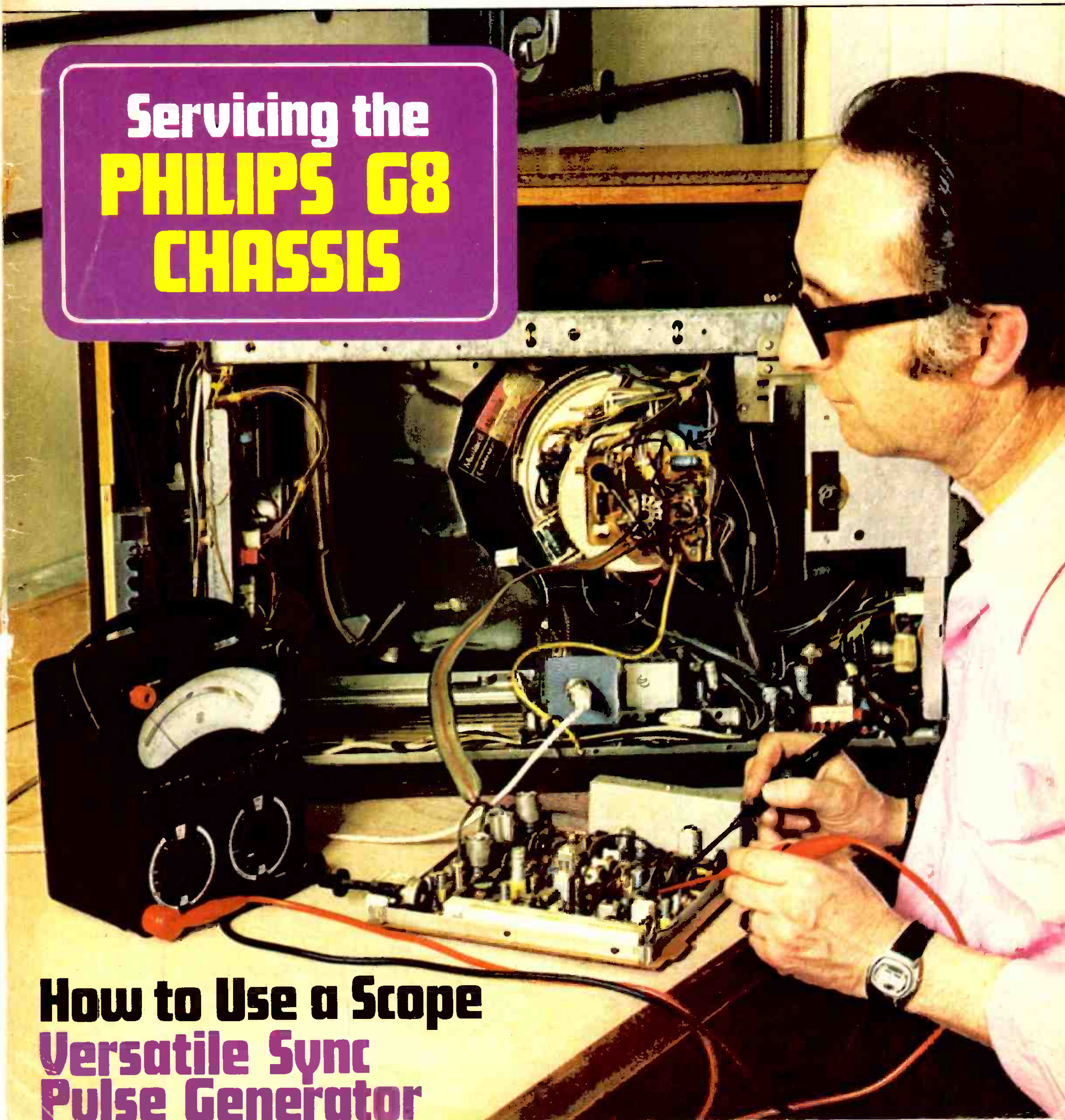
JUNE 1978

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

50p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS



Servicing the PHILIPS G8 CHASSIS

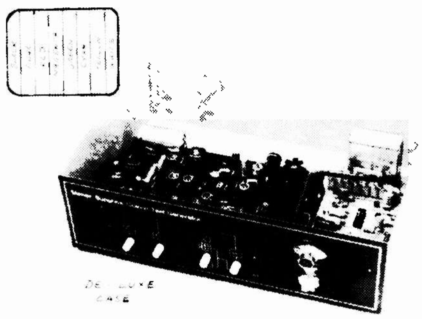
How to Use a Scope

Versatile Sync Pulse Generator

MANOR SUPPLIES

COLOUR BAR GENERATOR

plus CROSS HATCH KIT (Mk. 4)



- ★ Output at UHF, applied to receiver aerial socket.
- ★ In addition to colour bars, all R–Y, B–Y and Lum. Combinations.
- ★ Plus cross hatch grey scale, peak white and black levels.
- ★ Push button controls, small, compact battery operated.
- ★ Simple design, only five i.c.s. on colour bar P.C.B.

PRICE OF MK4 COLOUR BAR & CROSS HATCH KIT £35.00 + 8% VAT + £1.00 P/Packing.

CASES, ALUMINIUM £2.40, DE-LUXE £4.80, BATT. HOLDERS £1.50. ADD 8% VAT TO ALL PRICES!

ALSO THE MK3 COLOUR BAR GENERATOR KIT FOR ADDITION TO MANOR SUPPLIES CROSS HATCH UNITS. £25.00 + £1.00 p.p. CASE EXTRA £1.40. BATT. HOLDERS £1.50. ADD 8% VAT TO ALL PRICES.

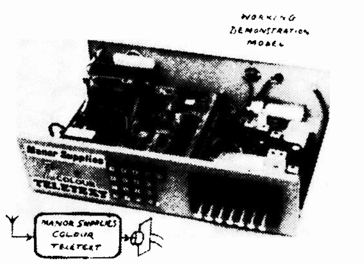
- ★★ Kits include drilled P.C. board, with full circuit data, assembly and setting up instructions.
- ★★ All special parts such as coils and modulator supplied complete and tested, ready for use.
- ★★ Designed to professional standards.
- ★★ Demonstration models at 172 West End Lane, NW6.
- ★★ Every kit fully guaranteed.

MK4 DE LUXE (BATTERY) BUILT & TESTED £58.00 + 8% VAT + £1.20 P/Packing.

ALTERNATIVE MAINS SUPPLY KIT £5.78 + 8% VAT + 65p P/P. VHF MODULATOR (CH1 to 4) FOR OVERSEAS £3.50. INFORMATION ON VIDEO TAKE-OFF FOR C.C.T.V.

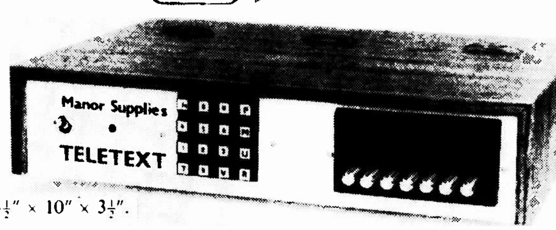
MANOR SUPPLIES TELETEXT 77 KIT (incl TEXAS DECODER). Full facilities in colour. External unit. AE input to set. Write or call for further information. See working demonstration model! Easy to build and results guaranteed for every completed unit.

Texas XM11 Decoder £130.00 p.p. £1.00.
Auxiliary Units £88.00 p.p. £1.50
De Luxe Case £14.80 p.p. £1.00.
Add 12½% VAT.
Separate Price List for Individual Units available.



Changes from Teletext to picture without switching aerials.

Armchair control of Teletext and T.V. stations.



15½" × 10" × 3½".

COLOUR, UHF & TELEVISION SPARES

T.V. PORTABLE PROJECT LOPT. SCAN COILS. DRIVER **£12.50;** EHT RECT. **£1.20;** ELC1043/05 **£5.50,** CONTROL UNIT **£1.00;** VIS GAIN. VIS SELECT (TESTED) **£3.80;** PACKS: I.C. **£5.20,** CAPS TANT **£2.75,** ELECTROLYTICS **£3.20,** CERAMICS **£2.00,** POLY-ESTER ETC. **£1.35; PRESETS 90p,** TRANSISTORS **£3.90, RESISTORS £2.50,** SEMICONDS **£3.80, BRIDGE REC. £1.95,** C106 **90p;** BYX71/600 (2) **£2.40;** RELAY **£2.25,** CONTROLS **£1.18;** 6MHz FILTER **68p;** COIL **£1.00;** 3A CHOKE **18p;** p.p 85p. MAINS TRANSFORMER **£5.80** p.p. £1.00. OTHER PARTS AVAILABLE. DEMONSTRATION MODEL WORKING AND ON VIEW AT 172 WEST END LANE. NW6. **SPECIAL OFFER** FOR SHOP CUSTOMERS. TOSHIBA 14" CRT BRAND NEW **£12.50.**

CROSS HATCH UNIT KIT, AERIAL INPUT TYPE. INCL. T.V. SYNC AND UHF MODULATOR. BATTERY OPERATED. ALSO GIVES PEAK WHITE & BLACK LEVELS. CAN BE USED FOR ANY SET **£11.00** + 45p. p.p.* (ALUM. CASE **£2.00** p.p. 75p.*). COMPLETE TESTED UNITS. READY FOR USE (DE LUXE CASE) **£20.80** p.p. 90p.* ADDITIONAL GREY SCALE KIT **£2.90** p.p. 30p.*

"NEW TYPE" UHF SIGNAL STRENGTH METER KIT £18.00 p.p. 90p.* (**VHF VERSION £18.80** p.p. 90p*).

CRT TESTER & REACTIVATOR PROJECT KIT £19.80 p.p. £1.30*

"TELEVISION" COLOUR SET PROJECT. MARK II DEMONSTRATION MODEL WITH LATEST IMPROVEMENTS. WORKING AND ON VIEW, SPARE PARTS STILL AVAILABLE.

SPECIAL OFFER I.F. Panel, leading British maker, similar design to "Television" panel. Now in use as alternative inc. circuit and connection data, checked and tested on colour **£14.80** p.p. 95p.

STABILISER UNITS, "add on" kit for either 40V or 20V. **£2.80** p.p. 35p.
PHILIPS 210 or 300 Series IF Panels **£2.50** p.p. £1.00.
PHILIPS 210, 300 Series Frame T.B. Panels **£1.00** p.p. 65p.
PHILIPS 19TG 170 Series Timebase Panels **£2.50** p.p. 90p.
BUSH A823 (A807) Decoder Panel **£7.50** p.p. £1.00.
BUSH 161 TIMEBASE PANEL A634 **£3.80** p.p. 90p.
BUSH 161 I.F. PANEL A583 **£3.80** p.p. 90p.
GEC 2040 Surplus Panels, ex-rental. Decoder **£5.00.** T.B. **£5.00** p.p. 90p.
GEC 2010 Series IF or T.B. Panels for spares **£1.00** p.p. 85p.
BRC 3000 Surplus/Salv Panels, Decoder **£7.50,** Video **£7.50** p.p. 90p.
DECCA Colour T.V. Thyristor Power Supply. HT, LT etc. **£3.80** p.p. 95p.
BUSH TV300 portable Panel incl. CCT **£5.00** p.p. 95p.
BUSH CTV174 Decoder plus C.D.A. **£8.50** p.p. £1.00.
BUSH TV Portable Eleven Volt Stab. Power Supply Unit **£3.80** p.p. £1.00.
PYE 697 Line T.B. P.C.B. for spares. **£1.50** p.p. £1.00.
MULLARD AT1023/5 convergence yoke. New **£2.50** p.p. 75p.
DLIE delay line. New **90p** p.p. 40p. AT1025/06 blue lat. **75p** p.p. 30p.
PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits **£3.75** p.p. 85p. or incl. yoke. **£5.00. PHILIPS** G8 panels for spares, decoder **£2.50** p.p. 85p.
VARICAP, Mullard ELC1043/05 UHF tuner **£5.50,** G.I. type (equiv. 1043/05) **£3.50** p.p. 35p. Control units, 3PSN **£1.25,** 4PSN **£1.50,** 5PSN **£1.80, Special offer 6PSN £1.00,** 7PSN De Luxe **£2.80** p.p. 35p. TAA 550 **50p** p.p. 15p. Salv. UHF varicap tuners **£1.50** p.p. 35p.
BUSH "Touch Tune" assembly, incl. CCT **£5.00** p.p. 75p.
VARICAP VHF, ELC 1042 **£4.80,** p.p. 35p. ELC 1042 on Pye P.C.B. **£5.40** p.p. 85p. Transistd. Turret Tuner **£1.50** p.p. 85p.
VARICAP UHF/VHF ELC 2000S **£10.50** p.p. 65p.
UHF/625 Tuners, many different types in stock. Lists available. **UHF** tuners transistd. incl. s/m drive, indicator **£2.85;** Mullard 4 position push button **£2.50,** 6 position push-button **£4.50** p.p. 90p. AE ISOL **30p** p.p. 20p.
TRANSISTORISED 625 IF for T.V., sound, tested. **£6.80** p.p. 65p.
PHILIPS 625 IF Panel incl. CCT **50p** p.p. 65p.
TURRET TUNERS, KB "Featherlight" VC11, Philips 170 series, GEC 2010 **£1.80.** GEC 2018, 2019, 2038, 2039 5 position **£4.20** p.p. 85p.
TBA "Q" I.C.s. 480, 530, 540, **£2.20,** 550, 560C, 920 **£3.20** p.p. 15p.
HELICAL POTS, 100K. 4 for **£1.20** p.p. 20p.
PHILIPS 19TG170 Mains Droppers, two for **90p** p.p. 50p

LINE OUTPUT TRANSFORMERS. New guar. p.p. 85p.

BUSH 145 to 186SS series **£6.95**
BUSH, MURPHY A816 series **£8.50**
DECCA DR1, 2, 3, 121/123, 20/24, MS1700, 2001, 2401 .... **£6.80**
DECCA MS2000, 2400 .... **£5.80**
FERG., HMV, MARCONI, ULTRA 850, 900, 950 Mk. 1 ...... **£7.30**
950II, 1400, 1500, 1590 .... **£5.90**
GEC 2000, 2047 series, etc.......... **£6.80**
INDESIT 20/24EGB **£6.40**
ITT/KB VC2 to 53, 100, 200, 300 **£6.80**
MURPHY 1910 to 2417 series **£6.95**
PHILIPS 19TG121 to 19TG156 . **£4.80**
PHILIPS 19TG170, 210, 300...... **£6.80**
PYE 11U, 368, 169, 769 series..... **£6.80**
PYE 40, 67 series (36 to 55)......... **£3.80**
PAM, INVICTA, EKCO, FERRANTI equivalents as above.
SOBELL 1000 series **£6.80**
STELLA 1043/2149 .... **£6.80**

SPECIAL OFFERS

BUSH TV125 to 139....... **£2.80**
EKCO 380 to 390........... **£1.00**
EKCO 407/417 .... **£1.00**
FERR. 1084/1092 .... **£1.00**
GEC 448/452 .... **£1.50**
KB VC1, VC11 (003) **£2.80**
MURPHY 849 to 939 ..... **£2.80**
REG 10-6, 10-17 etc. **£1.00**
SOBELL 195, 282 to 8.... **£1.50**
MANY OTHERS STILL AVAILABLE

COLOUR LOPTS p.p. £1.00.

BUSH 182 to 1122 etc..... **£9.80**
MURPHY Equivalents.... **£9.80**
DECCA "Bradford" (state Model No. etc) ... **£7.80**
GEC 2028, 2040............. **£9.20**
ITT CVC 5 to 9 .... **£5.80**
PYE 691, 693, 697 .... **£17.80**
THORN 8500................. **£9.80**

THORN 850 Time Base Panel, Dual Standard **50p** p.p. 80p.
MULLARD Scan Coils **Type AT1030** for all standard mono 110° models, Philips, Stella, Pye, Ekco, Ferranti, Invicta **£2.00** p.p. 85p.
THORN 3000, 3500 Tripler **£6.60** p.p.85p. Others available.
6·3V CRT Boost Transformers **£2.90** p.p. 75p., Auto type **£1.80** p.p. 45p.

CALLERS WELCOME AT SHOP PREMISES

THOUSANDS OF ADDITIONAL ITEMS AVAILABLE NOT NORMALLY ADVERTISED

MANOR SUPPLIES

172 WEST END LANE, LONDON, N.W.6.

(Near W. Hampstead tube stn: 28, 59 159 Bus Routes) 01-794 8751

Mail Order: 64 GOLDERS MANOR DRIVE, LONDON N.W.11.

