

TELEFUNKEN 711 CHASSIS

The trouble with this set is that after being on for ten minutes or so the width varies with the brightness. Does this mean a new e.h.t. tripler is needed?

The triplers used in this chassis are usually extremely reliable and we doubt whether this is the trouble. The most common cause of poor regulation is a fault in the overload protection circuit, which is intended to shut down the h.t. supply (U1) should the line output stage draw excessive current. Unfortunately it tends to do this due to faulty transistors in the protection circuit itself. Earlier sets use a two-transistor circuit (T551/T552), later ones a three-transistor circuit (T551/2/3). It's usually T551 (BC237) that's defective, but any of them can be responsible. The protection circuit can be disconnected by lifting one end of the 220Ω resistor R557. The set should then operate normally, with the contrast and brightness controls working satisfactorily, if the protection circuit is responsible for the fault. In the earlier two-transistor circuit there's a preset control R551 to set the circuit's sensitivity: this can be incorrectly set up. Reset by connecting a meter with the positive lead to the base of T552 and the negative lead to its emitter, setting R551 for a reading of 0·35V. The 100kΩ resistors R554 and R555 in the two-transistor circuit can also go open-circuit to give faulty protection circuit operation and poor regulation.

DECCA CTV25

The width control has no effect, and the width takes five-ten minutes to reach maximum after the set has been switched on – it gradually fills out by about an inch at each side. The width coil has been replaced, and new valves fitted. Correct width can be obtained by using the set e.h.t. control.

If the width control has no effect it might have had the wrong core fitted. If the e.h.t. is less than 25kV with correct width set by the set e.h.t. control (which is in the width stabilising circuit) this is likely and need do no harm. Check that the e.h.t. is up to par during the slow warm-up period. If not, the reservoir/smoothing capacitor C702A/B is suspect. If the h.t. is normal, check the components in the width stabilising circuit (R401, R403, VDR401 and the set e.h.t. control).

PYE 731 CHASSIS

For a very brief period smoke and flames came from the line output stage, following a loud crack. The mains fuse then blew, and the same thing happened with a replacement.

The usual cause of this trouble is the focus potentiometer. This has been replaced by a modified type, supplies of which can be obtained through dealers.

TEST CASE

185

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

An early Pye 691 colour receiver provided a normal monochrome picture with the colour control fully retarded, but when the control was set to the position previously established for best colour the saturation level was abnormally low and the display appeared to lack sufficient red hue. The sound was not affected.

The receiver employs three PCL84 triode-pentodes, one in each colour-difference signal channel, to drive the red, green and blue grids of the picture tube. The pentode sections serve as the colour-difference output stages with the triode sections acting as clamps. The control grids of the pentodes are driven by three BF194 transistor preamplifiers. Two of these are fed with the B – Y and R – Y signals from the appropriate chroma detectors, while the third is fed from the G – Y matrix.

The three valves appeared to be operating reasonably normally, but a finger-temperature test after the set had been running for a while gave the impression that the R – Y valve (V7) was a trifle cooler than the other two. It was thus concluded that this valve was low in emission. Sadly, replacement had no effect whatever on the symptom, neither did replacement of the other two valves, while detailed tests of the triode clamp circuits failed to expose any abnormalities.

The control grids of the valves are coupled through 0·022μF capacitors from the collectors of the transistors, and the bases of the R – Y and B – Y preamplifier transistors are returned to chassis via 5·6kΩ resistors. All three preamplifier transistors are npn devices, and forward turn-on current is fed to their emitters from a common –20V source via 12kΩ resistors. The R – Y and B – Y preamplifier transistor stages incorporate frequency compensation, using a 25μF capacitor in series with a resistor from emitter to chassis.

Tests made in and around the transistor preamplifier stages eventually brought the trouble to light. How did the preliminary analysis go wrong, and what was the most likely cause of the trouble? See next month's test case for the solution and for a further item in the series.

SOLUTION TO TEST CASE 184
– Page 331 last month –

Last month's Test Case item shows that it's possible to trace an intermittent colour fault with a good multimeter and a steady off-air test card transmission. The technician was able to focus on the chroma delay line driver transistor T29d by logical deduction and elimination. Since T29d's emitter voltage changed as the saturation reduced, there was clearly something wrong with the biasing of this stage. There are smoothing electrolytics in both the base and emitter circuits, and these were obvious suspects. Further tests revealed that the transistor's base bias altered appreciably during the fault condition, so it was decided to check C162d (4·7μF) in the base circuit. This turned out to be the cause of the fault – it's insulation resistance was changing as the temperature increased.

C162d forms part of an *RC* filter which smooths the output from the collector of one of the transistors in the bistable circuit, thus providing a colour-killer turn-on bias for the chroma delay line driver transistor which is without fixed forward bias. On the ITT CVC5-9 series of chassis the bistable is not triggered on monochrome, so there is then no turn-on bias for the delay line driver transistor. On colour the ident signal is rectified, the resultant bias being used to unblock the trigger pulse path to the bistable circuit.