PLEASE ADD 12½% VAT TO PRICES (EXCEPT * 8%)

TELEVISION

June
1978

Vol. 28, No. 8
Issue 332

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

Held over: We regret that due to shortage of space the concluding instalment in our series on the Saba H chassis has had to be held over until next month.

OUR NEXT ISSUE DATED JULY WILL BE PUBLISHED ON JUNE 19

TELEVISION SALE

DISCOUNT FOR QUANTITY

MONO
Rotaries 19" & 23"

	£
GEC	3.00
Thorn 950 etc.	3.00
K.B.	3.00
Pye	3.00
Thorn 1400	4.50

D/S P/B 19" 23"

	£
Thorn 1400	7.00
Bush 161 etc.	7.00
Baird 660 etc.	7.00
Philips 210 etc.	7.00
Pye Olympic etc.	7.00

D/S P/B 20" 24"

	£
Bush	10.00
GEC	10.00
Philips	10.00
Pye	10.00
Thorn	10.00

S/S 20" 24"

	£
Bush 313 etc.	12.00
Pye 169 chassis	12.00
Thorn 1500	12.00
GEC series 1 & 2	12.00
Decca MS series	12.00

S/S COLOUR

	19"	20"	22"	25"	26"
	£	£	£	£	£
GEC	40	45	45	45	50
Philips	–	–	45	45	50
Thorn	60	–	65	65	85
Bush	60	–	65	65	75
Kort	–	–	65	–	75

D/S COLOUR

	19"	25"
	£	£
Decca	20.00	25.00
Bush	20.00	25.00
Baird	20.00	25.00
GEC	20.00	25.00
Philips	–	25.00

PLEASE NOTE THERE IS 12½% V.A.T.

Please note all mono sets sold as 100% comp. No broken masks, no broken panels etc.
Colour sets sold with good c.r.t.s and 100% comp.
Working Mono £3.00 extra.
Working Colour £10.00 extra.
Supplied in 1's or 100's

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**BRIARWOOD T.V. LTD.
LEGRAMS MILLS,
SUMMERVILLE RD., BRADFORD.
TEL: 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	0.17
AC131	0.13
AC141	0.23
AC142	0.19
AC141K	0.29
AC142K	0.29
AC151	0.17
AC165	0.16
AC166	0.16
AC168	0.17
AC176	0.17
AC176K	0.28
AC178	0.16
AC186	0.26
AC187	0.21
AC188	0.20
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	0.23
AF115	0.22
AF116	0.22
AF117	0.22
AF118	0.40
AF121	0.43
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24
AF170	0.25
AF172	0.20
AF178	0.49
AF180	0.60
AF181	0.30
AF186	0.29
AF239	0.43
AU113	1.29
BA130	0.08
BA145	0.14
BA148	0.17
BA155	0.10
BAX13	0.05
BAX16	0.08
BC107	0.12
BC108	0.12
BC109	0.12
BC113	0.12
BC114	0.14
BC115	0.12
BC116	0.12
BC117	0.13
BC119	0.24
BC125	0.15
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	0.09
BC148	0.09
BC149	0.09
BC153	0.12
BC154	0.12
BC157	0.10
BC158	0.11
BC159	0.11
BC160	0.28
BC161	0.28
BC167	0.13
BC168	0.10
BC169C	0.12

TYPE	PRICE £
BC171	0.12
BC172	0.12
BC173	0.15
BC177	0.14
BC178	0.14
BC179	0.14
BC182L	0.08
BC183L	0.07
BC184L	0.11
BC186	0.18
BC187	0.18
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	0.13
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	0.40
BD116	0.47
BD124	1.00
BD131	0.32
BD132	0.34
BD133	0.37
BD135	0.26
BD136	0.26
BD137	0.26
BD138	0.26
BD139	0.40
BD140	0.28
BD144	1.39
BD145	0.30
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	0.23
BF163	0.23
BF164	0.17
BF167	0.23
BF173	0.21
BF177	0.26
BF178	0.24
BF179	0.28
BF180	0.30
BF181	0.34
BF182	0.30
BF183	0.29
BF184	0.23
BF185	0.29
BF186	0.30
BF194	0.09
BF195	0.09
BF196	0.12
BF197	0.10
BF198	0.15
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12
BF222	0.12
BF221	0.21
BF224	0.12
BF256	0.37
BF258	0.27
BF259	0.27

TYPE	PRICE £
BF260	0.24
BF262	0.28
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	0.20
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	1.00
OC26	1.00
OC28	1.00
OC35	1.00
OC36	0.90
OC38	0.90
OC42	0.45
OC44	0.20
OC45	0.20
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

TYPE	PRICE £
1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.30
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
PY88	0.63
PY500A	1.50
PY81/800	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	1.45
TBA530Q	1.20
TBA540Q	1.45
TBA550Q	1.60
TBA560CQ	1.80
TBA570Q	1.00
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

TRANSISTORS, ETC.

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC107	0.48	AU103	2.40	BC192	0.56	BC377	0.29	BD234	0.68
AC117	0.38	AU107	2.75	BC204*	†0.39	BC394	0.39	BD235	0.63
AC126	0.36	AU110	2.40	BC205*	†0.39	BC440	0.52	BD236	0.63
AC127	0.54	AU113	2.60	BC206*	†0.37	BC441	0.59	BD237	0.68
AC128	0.46	BC107*	0.16	BC207*	†0.35	BC461	0.78	BD238	0.68
AC128K	0.55	BC108*	0.15	BC208*	†0.37	BC477	0.30	BD253	1.58
AC141	0.65	BC109*	0.16	BC209*	†0.39	BC478	0.25	BD410	1.65
AC141K	0.70	BC113	†0.22	BC211*	†0.36	BC479	0.33	BD433	0.65
AC142	0.60	BC114	†0.22	BC212*	†0.17	BC547*	†0.13	BD435	0.70
AC142K	0.65	BC115	†0.24	BC212L*	†0.17	BC548*	†0.13	BD436	0.71
AC151	0.31	BC116*	†0.25	BC213*	†0.16	BC549*	†0.15	BD437	0.74
AC152	0.36	BC117	†0.30	BC213L*	†0.16	BC550	†0.24	BD438	0.75
AC153	0.42	BC118	†0.24	BC214*	†0.18	BC556	†0.23	BD519	0.88
AC153K	0.52	BC119	†0.34	BC214L*	†0.18	BC557*	†0.16	BD520	0.88
AC154	0.41	BC125*	†0.30	BC225	†0.42	BC558*	†0.16	BD599	0.87
AC176	0.46	BC126	†0.30	BC237*	†0.16	BC559*	0.17	BD600	1.23
AC178	0.51	BC132	†0.20	BC238*	†0.15	BCY10	0.30	BD663BR	0.86
AC179	0.55	BC134	†0.22	BC239*	†0.22	BCY30A	1.06	BDX18	1.58
AC187	0.56	BC135	†0.21	BC251*	†0.25	BCY32A	1.19	BDX32	2.95
AC187K	0.65	BC136	†0.22	BC252*	†0.26	BCY34A	1.02	BDY16A	0.43
AC188	0.52	BC137	†0.30	BC253*	†0.38	BCY72	0.27	BDY18	1.55
AC188K	0.61	BC138	†0.32	BC261A*	†0.28	BD115	1.35	BDY20	2.20
AC193K	0.70	BC140	0.36	BC262A*	†0.28	BD123	1.50	BDY38	1.38
AC194K	0.74	BC141	0.44	BC263*	†0.26	BD124	1.85	BF115	0.48
ACY17	1.20	BC142	0.35	BC267*	0.20	BD130Y	1.56	BF117	0.45
ACY19	0.95	BC143	0.38	BC268*	0.28	BD131	0.58	BF120	0.55
ACY28	0.98	BC147*	†0.12	BC286	0.40	BD132	0.68	BF121	0.85
ACY39	2.02	BC148*	†0.12	BC287	0.49	BD133	0.70	BF123	0.48
AD140	1.79	BC149*	†0.13	BC291	0.27	BD135	†0.37	BF125	0.55
AD142	1.90	BC152	†0.42	BC294	†0.37	BD136	†0.38	BF127	0.51
AD143	1.78	BC153	†0.38	BC297	0.36	BD137	0.40	BF137F	0.78
AD149	1.92	BC154	†0.41	BC300	0.62	BD138	0.42	BF152	†0.19
AD161	0.68	BC157*	†0.13	BC301	0.38	BD139	0.46	BF158	†0.25
AD161/162	1.22	BC158*	†0.12	BC302	0.86	BD140	0.50	BF159	†0.27
AD162	0.71	BC159*	†0.14	BC303	0.64	BD144	2.24	BF160	†0.20
AF114	0.35	BC160	0.52	BC304	0.44	BD145	0.75	BF161	0.84
AF115	0.35	BC161	†0.58	BC307*	†0.17	BD150A*	†0.41	BF163	†0.65
AF116	0.41	BC167B	†0.15	BC308*	†0.14	BD155	†0.90	BF164	†0.95
AF117	0.42	BC168B	†0.14	BC309*	†0.18	BD157	0.51	BF166	0.50
AF118	0.98	BC169C	†0.15	BC317*	†0.15	BD158	0.75	BF167	0.38
AF121	0.68	BC170*	†0.15	BC318*	†0.15	BD159	0.68	BF173	0.35
AF124	0.38	BC171*	†0.15	BC319*	†0.19	BD160	2.69	BF177	0.36
AF125	0.38	BC172*	†0.14	BC320	†0.17	BD163	0.67	BF178	0.46
AF126	0.36	BC173*	†0.22	BC321A&B	†0.18	BD165	0.66	BF179	0.58
AF127	0.86	BC174A & B		BC322	†0.28	BD166	0.88	BF180	0.53
AF139	0.58		†0.26	BC323	1.15	BD175	0.90	BF181	0.53
AF147	0.52	BC176	0.22	BC327	†0.16	BD177	0.58	BF182	0.44
AF149	0.45	BC177*	0.20	BC328	†0.18	BD178	0.92	BF183	0.52
AF178	1.35	BC178*	0.22	BC337	†0.17	BD181	1.94	BF184	0.44
AF179	1.36	BC179*	0.28	BC338	†0.17	BD182	2.10	BF185	0.42
AF180	1.35	BC182*	†0.15	BC340	0.19	BD183	1.34	BF186	0.42
AF181	1.33	BC182L*	†0.15	BC347*	†0.17	BD184	2.30	BF194*	†0.14
AF186	1.48	BC183*	†0.14	BC348A & B		BD187	1.20	BF195*	†0.13
AF202	0.27	BC183L*	†0.14		†0.17	BD188	1.25	BF196	†0.14
AF239	0.73	BC184*	†0.15	BC349B	†0.17	BD189	0.71	BF197	†0.15
AF240	1.40	BC184L*	†0.15	BC350*	†0.24	BD222	0.78	BF198	†0.29
AF279S	0.91	BC185	0.36	BC351*	†0.22	BD225	0.91	BF199	†0.29
AL100	1.30	BC186	0.25	BC352A*	†0.24	BD232	0.91	BF200	†0.25
AL103	1.52	BC187	0.27	BC360	0.59	BD233	0.62	BF218	†0.42

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
BF222	†0.51	BPX29	1.62	MPSU05	0.66	ZTX500	†0.18	2N3819	†0.47
BF224 & J	†0.22	BR101	0.53	MPSU06	0.76	ZTX502	†0.22	2N3820	†0.72
BF240	†0.32	BR103	0.64	MPSU55	1.26	ZTX504	†0.28	2N3866	1.08
BF241	†0.31	BR303	1.06	MPSU56	1.32	2N404	1.30	2N3904	†0.20
BF244*	†0.51	BRC4443	0.96	MPSU60	0.82	2N696	0.46	2N3905	†0.20
BF245*	†0.43	BRY39	0.65	MPU131	†0.59	2N697	0.46	2N3906	†0.20
BF254	†0.48	BRY56	†0.44	OC26	1.90	2N706A	0.33	2N4036	0.94
BF255	†0.58	BSS27	0.92	OC28	1.49	2N708	0.29	2N4123	†0.17
BF256L*	†0.49	BT106	1.50	OC29	1.60	2N914	0.32	2N4124	†0.17
BF257	†0.47	BT109	1.99	OC35	1.25	2N916	0.46	2N4126	†0.17
BF258	†0.52	BT116	1.45	OC36	1.25	2N918	0.54	2N4236	2.20
BF259	†0.54	BT119	5.18	OC42	0.90	2N930	0.29	2N4289	†0.32
BF262	0.73	BU102	2.85	OC44	0.68	2N1164	8.29	2N4292	†0.32
BF263	0.88	BU105	†1.80	OC45	0.63	2N1304	1.40	2N4416	0.85
BF270	0.47	BU105/02	†1.95	OC70	0.65	2N1305	1.29	2N4444	1.90
BF271	0.42	BU108	†2.98	OC71	0.73	2N1306	1.49	2N4921	0.80
BF272A	0.80	BU126	†2.91	OC72	0.73	2N1307	1.32	2N5042	1.65
BF273	†0.33	BU204	†2.50	OC81	0.83	2N1308	1.53	2N5060	†0.28
BF274	†0.34	BU205	†2.78	OC81D	0.95	2N1711	0.47	2N5061	†0.30
BF336	0.63	BU206	†3.09	OC139	1.30	2N1893	0.52	2N5064	†0.63
BF337	0.65	BU208	†4.88	OC140	1.35	2N2102	0.71	2N5086	†0.49
BF338	0.68	BU407	†1.38	OC170	0.80	2N2217	0.55	2N5087	†0.50
BF355	†0.72	BUY77	2.50	OC171	0.82	2N2218	0.38	2N5208	†0.59
BF362	†0.49	C106D	0.80	OC200	3.90	2N2219	0.42	2N5294	0.66
BF363	†0.49	C106F	0.40	OC201	3.95	2N2221A	0.26	2N5296	0.68
BF367	†0.29	C111E	†0.46	OC202	2.40	2N2222A	0.41	2N5298	0.71
BF451	0.43	D40N1	0.64	OC205	3.95	2N2369A	0.40	2N5322	1.16
BF457	0.46	E1222	0.47	OCP71	1.98	2N2401	0.80	2N5449	†0.18
BF458	0.49	E5024	†0.19	ON236A	0.94	2N2484	0.35	2N5457	†0.46
BF459	0.52	GET872	0.46	R2008B	†2.62	2N2570	0.74	2N5458	†0.40
BF594	†0.16	MC140	†0.36	R2010B	†2.79	2N2646	0.82	2N5459	†0.58
BF596	†0.17	ME0402	†0.18	R2322	†0.75	2N2784	1.15	2N5494	0.85
BF597	†0.27	ME0404	†0.18	R2323	†0.85	2N2869	2.08	2N5496	1.05
BFR39	†0.39	ME6001	†0.18	ST2110	0.49	2N2894	0.45	2N6027	0.55
BFR40	†0.29	ME6002	†0.18	ST6120	0.46	2N2904*	0.40	2N6107	0.71
BFR41	†0.30	MJ2955	1.30	TIC44	†0.25	2N2905*	0.43	2N6122	0.60
BFR50	†0.29	MJ3000	1.68	TIC46	†0.35	2N2906*	0.36	2N6178	1.07
BFR52	†0.33	MJE340	0.68	TIC47	†0.45	2N2926G	†0.15	2N6180	1.39
BFR61	†0.29	MJE341	0.72	TIP29A	0.47	2N2926O	†0.14	2N6211	2.74
BFR62	†0.28	MJE370	0.74	TIP30A	0.50	2N2926Y	†0.14	2SB337BP	4.28
BFR79	†0.30	MJE371	0.79	TIP31A	0.51	2N2955	1.12	2SC458C	0.78
BFR80	†0.29	MJE520	0.85	TIP31C	0.67	2N3053	0.48	2SC643A	2.25
BFR81	†0.30	MJE521	0.95	TIP32A	0.56	2N3054	0.86	2SC930D	1.50
BFR88	†0.42	MJE2955	1.20	TIP32C	0.72	2N3055	0.72	2SC1061	1.45
BFT41	0.48	MJE3000	1.95	TIP33A	0.77	2N3250	0.52	2SC1172Y	3.55
BFT43	0.55	MJE3055	1.22	TIP34A	0.84	2N3254	0.58	2SD234	1.48
BFW11	1.02	MPF102	†0.40	TIP41A	0.72	2N3391A	0.38	3N128	1.60
BFW30	2.58	MPS3702	†0.33	TIP42A	0.80	2N3633	12.70	40250	0.98
BFW59	†0.19	MPS3705	†0.30	TIP2955	0.77	2N3703	†0.17	40251	1.14
BFW60	†0.20	MPS6521	†0.36	TIP3055	0.58	2N3704	†0.19	40327	0.67
BFW90	†.65	MPS6523	†0.36	TIS43	†0.44	2N3705	†0.17	40361	0.48
BFX29	0.38	MPS6566	†0.44	TIS73	†1.36	2N3706	†0.16	40362	0.50
BFX84	0.42	MPSA05	†0.30	TIS90	†0.23	2N3707	†0.18	40410	0.94
BFY50	0.38	MPSA06	†0.32	TIS91	†0.28	2N3708	†0.17	40429	0.88
BFY51	0.37	MPSA55	†0.43	ZTX108	†0.14	2N3715	1.70	40530	0.79
BFY52	0.36	MPSA56	†0.45	ZTX109	†0.16	2N3771	2.39	40595	1.39
BFY53	0.36	MPSA93	†0.56	ZTX213	†0.20	2N3772	2.58	40603	1.13
BFY90	1.98	MPSL01	†0.33	ZTX300	†0.16	2N3773	3.90	40636	1.25
BPX25	1.62	MPSU01	0.61	ZTX304	†0.26	2N3794	†0.40	40654	0.89

Alternative gain versions available on items marked*.

For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)	Type	Price (£)	Type	Price (£)
BRC1330	†0.93	SN76008KE	1.56	TBA240A	†3.98
CA810QM	2.44	SN76013N	1.56	TBA281	†2.07
CA3005	1.85	SN76013ND	1.40	TBA395*	†2.58
CA3012	1.45	SN76018KE	1.56	TBA396	†2.40
CA3014	2.23	SN76023N	1.56	TBA400	†2.20
CA3018	0.71	SN76023ND	1.40	TBA480Q	†1.84
CA3020	1.89	SN76033N	2.22	TBA500*	†2.21
CA3028A	0.80	SN76110N	1.20	TBA510*	†2.21
CA3028B	1.09	SN76115N	1.62	TBA520P*	†3.40
CA3045	3.75	SN76116N	1.78	TBA530*	†2.24
CA3046	0.70	SN76131N	1.32	TBA540*	†2.88
CA3065	†1.74	SN76226N	†2.00	TBA550*	†3.13
CA3068	1.90	SN70227N	†1.61	TBA560C*	†3.18
CA3130S	1.57	SN76228N	1.80	TBA570*	†1.29
FCH161	†2.40	SN76502N	†1.92	TBA611B	2.68
FCJ101	†3.32	SN76530P	†0.97	TBA641	2.55
LM309K	1.98	SN76533N	†1.36	TBA641A12	2.55
LM380N	1.30	SN76544N	†1.85	TBA641B11	2.90
LM1303N	3.08	SN76546N	†1.85	TBA651	†2.42
MC1307P	†1.82	SN76570N	†1.81	TBA673	†2.19
MC1310P*	†1.94	SN76620AN		TBA700*	†2.50
MC1312P	2.34		†0.99	TBA720AQ	†2.38
MC1327P*	†1.86	SN76650N	†1.48	TBA720Q	†2.38
MC1330P	†0.93	SN76660N	†0.64	TBA750*	†2.18
MC1350P	†1.22	SN76666N	†0.96	TBA800	2.05
MC1351P	†1.42	TA7073P	†3.51	TBA810AS	2.00
MC1352P	†1.42	TAA263	†2.20	TBA920*	†3.80
MC1357P	†2.92	TAA300	†2.20	TBA940	†3.52
MC1358P*	†2.30	TAA320	1.10	TBA950	†2.78
MC1458G	1.43	TAA350A	†2.48	TBA990*	†2.90
MC1496L	1.15	TAA370A	3.18	TCA270A*	†3.55
MC3051P	0.58	TAA435	†1.70	TCA280A	1.43
MFC4008	0.85	TAA450	†3.39	TCA290A	3.46
MFC4060A	0.98	TAA521	1.10	TCA420A	1.98
MFC6040	1.11	TAA522	2.09	TCA440	1.67
MIC1P	2.58	TAA550	0.45	TCA640	2.76
ML231	†3.57	TAA560	1.93	TCA650	2.76
ML232	†3.57	TAA570	†2.30	TCA660	2.76
NE555	0.72	TAA611A	1.20	TCA730	3.54
NE556	1.34	TAA611B	1.85	TCA740	3.04
NE566	1.95	TAA621AXI	2.43	TCA750	2.53
SAA1024	†5.70	TAA630Q	3.91	TCA760	1.52
SAA1025	†10.35	TAA630S	4.18	TCA820	3.29
SAS560	†2.01	TAA661A	1.75	TDA440	†4.36
SAS570	†2.01	TAA661B	1.75	TDA1003	1.52
SC9503P	†1.40	TAA700*	†2.80	TDA1004	2.73
SC9504P	†1.38	TAA840	†3.38	TDA1005	3.04
SL414A	1.91	TAA861A	0.95	TDA1022	6.89
SL432A	2.52	TAA930A	1.43	TDA1024	0.97
SL450	5.10	TAA930B	1.43	TDA1034	1.98
SL901B	†4.20	TAA960	†2.25	TDA2610	2.86
SL917B	†5.60	TAA970	†2.48	TDA2640	2.86
SL918A	†4.95	TAD100	†2.66	ZN414	1.45
SN72440N	†2.21	(Filter)	0.98		
SN76001N	†1.67	TBA120A	†0.90		
SN76003N	2.22	TBA120S*	†0.99		
		TBA120SA	†1.02		
		TBA231	1.32		

* Indicates Q version is also available.

DIODES

Type	Price (£)	Type	Price (£)
AA133	0.17	BY114	0.60
AA119	0.21	BY118	1.10
AA129	0.28	BY126	0.30
AA143	0.18	BY127	0.34
AAY30	0.16	BY133	0.35
AAZ13	0.30	BY140	1.40
AAZ15	0.32	BY164	0.82
AAZ17	0.26	BY176	2.80
AY102	2.55	BY179	0.91
BA100	0.24	BY182	1.14
BA102	0.28	BY184	0.39
BA110	0.80	BY189	5.30
BA111	0.70	BY190	4.90
BA115	0.15	BY206	0.26
BA116	0.38	BY238	0.25
BA121	0.85	BYX10	0.31
BA129	0.39	BYX38/600	0.70
BA145	0.19	BYX70/500	0.63
BA148	0.19	FSY41A	0.51
BA154	0.19	ITT44	0.08
BA155	0.16	ITT210	0.63
BA156	0.15	ITT827	0.80
BA157	0.25	MCR101	0.43
BA158	0.28	MR854	1.10
BA159	0.40	OA5	0.88
BA164	0.14	OA10	0.58
BA170	0.18	OA47	0.20
BA182	0.24	OA81	0.19
BA201	0.13	OA90	0.13
BA202	0.14	OA91	0.15
BA203	0.14	OA95	0.20
BA216	0.08	OA200	0.11
BA219	0.11	OA202	0.13
BA243	0.45	OA210	0.89
BA317	0.06	TIL209	0.14
BA318	0.07	TIL211	0.18
BAV10	0.12	TV2C	2.25
BAV21	0.18	IN914	0.06
BAW62	0.06	IN916	0.09
BAX13	0.07	IN4001	0.06
BAX16	0.09	IN4002	0.07
BAX17	0.20	IN4003	0.08
BAY72	0.16	IN4004	0.08
BB104B	0.52	IN4005	0.09
BB105B	0.33	IN4006	0.10
BB105G	0.30	IN4007	0.12
BR100	0.40	IN5400	0.15
BY100	0.35	IN5401	0.17
BY103	0.35	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
75W 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	0.65

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	0.68
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%) (†)

	Ea	10 of one value	50pc	100pc	500pc
			Mixes of a minimum of 10pcs of any value:		
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.40	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.40	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.80	£6.40	£26.90

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, 66, 87, 100, 120, 180, 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, 1.25, 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

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AMPLIFIERS (†)

CM6001/PU	Power unit for those marked* below	£9.42
CM6017	Set-back, battery op., single u.h.f. group	£9.21
CM6019/WB	Masthead, wideband u.h.f., with companion CM6020 power unit	£14.69
CM6030/WB*	Masthead, ultra wideband ch. 1-68	£17.88
CM6040/WB*	Masthead, wideband u.h.f.	£17.88
CM6051*	Masthead pre-amp, single group u.h.f.	£9.42

Please state which group required, if appropriate.

CAPACITORS

Metallised Paper (†)

2n2F	1500V DC	60p	10nF	500V AC	80p
2n2F	600V AC	24p	15nF	300V AC	30p
3n6F	1700V DC	60p	22nF	300V AC	32p
4n7F	1500V DC	60p	100nF	1000V DC	20p
10nF	1000V DC	22p	470nF	1000V DC	60p

Reversible Electrolytics (†)

33V	6μF	42p	50V	25μF	53p
50V	4μF	30p		32μF	55p
	6μF	30p		50μF	58p
	8μF	34p	150V	4μF	60p
	12μF	36p	250V	1μF	63p
	16μF	38p		2μ2F	86p

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Spindles for above 5p each

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

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TELEVISION

Only a couple of months ago in commenting on the "rationalisation" envisaged for the UK TV industry we pointed out that this would mean "someone, somewhere closing down". We didn't think that this would come to a head quite as soon as it has however. In the event, Thorn have announced the closure of two of their four TV plants – the two at Bradford – and have also announced that during the next three years a further 1,000 jobs in their other plants will go, making a total loss of jobs of some 3,200. Thorn are not alone in taking action, but since they are the largest TV setmaker in the UK it's instructive to consider their position.

Initially we were surprised by the announcement from Thorn. After all, their massive stake in the rental side has provided them with a sort of cushion that's enabled them to ride most of the various stop/go economic cycles relatively comfortably. But there's more to it than the present 40 per cent excess capacity in the industry. The future has to be considered, if there's to be one. In particular, investment decisions have to be made and can't be adjourned while our Japanese and continental competitors are making and implementing theirs.

The whole process of setmaking seems to be undergoing a radical change. The slaphappy procedures of five years ago now seem like something from a different age. But cast your mind back a little farther, say ten years ago. The tradition was that the retailer, who then had a reasonable mark up, was responsible for the final checks on a set and its final adjustment. The same was true of other industries: with cars you didn't bother too much about minor faults on a new car – they'd be put right (hopefully) when the famous first free service was done.

This easy-going approach to whether a thing did or didn't work properly continued into the epic 1972/3 boom. Then it was a matter of getting every set out of the factory almost regardless. You blame the setmaker? Anyone who recalls the angry – almost apoplectic – letters from dealers in the trade magazines at that time will hardly do so. The public wanted sets, the dealers wanted sets to sell, and setmakers did their best to turn them out.

Meanwhile in another part of the world others were building up production of TV sets (amongst other things). Now if you produce a basic chassis that's going to be sold in almost every country in the world several things are necessary. It's got to work straight out of the carton – the man in Bristol or Barcelona is not going to phone Kyoto to find out why not! That means thorough soak testing and factory presetting. And if a chassis might find itself in almost any market (with the appropriate tuner, decoder and a few power supply modifications) you might as well make it so that it complies with all known consumer/safety legislation. The end result is a highly reliable product, as we all know. And that's the one Thorn, Decca, GEC and so on are having to compete with.

Set testing, with cyclical soak test lines, plus factory setting up have been a feature of UK TV set production for some time. But it's one thing to test panels and sets after they're assembled, another to test everything *before* assembly. The latter goes hand in hand with automatic component insertion and is all part of the revolution in production techniques being undertaken at present in order to produce internationally competitive, reliable sets. But it costs a lot of money, and it loses jobs.

Thorn have embarked on a heavy investment programme because of the need to produce sets with optimum reliability, cut unit costs, and because of changes in receiver design (fewer components in the basic chassis). But this investment programme has occurred at a time when there is exess existing capacity, and when complete the result will be increased plant output. Inevitably this means that fewer plants will be required even if market conditions improve.

The only people who can be blamed to any extent for this unfortunate state of affairs are those who have mismanaged the UK's economy over the years, making it impossible for firms to plan their investment and evolve in an orderly way. A more stable economic climate would have enabled changes to be phased in gradually. Instead, all too often things have had to be left until some sort of crisis arises. There are few industries one can think of where this has not been the case at one time or another.

Coinciding with the shocks from Thorn came Decca's announcement of the closure of its Willenhall TV production line, reducing Decca's colour set manufacturing capacity by a third with production concentrated at Bridgnorth. Hitachi are understood to be having talks with GEC with a view to acquiring the Hirwaun plant, while Toshiba are negotiating with Rank over the possibility of joint production at Plymouth. The way we read this, it would appear that after the long period of loss making in the UK's TV industry foreign investment is the only way of ensuring the survival of these plants.

All in all it seems that things have been brought to a head. One can only hope that adequate investment funds will be available to ensure that a leaner industry will be producing the advanced technology, reliability assured sets necessary in the highly competitive climate of today's world TV market. How much of the industry will remain UK owned and financed remains to be seen.

CK CABINET SERVICES

The above firm has informed us that it is no longer able to accept new orders for the cabinet kits for the Television monochrome portable. Full constructional details of the cabinet were given in our January 1978 issue.

Teletopics

SONY LAUNCH BETAMAX IN THE UK

The pace of the VCR battle in the UK seems to be hotting up. Last month came the announcement of the JVC VHS machine and of the increase in the playing time possible with the Philips N1700. This month comes the announcement that the Sony Betamax machine is now available for use with the UK TV standard, with no less a person than Akio Morita, Sony's chairman and co-founder, addressing the official launch of the machine at the Grosvenor House Hotel. It's also been announced that the Akai VCR, which uses the VHS system, will be available in the UK later this year. One catches a whiff of the battles that have been going on in the US for the last year or so as the Japanese contestants now transfer their attention to the European market. No one believes that the market, especially in the UK, is all that great, at least for the foreseeable future. But whoever manages to get their system established as the standard one will dominate the field indefinitely. At present, the Philips, VHS and Betamax systems are incompatible. A growing list of firms have made agreements to market VHS machines, including National Panasonic, Hitachi, JVC, Akai, Mitsubishi, Sharp, RCA, Sylvania, General Electric, Thomson-Brandt and Nordmende. Thorn is understood to be having talks. Firms which have agreed to market Betamax machines include Zenith, Toshiba, Sanyo, Pioneer and Aiwa.

Sony's UK Betamax machine is the SL8000UB, the latest in a series of Betamax VCRs which have been sold in the US and Japan since 1975. Over half a million have been sold to date. It's expected that the SL8000UB will retail at around £750 including VAT, with tapes ranging from £6.98 for half an hour to £13.50 for three hours fifteen minutes. Obtaining over three hours' playing time from the compact cassette is achieved by means of the Sony developed slanted-head system. This prevents interference between adjacent tracks – a detailed account of how the technique is used in the Philips machine appeared in our April issue. Sony's cassette is said to be the smallest, containing 750ft. of ½in. tape in the longest playing version (L750). Another Sony developed feature is the U-loading method.

The Betamax VCR incorporates a tuner unit and a time switch which can be preset up to three days in advance to give recording times of 15, 30, 45, 60, 75, 90 or 105 minutes or to the end of the tape. The machine can also be used in conjunction with a camera and microphone, while 8 or 16mm film can be easily transferred to the cassette. The output is at u.h.f., and the VCR provides a test pattern to assist in tuning the set to the VCR output.

The tape speed is 18·73mm/sec, the horizontal resolution greater than 270 lines, in colour, and the signal/noise ratio greater than 42dB.

A pause/still picture facility is available on both the machine and a remote control unit which is supplied as standard. This enables the viewer to edit unwanted material when recording and provides a still picture during playback. The pause can last up to three minutes but is then automatically cancelled to avoid damage to the tape and the heads.

Sony claim a basic head life of 1,000 hours, but say that in practice the life is much greater. The tape is produced by Sony and is of the chromium dioxide type.

TRANSMITTER OPENINGS

The following relay transmitters are now in operation:

Dover Town ITV (Southern Television) channel 23. Receiving aerial group A.

Hunmanby (North Yorkshire) BBC-1 channel 40, ITV (Yorkshire Television) channel 43, BBC-2 channel 46. Receiving aerial group B.

Nailsworth (Gloucestershire) ITV (HTV West) channel 23, BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.