QUERY COUPON

Available until 15th May 1978. One coupon, plus a 50p (inc. VAT) postal order, must accompany EACH PROBLEM sent in accordance with the notice on page 384.

TELEVISION MAY 1978

Published on approximately the 22nd of each month by IPC Magazines Limited, King's Reach Tower, Stamford Street, London SE1 9LS. Filmsetting by Pacesetters, London SE1. Printed in England by Carlisle Web Offset, Newtown Trading Estate, Carlisle. Distributed by IPC Business Press (Sales and Distribution) Ltd., 40 Bowling Green Lane, London EC1R 0NE. Sole Agents for Australia and New Zealand – Gordon and Gotch (A/sia) Ltd.; South Africa – Central News Agency Ltd. "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to VAT, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

AD 161-162	pair 70p
40 M/A 160 M/A 250 M/A 800 M/A 1 Amp 1·15 Amp 1·6 Amp 2 Amp 2·5 Amp 3 Amp 3·15 Amp 4 Amp	**20MM** Fuses Mixed Values Anti Surge and Quick Blow 30 for **£1.00**
3500 Thorn Triplers	**£3.50**
LP1193/1 Mallard	**£2.50**
TK25KC15BL Ex Panel Pye	**£1.50**
TS2511TBH GEC	**£4.00**
TS2511TBK Rank 823	**£4.00**
TS2511TDT Thorn	**£4.00**
TS2511TBQ Pye	**£1.50**
TS2511TCE	**£3.00**
TS2511TCF	**£3.00**
1730 Decca	**£1.00**
Mains Droppers 69R + 161R Pye	**40p**
Rank/Bush Mains Dropper 302R/70R/6R2	**40p**
147R + 260R Pye	**40p**
Thorn Mains Droppers 6R + 1R + 100R	**35p**
Thorn Mains On/Off Switches, Push Button or Rotary	**15p**
Thorn 2000 & 3000 Series Hearing Aid External Loudspeaker Unit	**£2.00**
470M/100v	**25p**
Focus Unit 3500 Thorn	**£1.00**
Thorn 8500 Focus Unit	**£1.00**
4 Push Button Unit UHF Thorn	**£3.50**
D.P. Audio Switch	**7½p**
4 Push Button Unit for Varicap	**£1.00**
7 Push Button Unit for Varicap	
RJZ243619 Replacement for ELC 1043 UHF Varicap new	**£2.50**
BF127, BC350, BF194, BF264, BF178, BF184, BF180, BF121, BC460, BF181, BF257, BF395, BF182, BF137, BC263B, BC300, BC161, BF273, AC128, BF185	**15p EACH**
3300/40v, 680/40v, 680/50v, 220/63v, 2200/50v, 2200/10v	**12½p EACH**
2N930, BC183, 2N2222, BF195, 2N3566, BF198	**10p EACH**
BF336	**30p**
MJE2021 90V 80V SJE5451 5A	**15p EACH**
90V 661 NPN 80W 5A 660 PNP	**28p PAIR**
EHT lead & anode cap	**25p**

50 Mixed Diodes	**£1.00**
1N5349 Diode 12V Z/Diodes	**10p EACH**
400 MFD/350V	**50p**
Mullard UHF T/Units	**£1.50**
300 Mixed Condensers	**£1.50**
300 Mixed Resistors	**£1.50**
30 Pre-sets	**50p**
100 W/W Resistors	**£1.50**
40 Mixed Pots	**£1.50**
20 Slider Pots	**£1.50**
Mixed Components 1lb for	**£1.50**
BD116	**30p**
TIP115	**25p**
TIP117	**25p**
100 Mixed Electrolytics 1000 MFD to 4 MFD	**£2.50**
120 Mixed Pack of Electrolytics & Paper Condensers	**£1.20**
100 Green Polyester Condensers Mixed Values	**£2.00**
·1 MFD 2000v	**15p**
·1 MFD 800v ·01 MFD1000v ·047 MFD1000v ·47 MFD 630v ·0047 MFD 1000v ·0022 MFD 1500v	**8p EACH**
200+200+100M 325v	**40p**
470+470M 250v	**40p**
100+200M 325v	**30p**
200+200+100+32M 350v	**70p**
150+200+200M 300v	**50p**
800M 250v	**20p**
600M 300v	**£1.00**
400M 400v	**£1.00**
800+800M 250v	**60p**
200+100+100+50M 300v	**45p**
200+100+100M 350v	**70p**
100M 450v	**25p**
33/450v	**25p**
47M 450v	**25p**
680M 100v	**25p**
6800M 40v	**35p**
100M 350v	**20p**
22M 350v	**20p**
33000 10v	**30p**
15000 40v	**50p**
2·2/63v, 10M 40v, 220M 10v, 2·2M 100v, 22M 100v, 4·7M 63v	**5p EACH**
Plessey Green Condensers: 6800M 16v, 1000M 50v, 2200M 16v, 1500M 25v, 1000M 10v, 1000M 10v, 4700M 25v, 1500M 40v, 680M 63v, 1000M 25v, 1000M 63v, 1500M 50v, 3000M 16v, 4700M 16v, 330M 100v, 1000M 16v, 4700M 10v, 100M 63v, 1000M 63v, 3300M 25v, 1000M 40v	**12½p EACH**
6 Push Button Unit for Varicap Thorn 4000	**£2.00**
6 Push Button Unit with Cable Form for 1590 series for Varicap Tuner	**£1.00**
VHF Varicap Units New	**£2.50**