Tarbert (Loch Fyne) BBC-1 (Scotland) channel 21, ITV (Scottish Television) channel 24, BBC-2 channel 27. Receiving aerial group A.

All these transmissions are vertically polarised.

REBUILT TUBES GET BSI APPROVAL

Whilst new TV tubes have for many years been built to an international specification (IEC65) to meet safety requirements, this situation has not applied to date to rebuilt tubes. The British Standards Institution has now prepared, in conjunction with the Electronic Components Industry Federation, a scheme which lays down a method to ensure that reprocessed tubes meet intrinsic safety and mechanical strength requirements. Rebuilt tubes in the Mullard Colourex range and Thorn New Life range are the first to have been awarded the new BSI certificate of approval.

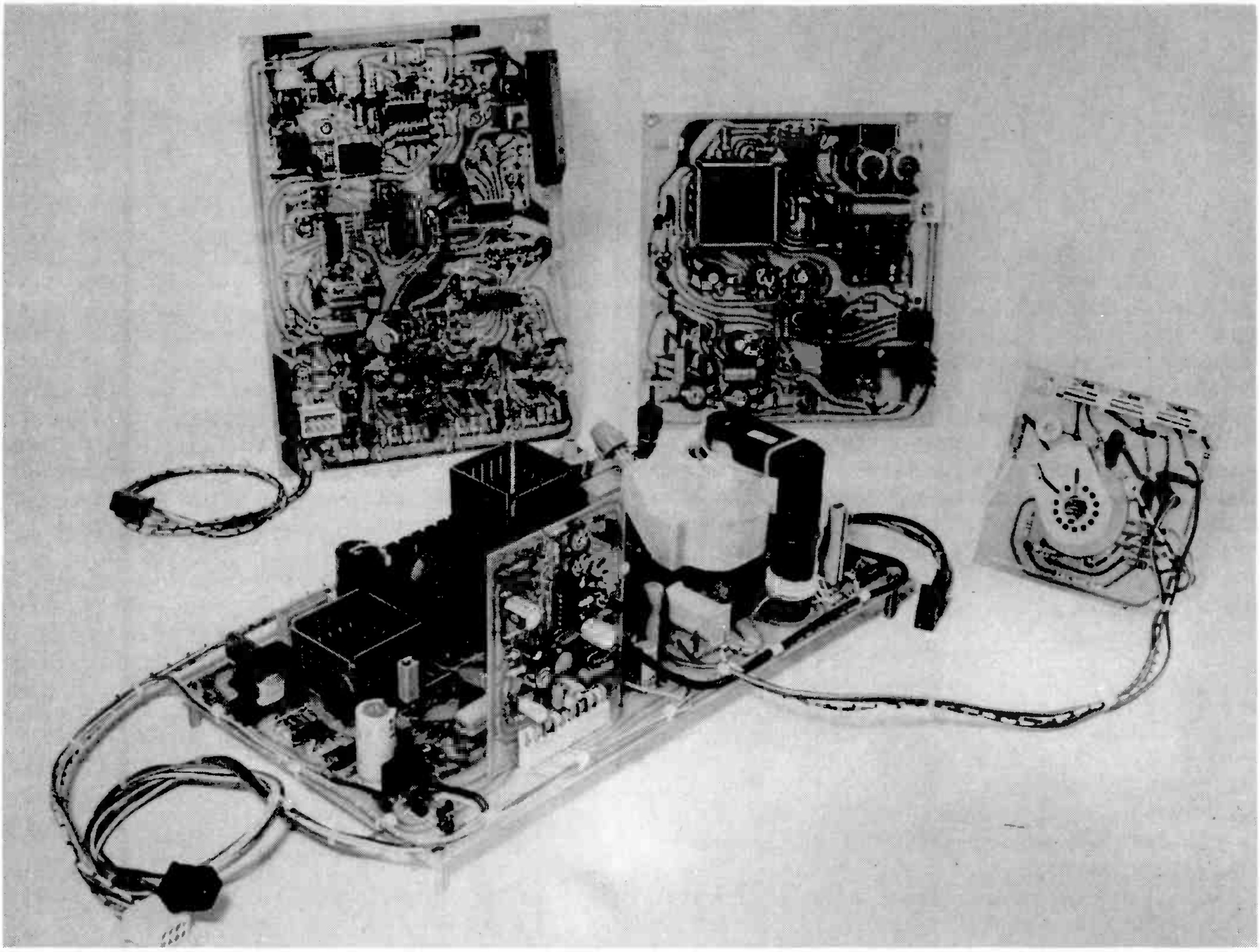
MARCONI INTRODUCE NEW COLOUR CAMERA SYSTEM

Marconi have introduced an entirely new colour camera system, their Mark IX. There are two basic cameras, with a common control unit and a host of optional facilities to meet all known broadcaster requirements. Both cameras are suitable for either studio or outside broadcast use, and are capable of fully automatic or manual operation. Power consumption is so low that battery operation for long periods is possible and, used with triax cables, excellent pictures can be produced nearly a mile from the control unit. The power consumption figures quoted are 350W for the studio version of the system and 250W for the portable version. The Mk. IX family is announced as a natural development from the Mk. VIII, of which 500 are in use in thirty countries throughout the world.

FORGESTONE'S 20AX COLOUR RECEIVER KIT

Forgestone Colour Developments have introduced a new colour receiver kit, Model 500, designed around the Mullard 20AX in-line gun c.r.t. Choice of this tube was dictated by the basic receiver design concept, giving high performance, reliability, ease of construction and setting up and a system that was suitable for export to all countries using the PAL system.

The chassis uses up-to-date techniques and devices



The Forgestone 500 20AX colour receiver kit. Foreground, power supply/line timebase panel and c.r.t. base panel. Rear left the decoder panel and right the field timebase and EW correction panel.

throughout. There's a switch-mode power supply employing the TDA2581 i.c. as the control device. This enables the line drive to be taken directly from the switch-mode output transformer. The various protection circuits for over-voltage, excess current, beam limiting etc. are all associated with this control i.c. A single BU208 line output transistor drives a diode-split line output transformer to provide the e.h.t., and the class D field output stages uses the TDA2600 i.c. on an ample heatsink. A novel regulation circuit is used to keep the picture size constant with changes of beam current. The rest of the receiver consists of a high-performance four-chip decoder driving class B RGB output stages, with a choice of i.f.s and tuners for various world markets.

The total consumption of the receiver is just over 100W. A full l.s.i. teletext kit for use with the receiver will also be available, and this kit is also being offered now for use with the previous 400 chassis.

HOLOGRAPHY

We haven't had much to say on holography, a method of obtaining three-dimensional displays, since we published a feature on the subject in our January 1971 issue. It seems that ways of exploiting the technique for consumer electronics products are proving hard to find. Problems include the fact that colour holograms have not been perfected, while in general holograms cannot incorporate movement. An interesting development is described in the latest issue of *Video* however, the intergram or multiplex hologram. This is not a true hologram, since it possesses either vertical or horizontal parallax but not both. There are advantages however: intergrams can be viewed using ordinary white light instead of laser light, they can incorporate movement, and any number of copies can be made from a master by using simple optical processing.

COLOUR PICTURE IMPROVEMENT

The conventional approach to colour receiver decoding gives good enough results but is nevertheless a compromise. The main problem arises because of the need to transmit the chrominance information within the luminance signal bandwidth. The method of separating these signals used in all commercial receivers is to incorporate a sharp notch filter at the colour subcarrier frequency in the luminance channel and bandpass filtering in the chrominance channel. This doesn't give complete separation of course, while the luminance response is impaired with loss of definition. A more sophisticated way of separating the signals is to use a comb filter – in the same way as the U and V chrominance signals are separated by the delay line/matrix network. This is not difficult to do with the NTSC colour system, but presents problems with the PAL system due to the V signal phase alternations and the more complex relationship between the colour subcarrier and the line frequencies. An interesting practical solution to the problem is presented in the December 1977 issue of *BBC Engineering*.

Transistors in TV Circuits

Part 2

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

PART 1 of this series enumerated the principal properties of bipolar and field-effect transistors. This and subsequent parts describe typical applications of transistors in television receivers. The examples chosen are taken from manufacturers' circuit diagrams and are usually simplified to emphasise the fundamental nature of the circuit. For each example the particular transistor properties that are exploited to achieve the desired performance are made clear. As a rough and ready classification the circuits are arranged in order of frequency: this part is devoted to circuits used at zero frequency, field frequency and audio frequencies.

Series Regulator Circuit

Portable television receivers are designed to operate from batteries (usually 12V car batteries) and from the a.c. mains. The receiver usually has an 11V supply line, and circuitry is required to ensure that the supply line is at this voltage whether the power source is a battery or the mains. The supply line also needs to have good regulation, i.e. a low output resistance, to ensure that the voltage remains constant in spite of variations in the mean current taken by some of the stages in the receiver.

Fig. 1 shows a typical circuit of the power-supply arrangements. The mains transformer and bridge rectifier are designed to deliver about 16V. The battery can be assumed to give just over 12V. Both feed the regulator circuit Tr1, Tr2, Tr3, which gives an 11V output and can be regarded as a three-stage direct-coupled amplifier.

The first stage Tr1 is required to give an output current proportional to the difference between two voltages, one being a constant voltage derived from the voltage-reference diode D1 (which is biased via R3 from the stabilised supply). The second voltage is obtained from a preset potential divider connected across the output of the unit, and is therefore a sample of the output voltage. In effect therefore Tr1 compares the output voltage of the unit with a fixed voltage and gives an output current proportional to the difference between them. Clearly a field-effect transistor could do this, but the low input resistance of a bipolar transistor is no disadvantage and it can give a current

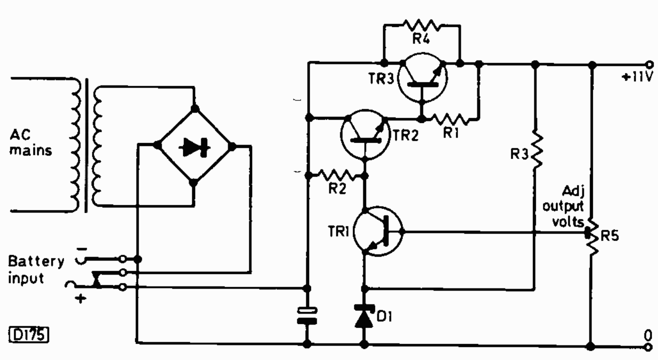


Fig. 1: Typical power supply circuit for a portable mains/battery TV receiver, incorporating a series regulator circuit to provide a stabilised 11V rail. R4 enables the circuit to start up, and shares the dissipation with the series-regulator transistor TR3.

output many times that of a field-effect transistor and is generally preferred therefore.

The output current of the first stage is amplified by the two subsequent stages and then becomes the output current of the unit. Clearly therefore Tr2 and Tr3 should be current amplifiers and they normally take the form of emitter-followers or common-emitter stages (which have the same current gain). By adjusting the preset control we can alter the fraction of the output voltage applied to the first stage and can thus set the output voltage of the unit at any desired value within a certain range.

By making assumptions about the current gain of the transistors we can calculate the degree of regulation obtainable. For example, suppose the gain of Tr2 and Tr3 in cascade is 1,000, and that the current output demanded from the unit changes by 0·1A (for example due to the disconnection of part of the load). The corresponding change in Tr1's collector current is 0·1mA and, if the standing collector current of Tr1 is 1mA, then its mutual conductance is approximately 40mA/V and the base voltage must change by 2·5mV to bring about the required change in collector current. If the preset potential divider feeds one half of the output voltage to Tr1's base, then the change in output voltage must be 5mV. Thus an 0·1A change in output current brings about only 5mV change in output voltage: this represents an output resistance of only 0·05Ω.

Field Sawtooth Generator

In some television receivers an astable multivibrator is used to generate the sawtooth signal required for vertical deflection. A multivibrator is fundamentally a generator of rectangular current pulses, but these can be used to discharge the capacitor in an *RC* charging circuit, thereby generating an approximately sawtooth voltage. In essentials a multivibrator consists of two switching devices so interconnected that when one is 'on' the other is 'off'. Transistors are particularly well suited for use in multivibrators because of their well-defined 'on' and 'off' states: that's to say, when they are fully conductive they are a good approximation to a short-circuit and when they are 'off' they are a good approximation to an open-circuit.

Fig. 2 shows the circuit of an astable multivibrator used as a field oscillator. Tr1 and Tr2 are arranged as common-emitter amplifiers, and each collector is connected to the other base. This cross-coupling ensures that one transistor is 'on' when the other is 'off', and also provides the positive feedback which makes the changes of state very rapid.

When Tr1 is cut off by a negative-going field sync pulse applied to its base via D1, the abrupt rise in collector voltage is transferred by C1 to Tr2 base so driving Tr2 into conduction and discharging C2. The collapse of voltage across C2 provides the flyback period in the sawtooth output. Tr2 is held conductive by the current charging C1, which flows via R1 and the base-emitter junction of Tr2. As C1 charges, the charging current falls and a point is reached when Tr2's collector current begins to fall and the collector potential starts to rise. This rise is communicated to Tr1's

base by R5, and as soon as Tr1 begins to conduct there is a change of state, hastened by the regeneration characteristic of multivibrators. This ends with Tr1 conductive and Tr2 cut off.

The period during which Tr2 is conductive is determined primarily by the time-constant R1C1, and this is chosen to be long enough for Tr2 to discharge C2 completely. There is now a period of relaxation whilst C1 discharges through R3 and R4. During this period C2 charges via R7 and R8 to provide the forward stroke of the sawtooth output. The duration of the relaxation period depends on the time-constant (R3 + R4)C1 and on the voltage to which R3 is returned (this depends on the ratio of R2 to R1). By varying this time-constant, the free-running period can be adjusted. It's normally set by R3 to a value just greater than 20ms so that the sync pulses terminate the period of conduction of Tr1 earlier than would occur normally. R3 is thus the "field hold" control.

R7 determines the charging current which flows into C2 and hence the rate at which the voltage across C2 builds up: it thus controls the amplitude of the generated sawtooth and so is labelled "picture height". Diode D2 is cut off except when Tr2 is 'on', thus isolating R7, R8 and C2 from the multivibrator during the charging process.

Field Amplifier

The output from the field oscillator needs amplification to enable adequate current to be driven through the field scan coils. At the field frequency of 50Hz the scan coils are predominantly resistive: thus the voltage across them must also be of sawtooth waveform. The problem of driving the field scan coils has much in common with that of driving the speech coil of a loudspeaker, and very similar circuits can be used for both purposes. This is hardly surprising, because a field amplifier must amplify a wealth of harmonics in addition to the fundamental 50Hz component in order to preserve the linearity of the waveform. The frequency range of a field amplifier does not therefore differ greatly from that of an audio amplifier.

Appreciable power is needed to drive the field scan coils. Thus a natural choice for the output stage consists of bipolar transistors operating in the common-emitter mode, since this is the only circuit arrangement which gives appreciable current and voltage gain. It helps too if the output stage consists of two transistors in push-pull, because the bias can be adjusted to give class B operation, resulting in a highly efficient and therefore economical stage. The transistors can be connected as a single-ended push-pull stage as shown in the simplified circuit diagram shown in Fig. 3.

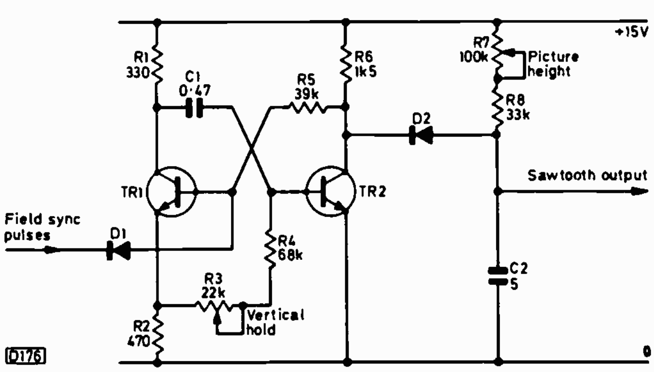


Fig. 2: An astable multivibrator used as a field oscillator. The charging capacitor C2 is discharged when TR2 switches on, giving the flyback action.

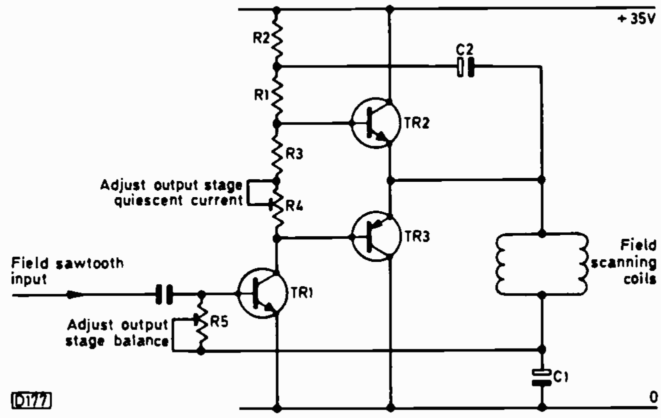


Fig. 3: Field driver and class B output stage, simplified by the omission of the linearity feedback network.

The bases of the push-pull pair Tr2 and Tr3 are driven in phase by the driver stage Tr1, but because Tr2 and Tr3 are complementary types they operate automatically in push-pull. If the transistors are biased to operate in class B, each amplifies one half of the sawtooth waveform whilst the other is cut off.

Because Tr2 and Tr3 emitters are commoned and feed the scanning coils (via C1) it might appear that the output pair are emitter-followers. If this were so the driver stage would need to deliver a very large voltage swing to the bases to obtain the required output power, the voltage gain of an emitter-follower being less than unity. It would perhaps be more accurate to say that the high input resistance of emitter-follower stages would require the driver stage to generate a large voltage swing (peak-to-peak value almost equal to the supply voltage) to drive adequate input current into the output stage.

To obtain the lower input resistance available from common-emitter stages (and so enable the driver stage to function as a true current amplifier) the signal generated across Tr1's collector load resistor R1 must be applied between the bases and emitters of Tr2 and Tr3. The lower end of R1 is connected directly to Tr2's base and, via the low-value resistors R3 and R4, to Tr3's base. A low-impedance path is therefore required between the upper end of R1 and the common-emitter connection: this is provided by C2 and the decoupling resistor R2 which is necessary to prevent a short-circuit of the scanning coils. In this way Tr2 and Tr3 are persuaded to operate in the common-emitter mode.

R4 controls the standing difference between the base and emitter voltages of each output transistor and thus determines the common collector current in the absence of a signal. It's adjusted to minimise the distortion, known as crossover distortion, which arises at the centre of the sawtooth waveform as one transistor is cut off and the other begins to supply the output current. R4 could be labelled "set quiescent current".

For optimum operation of the circuit, the common-emitter potential of the output stage in the absence of a signal should be equal to one half of the supply voltage. This potential depends on the standing collector current of Tr1, and thus stability of this current is particularly important. It is achieved in this circuit as in many others by providing a direct-coupled negative feedback loop between the common emitter connection and Tr1's base. Resistor R5 provides this loop, and any unwanted increase in Tr1's collector current causes a fall in Tr1's collector voltage and thus in the common emitter voltage. This in turn causes a drop in

Tr1's base bias, so offsetting the original increase in Tr1's collector current. By adjustment of R5, the mean voltage at the common emitter connection can be set to the required value: thus R5 is made a preset component which could be labelled "adjust output stage balance".

For wide deflection angle picture tubes the current in the scan coils must be modified from a pure sawtooth waveform in order to achieve linearity of scan (i.e. scan correction). For example, a field-frequency parabolic waveform may be superimposed on the sawtooth. Thus practical field amplifiers include additional circuits to provide such correction, and these usually contain adjustable components (linearity controls) to enable optimum linearity to be achieved. Other components may be introduced to provide pulses coinciding with the flyback strokes for flyback blanking.

FET Buffer

In some field oscillators it's important that the fundamental capacitor across which the sawtooth waveform is developed should not be shunted by the following field amplifier. Thus a high-impedance circuit may be inserted between the capacitor and the field amplifier to provide the necessary isolation. A field-effect transistor is the ideal buffer, and Fig. 4 shows an example of a circuit incorporating such a transistor.

In this circuit the fundamental capacitor C1 is charged from the potential divider R1, R2, this particular arrangement being adopted because the consequent distortion of the sawtooth waveform is useful for scan correction.

The field-effect transistor is connected as a source-follower to give a low output resistance for feeding the following field driver stage and for terminating the negative feedback loops which are used for linearity correction of the generated sawtooth waveform. The source circuit is also a suitable point at which to insert the sawtooth amplitude control (picture height).

Audio Amplifier

Audio amplifiers in television receivers commonly follow the general pattern of the field amplifier shown in Fig. 3. A typical circuit is shown in Fig. 5. Tr3 and Tr4 form a complementary push-pull pair operating in class B and driven by the class A driver stage Tr2. No adjustment is provided for setting the quiescent current in the output stage, but a measure of d.c. stability is ensured by the inclusion of the individual emitter resistors R8 and R9. Tr3 and Tr4 are arranged to operate as common-emitter amplifiers by returning the upper end of Tr2's collector load resistor R6 to the output stage emitters via C4 which also functions as a coupling capacitor for the loudspeaker.

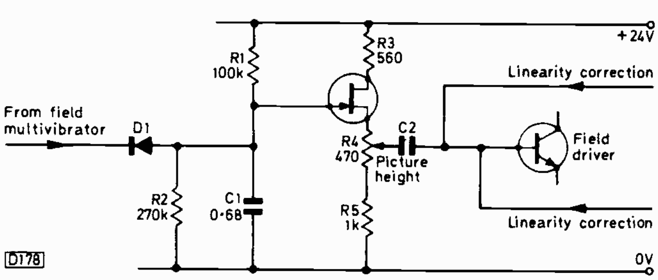


Fig. 4: Field-effect transistor used in a source-follower circuit to act as a buffer between the field charging circuit and the driver transistor.

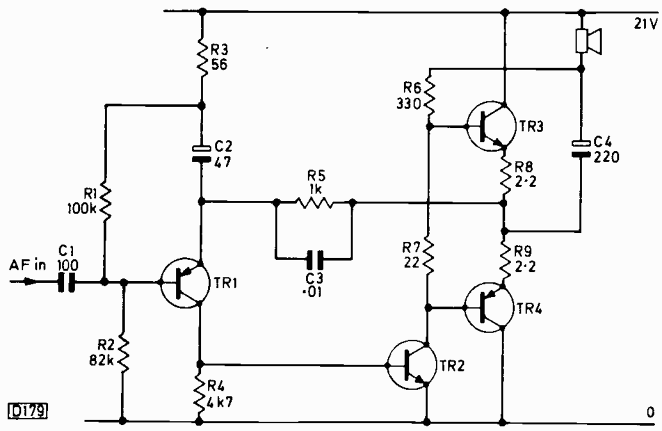


Fig. 5: Audio output amplifier circuit.

Tr1 is a class A current amplifier with signal-frequency feedback provided by R3 and R5 which set the voltage gain of the amplifier at approximately 18 (1000/56). Tr1 also operates as a d.c. amplifier which maintains the voltage at the junction of R8 and R9 (the output point) at half the supply voltage. Tr1's base voltage is stabilised at 11V by the potential divider R1, R2, R3, and the emitter is connected by R5 to the output point. Any variation in the mean voltage at the output point causes an alteration in Tr1's emitter voltage and thus in its collector current. This is amplified by Tr2 which applies a correcting signal to the bases of Tr3 and Tr4, the entire amplifier being direct coupled. This design therefore avoids the need for the two preset controls in Fig. 3.

CONTINUED NEXT MONTH

How to Use a Scope

Andy Denham

THE aim of this article is to persuade engineers to make the fullest possible use of the oscilloscope, their most valuable friend in the jungle of electronics. The instrument is loved by few and spurned by far too many as being too complicated to set up and inconclusive in the results it gives. The inconclusiveness mainly comes from either lack of practice or inability to use the controls properly. Since most service manuals provide a comprehensive set of scope waveforms however, it seems a great pity not to make use of this method of seeing almost instantly what is (or isn't) there.

At one place where I worked each field engineer was given a scope to keep in his car – if he asked nicely – and I must admit that that's where I developed the habit of making full use of the scope. I've made a nuisance of myself at many other places trying to get the same privilege.

To start with, let's take a look at basic scope requirements and the type of display tube used. The most noticeable difference between a TV and a scope tube is the enormous length of the latter compared to the screen size. The old ex-WD VCR97 for example is a six inch tube and is some 20in. long – a 24in. monochrome set's tube is about the same length or less.

This length means that the deflection angle in a scope is narrow, giving various benefits. First, the voltage swing required to give a full-screen transition with the electrostatic deflection used is kept down. Secondly, the tube face can be flat without detriment to focusing, since the beam length does not increase significantly towards the edges of the screen. Thirdly, for the same reason the horizontal scan can be truly linear and there is no need for scan-correction.

The construction of a scope tube is basically as shown in Fig. 1, though more modern tubes have at least one more electrode. This is used to provide astigmatism correction – to compensate for the fact that the spot tends to be oval under high brightness conditions.

Driving the Tube

Typical power requirements are shown in Fig. 2. An e.h.t. of −5kV is typical, applied to the cathode via a resistive chain. The grid is at a lower voltage than the cathode; the first anode or accelerator is at about +400V with respect to the cathode; the focus anode is variable between about +400V and +700V with respect to the cathode; the final anode is earthed. This is by no means a fixed arrangement. You might find −2kV at the cathode and +3kV at the final anode – it depends on the designer.

A self-oscillating e.h.t. generator circuit is shown in Fig. 3 – flyback e.h.t. generation is impossible in a scope since the horizontal timebase has to operate over a wide frequency range and uses no transformers. The reason for using this type of circuit is to provide a stabilised supply (it's fed from a regulated l.t. rail) not only to meet the e.h.t. requirements but also to provide (usually) a supply for the deflection amplifiers as well. Another advantage is that the oscillator will cease if overloaded by touching etc.

The vertical (Y) deflection amplifier is required to work over a wide frequency range, say d.c. to 6MHz, with a flat response, i.e. ±3dB. This generally means that a d.c. amplifier is used – except in the more expensive type of laboratory scope which uses a chopper amplifier, or in simple scopes for a.f. testing. D.C. amplifiers are prone to drift however, and unless precautions are taken the trace will drift about on the screen. The usual method employed to reduce drift is to use a differential amplifier with feedback.

The timebase which provides the horizontal (X) deflection produces a linear sawtooth at various speeds, typically from 0·1Hz to 200kHz. It must be capable of being synchronised to the incoming waveform fed to the Y amplifier. An external input is usually provided for the X amplifier for certain purposes, and provision is made to apply external sync.

Flyback blanking is applied to the c.r.t. grid in the same way as in a TV set, and there's usually access to the c.r.t. cathode so that the cathode can be driven (Z axis).

Dual-trace Scopes

Some scopes are of the dual-trace variety. There are two basic approaches to obtaining this facility – using a double-beam c.r.t., or providing a chopping action by switching one beam between two inputs. More on this later. If chopping is used, blanking is applied during the chop process in order to remove the vertical transitions that would otherwise be visible as the trace chops from one waveform (Y′) to the other (Y″).

Obtaining a Trace

This brief look at basic scope requirements has led us to the point where we should be able to appreciate the functions of most of the controls. All that remains then is to set the thing up on the bench and watch it.

Make a practice of switching test equipment on at least twenty minutes or so before using it. This ensures that there is minimum drift while you're setting it up – and gives you time to think about the job in hand.

So switch the scope on and when the trace has appeared go away for a quarter of an hour. Why when the trace has appeared? Well, suppose several people use the scope in question. The time is likely to come when someone has switched the timebase off, using the X amplifier with external drive, and has not switched the timebase on again. If you don't wait for a trace, the black spot in the centre of the screen will be quite pronounced by the time you return.

Suppose that a trace doesn't appear? Look for a control marked "trig/sync". If this is set in the trigger mode, the timebase will usually only just trigger with a signal from the sync separator present. With no signal applied however the normal arrangement is that the display is blanked. So have a go at this knob first.

If the display still fails to appear, check that the brightness is turned up, and set the X and Y shift controls to approximately centre. This should give some sort of display.

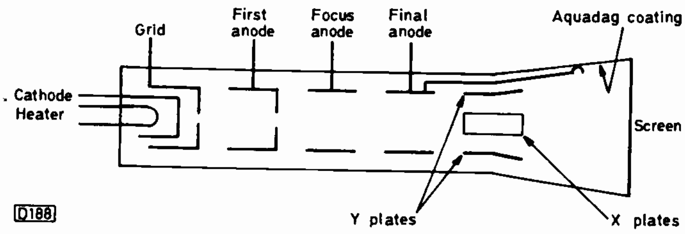


Fig. 1: Basic scope tube construction.

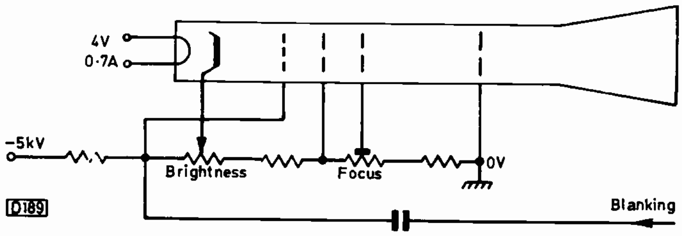


Fig. 2: Typical scope tube power supply arrangement.

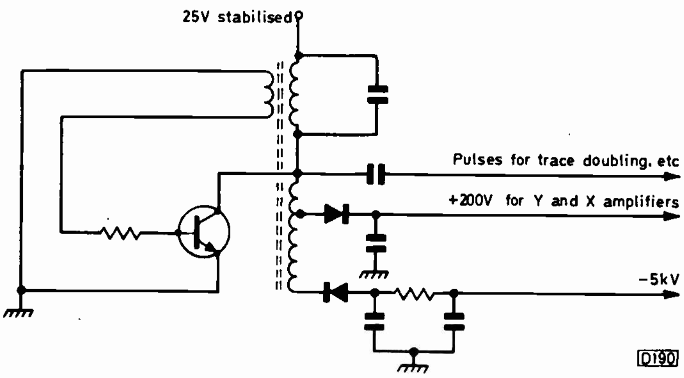


Fig. 3: Self-oscillating e.h.t. generator circuit. Frequency approximately 10kHz.

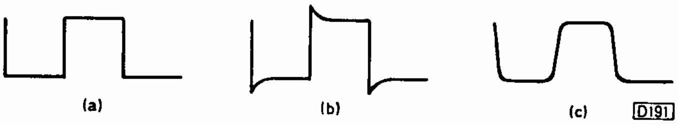


Fig. 4: (a) Squarewave as it should appear. (b) Incorrectly adjusted compensating capacitor – poor l.f. response plus excessive overshooting. (c) Poor h.f. response – verticals sloping and corners rounded off.

If all that's seen is a spot, switch the timebase to a setting other than X or ext: a line should then be seen. Reduce the brightness control setting to the lowest acceptable level to prevent a black line being burnt on the c.r.t. screen.

We'll assume then that you now have a single horizontal line in the centre of the screen. It would be advisable next to check the calibration and h.f. response of the Y amplifier. With most commercial scopes a squarewave calibration pulse is available. It's usually at 50Hz and of a set amplitude, generally around 1V p-p (peak-to-peak, i.e. between the positive and negative peaks of the signal).

Calibration and HF Response

We'll assume that the calibrate output is 1V p-p at 50Hz. To display two complete waveforms on the screen, the timebase must run at half this frequency, i.e. 25Hz. Connect the probe to the calibrate pulse output and set the timebase to display two complete cycles. Assuming that the tube has a ten-division graticle horizontally, the timebase must be set to four milliseconds per division (1/25th second for ten divisions, therefore 1/250th second per division). This assumes that the timebase calibration is done at 50Hz. The timebase coarse frequency is normally given in multiples of 0·1μsec per division, i.e. 0·1-1μsec, 1-10μsec, 10-100μsec, 0·1-1msec, 1-10msec, 10-100msec and 0.1-1sec/div. So for our purposes a setting of 1-10msec/div would be selected and the fine frequency control set to a little before half way. The incoming signal will then trigger the timebase to give a display consisting of two squarewave cycles.

Since the object is to calibrate the unit, as large a display as possible should be used. The most common type of probe is a divide-by-ten one, so if the calibrate output is 1V p-p a Y amplifier setting of 0·1V per vertical division will give a one unit display on the screen. To get a larger display, switch to 0·01V/div (ten units on the screen) or possibly 0·02V/div in the case of a small screen calibrated in half inches.

The preset gain having been thus set by means of the range switch, the fine or variable gain is next set to the calibrate position. At this point the set gain trimmer is adjusted to give the calculated display height.