Thorn 1590 Mains Lead & On/Off Switch & Control Panel with 3 Slider Pots	**£1.00**
VHF Varicap Units New, 49·00-219·00 MHZ	**£1.50**
Reject VHF Varicap Units UHF	**50p**
AE Isolating Socket & Lead	**45p**
6 Position 12·5k V/Resistors Units for Varicap	**50p**
EHT Rectifiers Sticks Used in Triplers x80/150, CSD118xMH	**12p EACH**
CSD118xPA	**12p**
3 Off G770/HU37 EHT Rec. Silicone, used in Tripler	**15p**
Bridge Rectifiers 3 Amp	**40p**
1A 100v	**20p**
2A 100v	**25p**
W005M	**20p**
BY127	**10p**
1N4005	20 for **£1.00**
1N4006	20 for **£1.00**
1N4007	20 for **£1.00**
BYX94 1200v 1 Amp.	15 for **£1.00**
BB105 UHF, BA 182 Varicap Diodes, BB103 VHF	12 for **£1.00**
BY176	**£1.00**
BA248	**7p**
BY133	**12p**
BYX55/350	**10p**
BY210/400	**5p**
BY206	**15p**
BT106	**95p**
BT116	**95p**
BY212	**15p**
12 Kv Diodes 2 M/A	**30p**
18 Kv BYF3123 Silicone	**30p**
160PF 8Kv, 270PF 8Kv, 1000PF 10Kv, 1200PF 10Kv, 1000PF 12Kv, 160M 25v, 220M 25v, 1000M 16v, 220M 35v, 220M 40v, 220M 50v, 470M 25v, 22M 315v, 100M 50v, 330M 10v, 330M 25v, 330M 35v, 330M 50v, 330M 63v, 470M 25v, 470M 35v, 470M 40v, 47/63	**10p EACH**
SN76533N	**£1.00**
TBA990	**£1.00**
SN76660N	**50p**
SN76650N	**£1.00**
TBA560Q	**£2**
TBA540	**£1.00**
TIS91	**25p**

TDA100	**£1.00**
SAB550	**£1.50**
TBA530	**£1.00**
TBA920Q	**£2.00**
SN76003N	**£1.50**
SN7660N	**£1.00**
1N4148	**3p**
BF198	**10p**
BF274	**10p**
BA159	**10p**
BY184	**25p**
BY187	**50p**
TAA550	**30p**
TBA510	**£1.00**
TBA480Q	**£1.00**
TBA550Q	**£1.50**
TBA720A	**£1.50**
TBA790B131	**£1.00**
TBA800	**95p**
SN76115N	**£1.00**
TAA700	**£2.00**
TBA530Q	**£1.00**
TBA550	**£2.00**
SN76544N	**50p**
SN76640N	**£1.00**
SAA570	**50p**
TBA120A	**50p**
TCA270Q	**£2.00**
TCA270SQ	**£2.00**
Star Aerial Amps CHANNEL B+C	**£4.00 EACH**
TV18	**40p**
TV20	**50p**
Rectifier Sticks & Lead	
R2008B	**£2.00**
BU105	**£1.00**
BU105/04	**£1.00**
BU205	**£1.00**
BU208	**£1.75**
BD130Y	**20p**
2N3055	**45p**
BRC1693 Thorn	**80p**
BD138	**20p**
BD252	**20p**
Audio O/P Trans. RCA16572, RCA16573	**40p PAIR**
BU 204 Ex Panel, BU105 Ex Panel, BU126 Ex Panel	**50p EACH**
5A-300 TIC106 Thyristors	**25p EACH**
RCA40506 Thyristors	**50p**
BC108	**7p**
BD610, BD619	**80p PAIR**
MJE2955	**50p**
BD207	**35p**
BC188	**10p**
BC149C	**7p**
Aerial Amp Power Supplies 15 volts	**£1.50**

SENDZ COMPONENTS

2 WOOD GRANGE CLOSE, THORPE BAY, ESSEX.

Reg. Office only –
No personal callers. Thank you.
Free Postage applies in U.K. only.

PLEASE ADD 12½% VAT