The other use for the calibration squarewave is to check the scope's transient response and, if possible, adjust this. Most probe kits contain instructions for adjusting the probe – all divide-by-ten probes have an integral compensating capacitor which can be adjusted for optimum transient response (see Fig. 4). This can normally be adjusted through an access hole, by means of a small trimming tool, or by twisting the body of the probe. It's instructive to watch the display as lower sensitivities are selected, checking for correct display height and response.

Locking the Display

This calibration check can also be used for learning the techniques for manipulating the other controls. With the scope set to trigger positive, adjust the trigger/sync control first one way then the other. In one direction the display will tend to run, i.e. drop out of lock. At this point the fine frequency control can be adjusted and, depending on the type of trigger employed, the display may lock again or run though slowly. As the control is advanced in the other direction, the display will lock firmly at some point and then vanish altogether – or in some very old units, such as the Cossor 1038 Mk. III (mustn't grumble, gave only £7·50 for it), it will become a bright dot at the left of the screen. The reason is that at this point there is insufficient drive to trigger the oscillator, which stops and blanks the display.

With the sense switch set to trigger negative, the same results should be achieved – provided the input waveform is symmetrical. If the input consists of pulses however, set the switch to trigger off the pulses which have the sharpest spikes.

Switching to the sync position will still give a display, but in this mode the control will need to be reset to achieve stability each time the input waveform changes from say a flyback pulse to a squarewave drive pulse. In this position however the display does not vanish when there is no signal. It can be used therefore to display waves with small spikes which are insufficient to operate the trigger.

By and large then for TV work the trigger position is used, as once set to say line frequency the display will appear for almost all shapes of waveform at this frequency – with no more than switching between trigger positive and negative. In most recent scopes even the selection of positive or negative triggering may be automatic, as may the operation at different frequencies, the instrument switching itself automatically between h.f., line and field sync. In dual-beam scopes either the Y′ or Y″ input can be used to synchronise the display, and most scopes can also be synch-

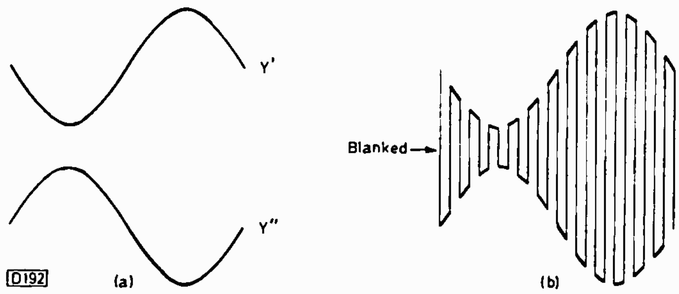


Fig. 5: The "chop/alt" mode. (a) Display. (b) Using the chop technique at l.f. (effect exaggerated).

ronised externally, say to the line output stage by connecting a piece of wire to the external sync input at one end while the other end is laid near the line output transformer, or from the receiver's sync output.

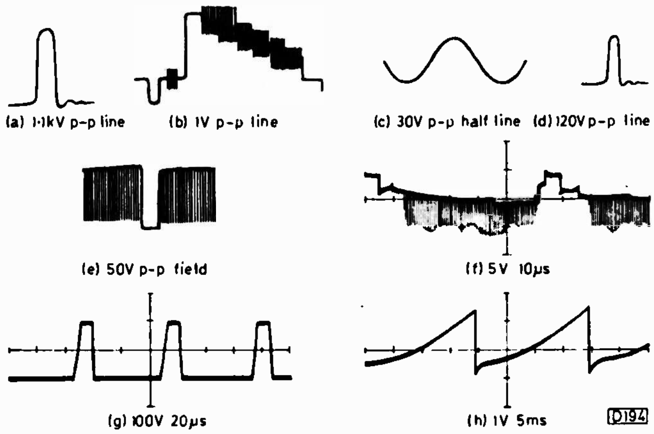


Fig. 7: Typical oscillograms – see text.

Dual-trace Operation

If the scope has a control marked "chop/alt" it's a dual-trace scope using a single-beam c.r.t. Trace doubling at the lower frequencies is done by breaking up the waveforms into small time intervals and switching the single beam between the two inputs, with the vertical transitions blanked. The idea is shown in Fig. 5. At higher frequencies the switching becomes apparent so the two displays are traced alternately instead. This approach cannot be used at low frequencies since first one then the other trace would be seen, nor at medium frequencies since the display would be subject to serious flutter. Thus for lower frequencies (up to about 100Hz) chop is usually used while above this the alternate display mode is used.

With a dual-beam unit the same principles are employed but there are separate Y amplifiers and the tube has two separate sets of Y plates and sometimes two separate guns.

When displaying two waves simultaneously, set the triggering to operate from the waveform that has the most pronounced spikes.

Range Switch Markings

A word or two on the subject of range switch markings. These are usually similar to those on the timebase range control, marked in volts or millivolts per division (usually a centimetre). Thus a setting of 10V/cm will give a display height of 5cm with an input *to the amplifier* of 50V p-p. Using a ÷10 probe, a 5cm display will represent an input of 500V p-p to the probe. Most modern scopes have a times ten switch which multiplies the gain by ten at the expense of bandwidth. If it's necessary to examine a small signal sitting on top of a large pulse, the gain should normally be set so that the display is large enough to be able to see the small signal clearly, the shift control then being adjusted so that the signal appears on the screen. Such antics are required when setting the burst gate timing

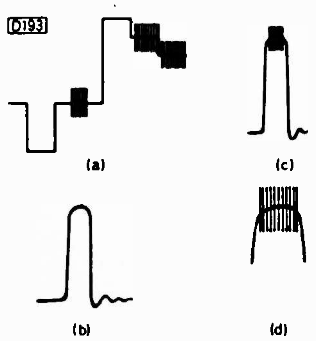


Fig. 6: Burst gate timing. (a) Video signal with the burst on the back porch of the sync pulse. (b) Burst gating pulse. (c) Pulse with burst, scoped at the base of the burst gate/amplifier transistor. (d) Gain and width increased to show up the burst more clearly.

on Bush decoders and on other occasions such as setting the fifth harmonic tuning on the Philips G6 chassis. See Fig. 6.

Control Settings to Use

So the first decision we have to make is which Y setting to select to display the amplitude of pulse we expect to see, secondly will the trigger setting suffice, and finally which speed to set the timebase at? Having made these decisions we observe the trace and compare it with the one shown in the service manual. This brings us to the next problem: how to read a setmaker's oscillograms, and how to interpret the results obtained?

Interpreting the Display

Service manuals have for many years contained i.f. response curves and oscillograms in addition to the other data. Some oscillograms are drawings, others photos. Sometimes the frequency is given, alternatively either line or field frequency is indicated. Where the timebase speed is specified the deflection sensitivity is usually given. The alternative is to give peak-to-peak figures for the pulses. Some typical oscillograms are shown in Fig. 7.

Fig. 7(a) shows a 1·1kV p-p flyback pulse taken at line frequency, Fig. 7(b) a 1V p-p video waveform, Fig. 7(c) a typical decoder ident waveform, Fig. 7(d) the sort of pulse used for burst gating, and Fig. 7(e) a field frequency display of the line and field flyback blanking pulses commonly found on the c.r.t. grid – the vertical spikes are the line flyback blanking pulses. Fig. 7(f) shows the video input to the luminance delay line in the Thorn 3000/3500 chassis, with 5V indicating the Y amplifier setting, i.e. Y sensitivity 5V/div, and 10μsec the horizontal speed, i.e. 10μsec/div. Similarly the clipped pulse shown in Fig 7(e) is at 100V/div (i.e. 200V p-p) and 20μsec/div (approximately 65μsec). Fig. 7(h) shows the feedback applied to the field linearity circuit, and is at 1V/div and 5msec/div, i.e. 2V p-p and 20msec (field speed).

Whilst there will be variations between the oscillograms shown in the manual and the results obtained on particular sets, there should be at least some similarity provided the instructions given in the manual are observed. Again referring to the Thorn 3000/3500 chassis, the manual states that the waveforms shown were taken from a typical set displaying a correctly adjusted colour picture – test card F or the colour bars unless otherwise stated. Comparable results will be obtained therefore only when these provisos are observed. Some waveforms will remain unchanged under

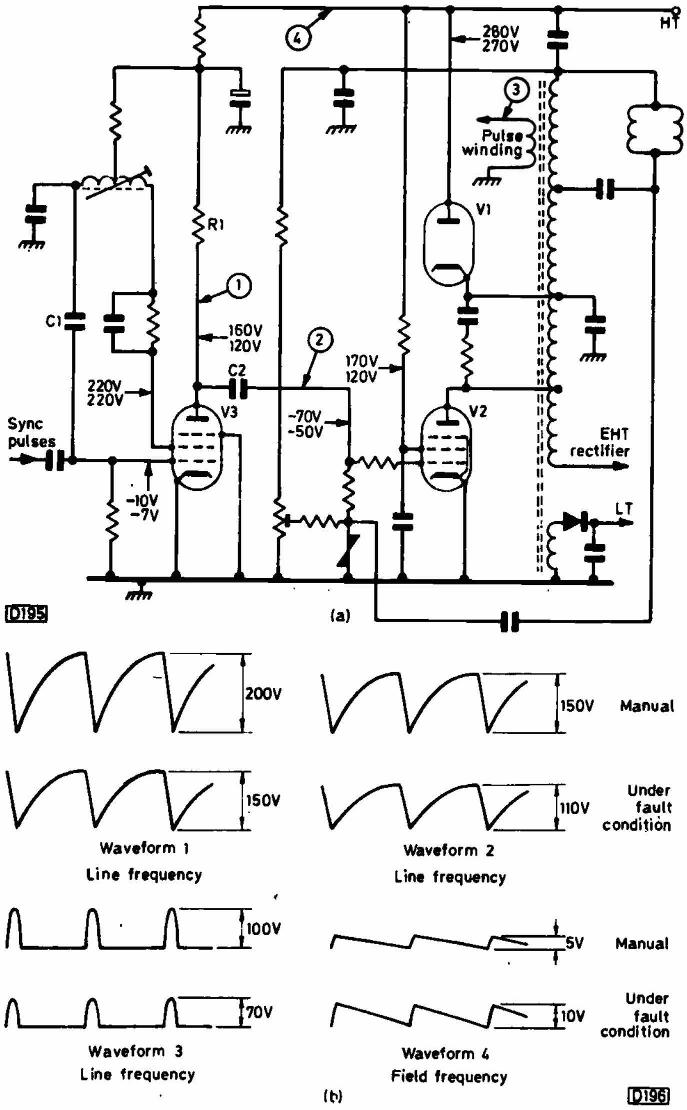


Fig. 8: (a) Typical valve line timebase. Upper voltages correct, lower as found. (b) Waveforms under correct and fault conditions.

most conditions, but some change drastically. Unfortunately only experience will tell you which will and which won't change.

Having had a look at the trace and compared it with the one shown in the manual, what is the next step? Fig. 8 shows the circuit of a typical valve line timebase, which we'll assume is not operating correctly. Let's take the symptoms, lack of width, low e.h.t. and the line output valve overheating. All valves have been replaced. It's obvious from the voltages that in this particular case the line oscillator valve V3 has low anode voltage and is thus providing inadequate drive to the line output stage. Since the valve's screen grid voltage is correct, it would be reasonable to assume that R1 has increased in value, though

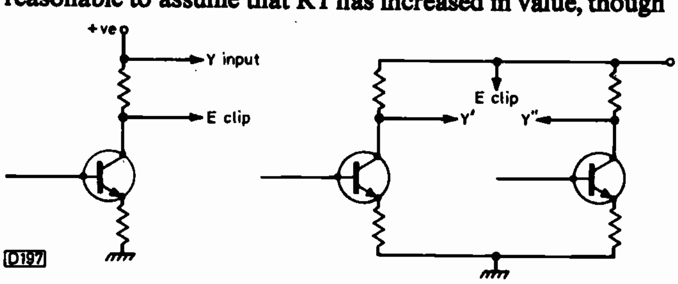


Fig. 9: Current checks. (a) Measuring the voltage (p-p or d.c.) across a resistor enables the current to be calculated (Ohm's Law). (b) Comparing two currents: the earth clip is connected to the common supply line point.

it's also possible that C2 or C1 is leaky. The waveforms reveal all however. A reduced amplitude output from line oscillator will reduce all the a.c. waveforms in the line output stage. Since the line output valve operates in class C, generating its own grid bias through grid current flowing when it's switched on, the low drive will result in decreased bias (−50V instead of −70V) and increased direct current flowing in the stage. This means increased ripple on the h.t. line (waveform 4) as well. The versatility of the oscilloscope lies in the fact that it enables you to see the actual shape of the applied voltages as well as their amplitudes.

Measuring Voltages and Currents

The scope has many other uses of course. Most commercial gear is capable of both a.c. and d.c. amplification, so the scope can be used as a voltmeter. By selecting d.c. input and noticing the displacement of the display, the applied d.c. voltage can be deduced. This technique can also be used where an a.c. variation is superimposed on a d.c. bias. In this case it's necessary to select a.c. input and set the shift so that there is a datum point – one of the horizontal lines. D.C. is then selected and the displacement noted.

Current can also be determined, by measuring the voltage (d.c. or peak-to-peak) across a known value resistor (see Fig. 9).

Earthing Arrangements

One point which must be made is that if the scope is to be used on a TV set which is not being run from an isolation transformer (ahem!) it must on no account be earthed. The reason is simple: many recent receivers use the "split mains" technique, with the chassis at half mains voltage with respect to earth. The use of earthed test gear on this type of set leads to blackened earth clips, burnt fingers and nervous engineers. For the same reason current measurements must not be made with an earthed scope, nor if two beams are in use should two measurements be attempted simultaneously with the earth clips connected to points at different potentials.

Lissajous Figures

Oscilloscopes usually have an X input. The gain here is normally adjustable over only a small range, usually by means of the "width" control. One use of this facility is to produce Lissajous figures, where generally the same frequency (though not always) is applied to the X and Y amplifiers. The shape of the display thus obtained will vary depending on the phase relationships of the two inputs. With the same gain and the signals in phase the result will be a circle. With one frequency twice the other, two loops will be seen. With different gains but the same frequency there will be an ellipse, the exact position of the ellipse depending on the phases of the inputs. These features can be used for phase alignment, for example when making decoder adjustments. The exact procedure is described in the Philips G6 and G8 manuals.

Alignment

The scope is also useful for alignment. Again the exact procedure has been described elsewhere, for instance in the December 1976-March 1977 issues of this magazine (see

– continued on page 426

Letters

WIDTH CONTROL CIRCUITS

I would like to make a point regarding the width potentiometer in the Philips 210 and 300 chassis since this came up in a couple of places in your April issue. Dud spots on the width control are a common cause of lack of width in chassis such as the Thorn 1400 and 1500. In these Philips chassis however the position of the width control in the circuit is different – for a comparison, see Fig. 1. Because of this, a width control with a dud spot (open-circuit wiper) will on these chassis result in excessive width.

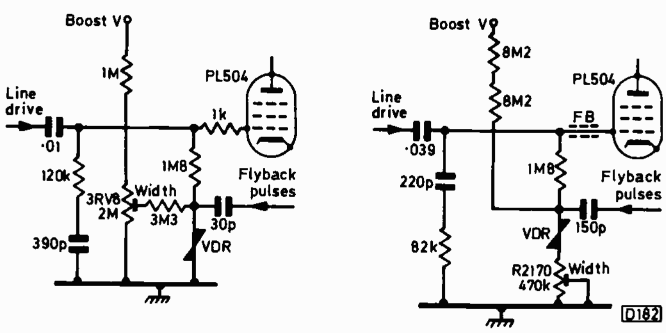


Fig. 1:– Alternative width control circuits. Left, Rank A774 chassis, right Philips 300 chassis.

Whereas in the more usual Thorn type circuit a dud spot results in failure of the voltage tapped from the boost supply to offset the negative voltage generated by the width stabilising circuit – through the action of the v.d.r. – in the Philips type arrangement, which is also used in several hybrid colour sets, the dud spot means that an increased voltage will be developed across the width potentiometer so that the voltage at the line output valve's control grid moves positively. The system switch can also be responsible for excessive width on the Philips 210 chassis, when it goes intermittent. – **G. Varns,** *Guildford, Surrey.*

RENOVATIONS AND A SIMPLE CRT REJUVENATOR

I own a small TV shop and buy a lot of ex-rental sets, so Mr. Dixon's comments in the April issue were of interest. Personally, I don't feel that the chassis he mentions are all that economic for renovation since in my experience both are prone to line output transformer trouble. I buy mainly GEC single-standard monochrome and single-standard hybrid colour sets, which I find to be very reliable, reasonably cheap, and easy to service.

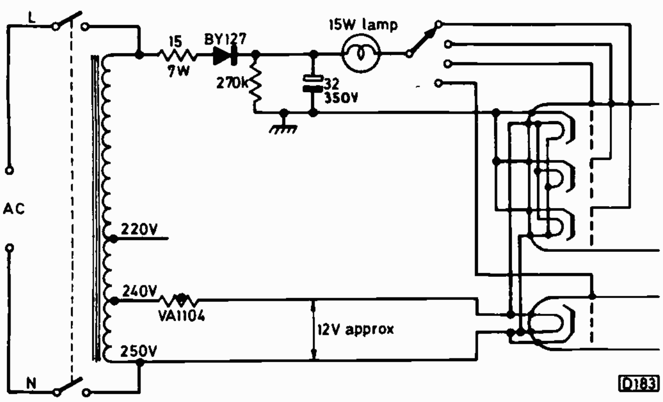


Fig. 2: Simple c.r.t. rejuvenator circuit.

The c.r.t. booster circuit you give seems much too expensive for a simple tool. Fig. 2 shows the simple circuit I've used for a couple of years. You can pulse it by switching the wafer switch or adding a button in the grid circuit. I've had 90% success with this, and it costs virtually nothing to build since most engineers will have all the parts required.

The thermistor ensures that the heater voltage gradually builds up to 12V so as not to damage the tube. The auto transformer is from the Thorn 950 chassis, using the 10V tap between 250V-240V for the heater(s). The high-voltage end of the winding is connected to mains neutral in case the heaters short to earth.

I hope this circuit will help others. – **J. Pierce** *(Shaw, Lancashire).*

NON-TRADE REPAIRS

I read with interest R. A. Fisher's letter on TV Cowboys in the April 1978 issue. Presumably Mr. Fisher is in the trade! I'm not, and would like to offer my view on certain aspects of the subject.

My hobby is radio and TV servicing and, as you might expect, word gets around the neighbourhood and as a result I accumulate all sorts of repairs: unlike those referred to by Mr. Fisher, I don't advertise any service. The main point I'd like to make however is that there are reasons for customers using "non-professional" service men – and not simply cost, though this certainly plays a great part. Take the following examples which illustrate how some sets ended up with me for repair.

First a Bush Model TV181 (A774 chassis) which was taken by a neighbour to the largest TV retail organisation in our area for a quotation for repair. A figure of approximately £20 was quoted, as "the line output transformer needed replacement". The set was only a second one, so the customer didn't leave it. At a latter date he asked me to have a look at it. To cut a long story short, after replacing the line output valve and its screen grid feed resistor the set worked perfectly, and has continued to function without fault for over a year. So much for the line output transformer, and this customer will not return to that retail organisation again.

Secondly, a Thorn 1591 portable chassis which was taken to another, smaller retail outlet for repair. The shop refused, saying that the repair would cost more than the set was worth. I ended up looking at it, and again cutting the story short a new e.h.t. rectifier stick and line output transistor restored the set to normal working order. It continues to work perfectly. Would you consider that an uneconomic repair? – the set was only three years old!

Thirdly I was asked to look at a hybrid GEC colour set with the the trouble no results on switching on. The owner had contacted the shop where he'd bought the set and had been told that there was a minimum £10 call-out charge, plus £6 per hour, plus parts etc. Further, they couldn't come for at least four days. The fault turned out to be the thermistor in the degaussing/heater circuit, and a replacement cost me 40p. Again the set has given no trouble since.

The above are only a few recent examples. There are many other factors which don't endear the trade to the public – exhorbitant charges, poor turn round time, poor customer courtesy, bodged repairs, lack of interest in carrying out repairs once a set has been sold, and so on.

Until the trade can offer a more consistent, good quality service at a reasonable cost and with a reasonable repair time, customers will continue to go to the so-called TV cowboys. I entirely agree with all comments about bodgers, both inside and outside the trade – they should certainly be stopped, if only in the interests of safety! But not all those outside the trade fall into this category – many genuine enthusiasts can offer an effective service to the public so long as tax and other legalities are observed.

For my own part, while I've had no formal training I consider that I can carry out a safe, lasting repair. If I think I cannot do this I won't touch the set! My knowledge has been gained by years of reading and practical experience – gained with the help of friends in the trade I might add – and I've enough common sense to admit that I don't know everything and that some repairs (e.g. decoder alignment etc.) must be referred to the shop where the set was bought, where both the equipment available and the experience *should* be better.

Mr. Fisher's comments may seem to be correct in theory. In practice it won't work until customers gain greater satisfaction from the trade's efforts. – **K. Blower,** *Steeton, Nr. Keighley, Yorks.*

CRT REJUVENATOR USE

I think you did an excellent job of building up a c.r.t. rejuvenator design for constructors to make, based on my original circuit. There are one or two points I'd like to make however.

First, C3 is not there to provide transient suppression but controls the pulse width. Without it, the relay would behave as a buzzer. When Tr1 conducts it discharges C3. When Tr1 switches off, C3 recharges and the charging current, flowing via the relay coil, holds the relay on for a while.

From several years' experience of using this rejuvenator, I've found that the following procedure is best.

Switch to pulsed operation with normal heater voltage. The light should flash after a few pulses. There should also be small areas of blue glow in the c.r.t. gun. When the blue glow stops, switch to continuous operation. If the light fades, more treatment is needed: if the light is constant the tube is now o.k.

Heater boost should be needed only with stubborn tubes.

Few tubes fail to respond. Those that do are generally 20/24in. monochrome ones. They seem to have planned obsolescence. – **W. E. Harrison,** *Windsor.*

YOUR PROBLEMS SOLVED

I would like to add some comments on a few of the problems mentioned in the April *Your Problems Solved* feature. First, the Pye hybrid colour set (697 chassis) with a difficult hum bar problem. This could be an open-circuit tuner a.g.c. decoupler (mounted on the tuner panel) which can cause a hum bar if the signal is of such strength that a.g.c. is applied to the tuner. If the set is of the type with a single screened a.f.c. lead the screening could be picking up mains hum. Alternatively the electrolytic above the a.f.c. can could be open-circuit.

The weak line sync on a Philips G8 set is usually C4520 being open-circuit. This electrolytic decouples the emitter, not the collector, of the reactance transistor – you were probably misled in reading the circuit by the stabilising resistor R4519 between the supply and the emitter bias network. It's best to change the electrolytic from 16μF to 33μF as in later chassis.

Weak field hold on the single-standard Philips G6 chassis can be due to the black-level clamp transistor being open-circuit. Alternatively, under some signal conditions it's advisable to increase the value of the preceding coupling capacitor from 0·15μF to 0·47μF. The dual-standard G6 chassis suffering from field bounce probably has an intermittent 20,000μF decoupling capacitor across the shift control – check by shorting it out. Alternatively the 33kΩ 2W field oscillator load resistor can be responsible, as can incorrect setting of the field output stage bias control – this will cause every PL508 field output valve fitted to develop grid current.

I hope these comments will prove of help to someone! – **M. Phelan,** *Holmfirth, Yorks.*

PATTERN GENERATOR MODIFICATION

The original TV pattern generator design by P. J. Stonard (see January – March 1977 issues) was constructed and has proved useful. I decided however that the crosshatch pattern could be made more pleasing to the eye and more professional looking if the number of horizontal lines was halved. This can be done by adding a couple of extra CMOS i.c.s to the design.

The extra circuitry and the waveforms are shown in Figs. 3 and 4 respectively. IC10a divides waveform V by two to give waveform BA. Waveform V is inverted by IC11a, and the resultant $\overline{V}$ and BA waveforms are fed to the gate IC11b, giving waveform BC which is V divided by two (retaining the same negative-going pulse width). Waveform BC is then applied to pin 5 of the existing gate IC6b where V was originally applied.

The modification requires breaking the printed circuit track at pin 5 of IC6b so that the new circuitry can be interposed. I also changed R11 to 150kΩ.

The varicap modulator arrangement by E. Trundle (April 1975 issue) was used, so there was sufficient space on the board to mount the two extra i.c.s required. Careful adjustment of VR2 gave a crosshatch pattern with 16 vertical lines and 13 horizontal lines. – **G. Evans,** *Aberdare, Glamorgan.*

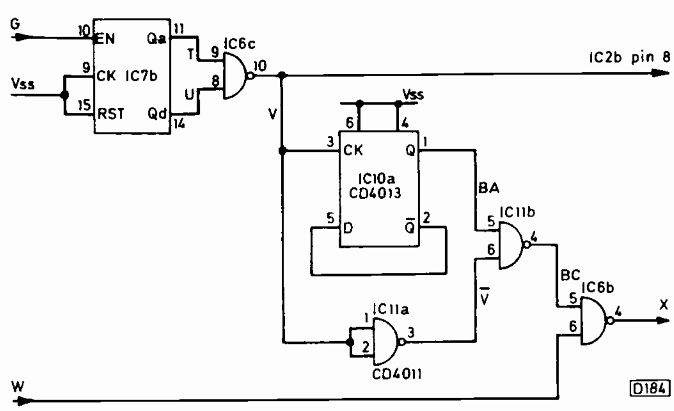


Fig. 3: Pattern generator modification.

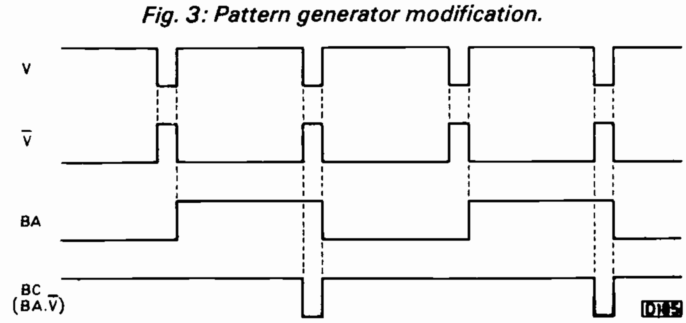


Fig. 4: Pattern generator modification waveforms.

Versatile Sync Pulse Generator

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

THIS article describes some methods of producing the timing signals for a full 2:1 interlaced sync pulse generator for closed-circuit television. Sync pulses and blanking signals are both produced with correct time relationships.

Basic Theory

There appear to be several standards for TV timings. The CCTV industry uses standards that differ slightly from broadcast standards, while there are also occasionally differences between CCTV manufacturers themselves. These differences are minor (e.g. 4μs for a sync pulse width as opposed to 4·7μs for broadcast standards).

The line pulses we shall produce are shown in Fig. 1. These are fairly self explanatory. The positive line pulses and the equalising pulses are used later in the field sync pulse. Briefly summarised, we have: line period 64μs; line blanking 12μs; line sync 4μs; front porch 2μs; back porch 6μs; positive pulses 4μs, falling edge coincident with line sync; equalising pulses 2μs.

It can be seen that these are all multiples of 2μs, so they can be provided by an oscillator of 2μs half period (250kHz) and a four-stage binary counter chain. The outputs of the counter chain can be decoded to pick off the required slots for each signal.

When we come to the field waveforms we find a slight difference of opinion. Most CCTV uses random interlace, but where 2:1 interlace is used there are two arrangements of the field sync pulse. This is not really the place to describe the full workings of a 2:1 interlaced picture, but briefly the camera scans alternate lines on the screen on one field scan (20ms), terminates the scan during a half line, then returns to scan the remaining lines. To scan a whole picture of 625 lines takes two field scans (40ms). This is done to reduce the bandwidth of the broadcast signal and is not strictly necessary in CCTV. It is used however, to have the same standards throughout the industry.

The first field sync standard we will call field sync A. This is shown on Fig. 2. We have field blanking of 20 lines, field sync of 5 lines. In the mixed syncs, positive line pulses of 4μs width, with the negative edge coincident with the line sync, are inserted at twice line frequency to maintain the synchronisation of the monitor's line oscillator during the flyback. Fig. 2. also shows the differences between the end of the even field and the end of the odd field. Note that in the latter the field sync and blanking start halfway through a line.

The second standard we will call field sync B. This is almost to broadcast standard, and is shown on Fig. 3. Again we have field blanking of 20 lines, but the field sync is now 2½ lines, delayed from the start of field blanking by 2½ lines. Into the mixed syncs are inserted 2½ lines of narrow (2μs) equalising pulses at twice line frequency before and after the field sync pulses, plus the 4μs positive line pulses into the field sync pulses as before. The equalising pulses give a smooth change from odd to even fields and back.

To produce the line waveforms we needed a 250kHz oscillator and a four-stage binary counter. To obtain 50Hz we note that:

$$50 \times 5 \times 5 \times 5 \times 5 \times 2 \times 2 \times 2 = 250\text{kHz}$$

To get from the 250kHz oscillator to 50Hz we need the first three stages of the line binary counter and four divide by five stages. As before, we can then pick off our timing slots to give us the pulses we want.

Our basic counter chain is shown in Fig. 4(a), and the timing waveforms produced by it in Figs. 4(b) to (d)

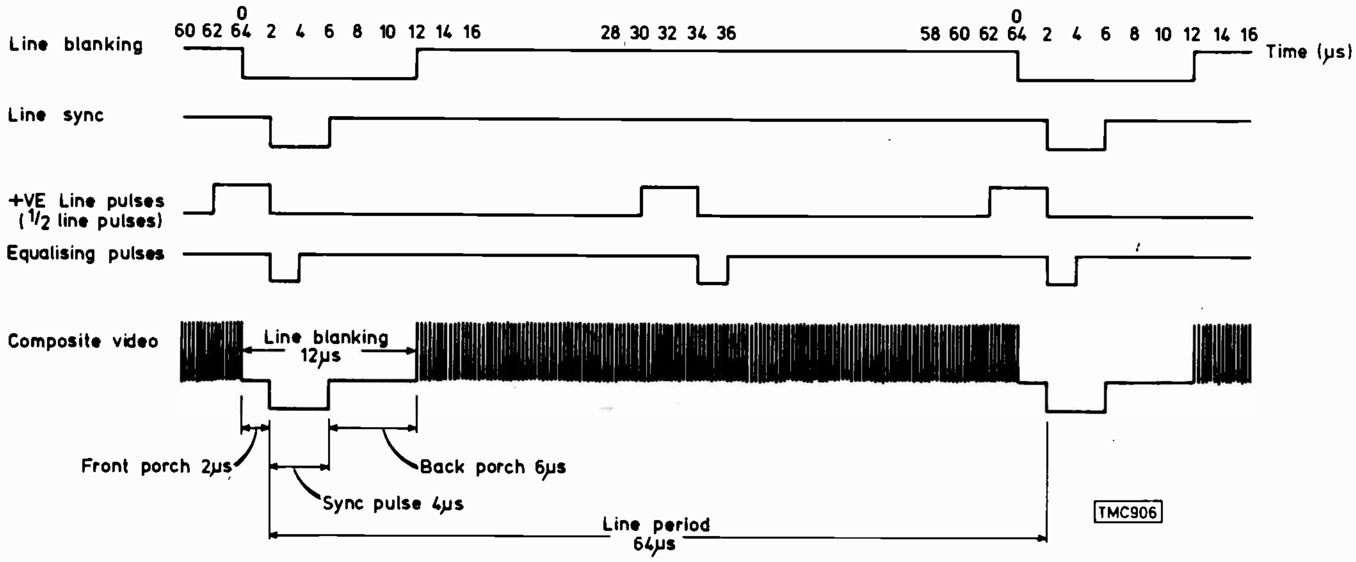


Fig. 1: Timing of the line frequency signals.

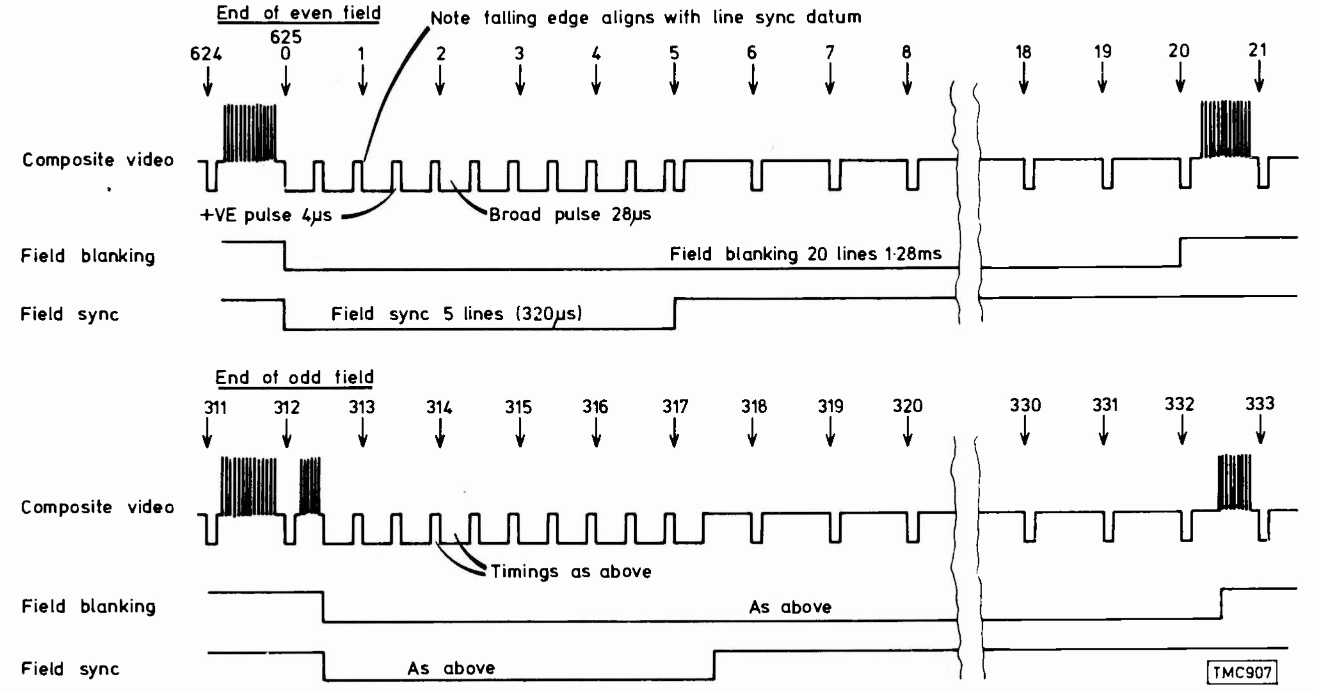


Fig. 2: Field sync waveforms – type A.

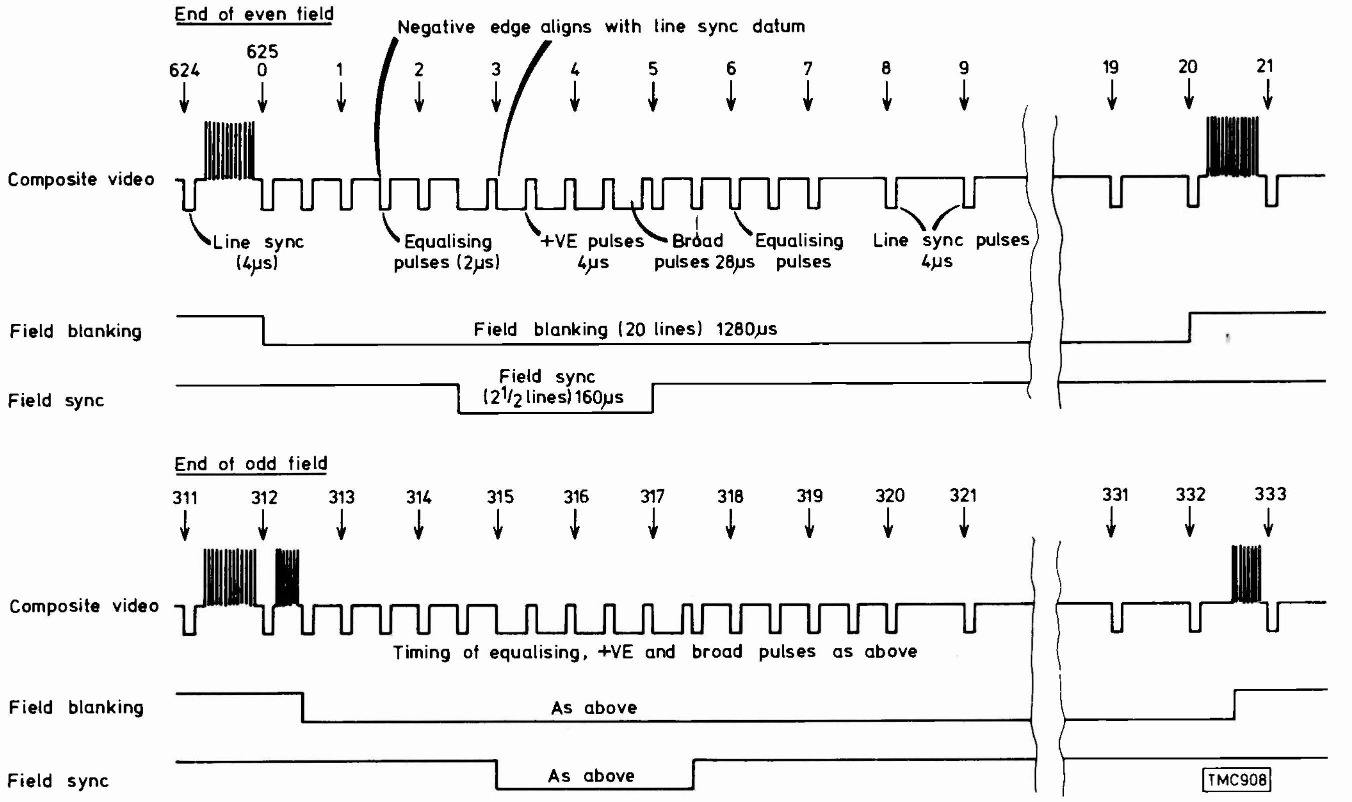


Fig. 3: Field sync waveforms – type B.

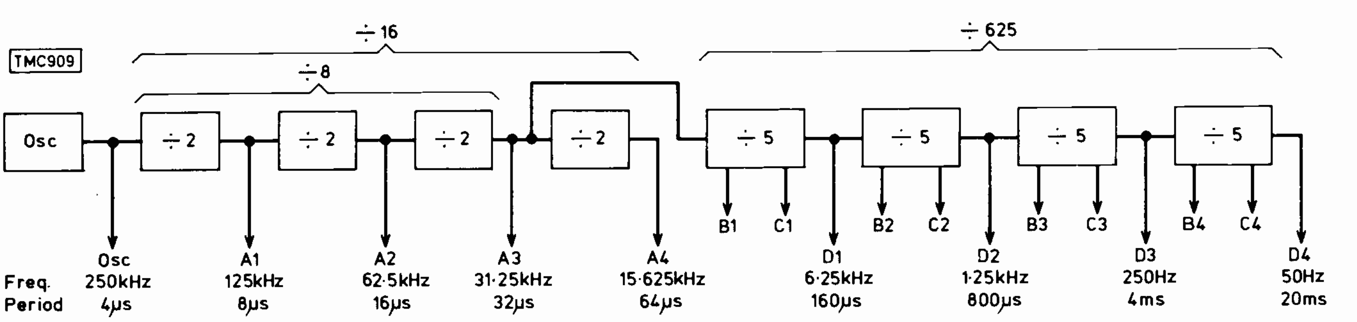


Fig. 4(a): Basic sync pulse generator counter chain.

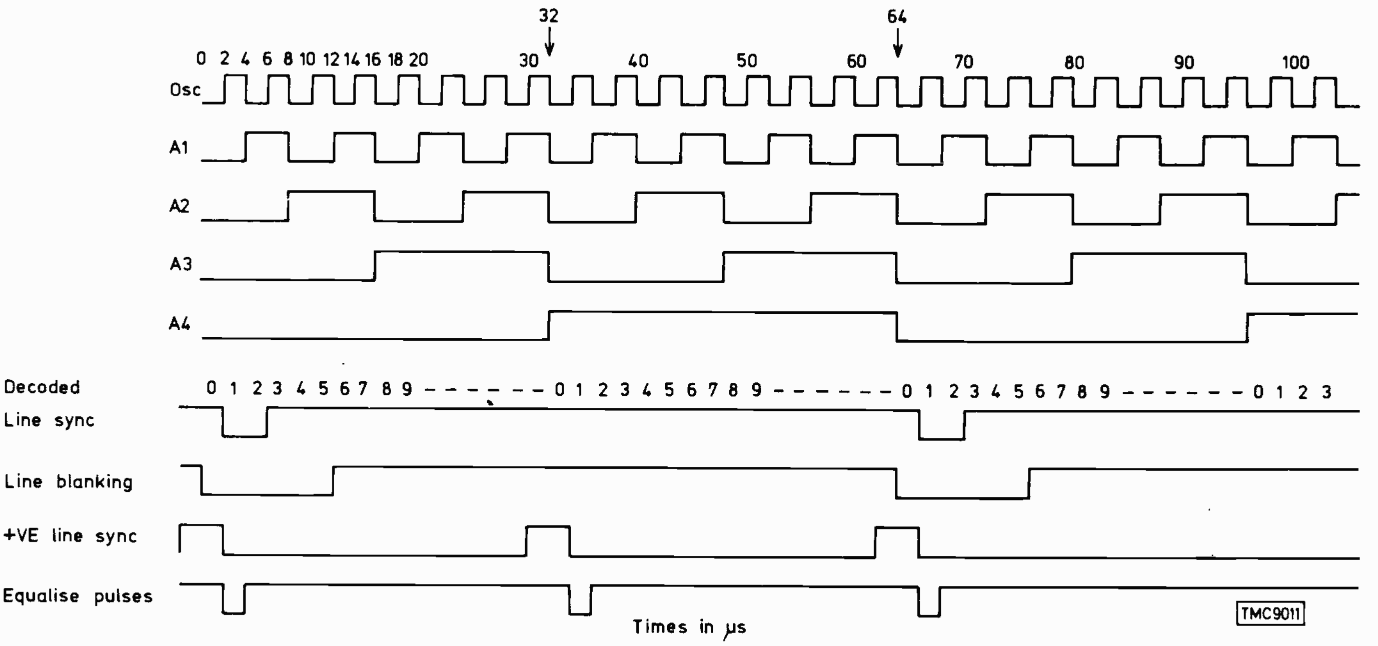


Fig. 4(b): Line waveforms from the counter chain.

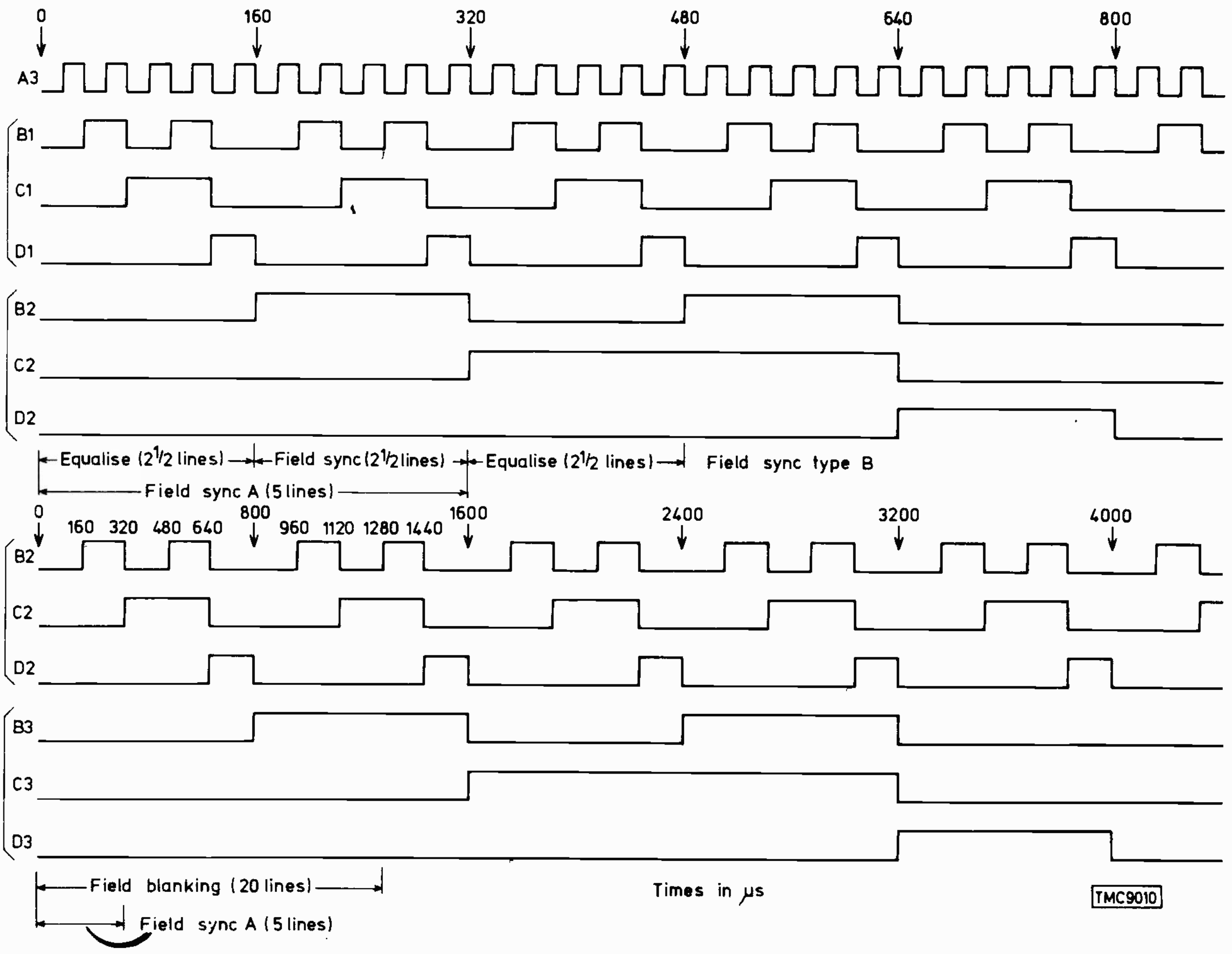


Fig. 4(c): Counter chain timing – continued in Fig. 4(d).

inclusive. The reasons for the A, B, C, D labelling will become apparent later. This counter chain is common to both types of field sync, the only difference being in the decoding.

All the decoding for the field signals is done off the divide-by-five counters. Because these are driven at twice line rate, it will take two complete cycles of the divide-by-625 counter before it aligns with the divide by 16 line counters. Interlacing is therefore automatic.

Practical Circuits

The basic counter chain is constructed around the 7490 decade counter i.c. Conveniently this consists of a divide-

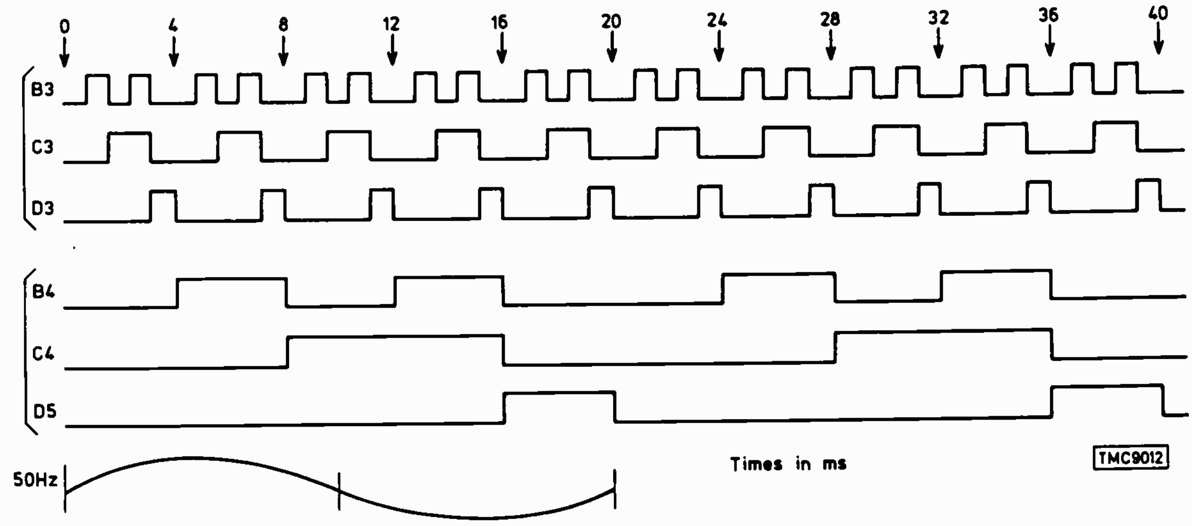


Fig. 4(d): Counter chain timing (concluded).

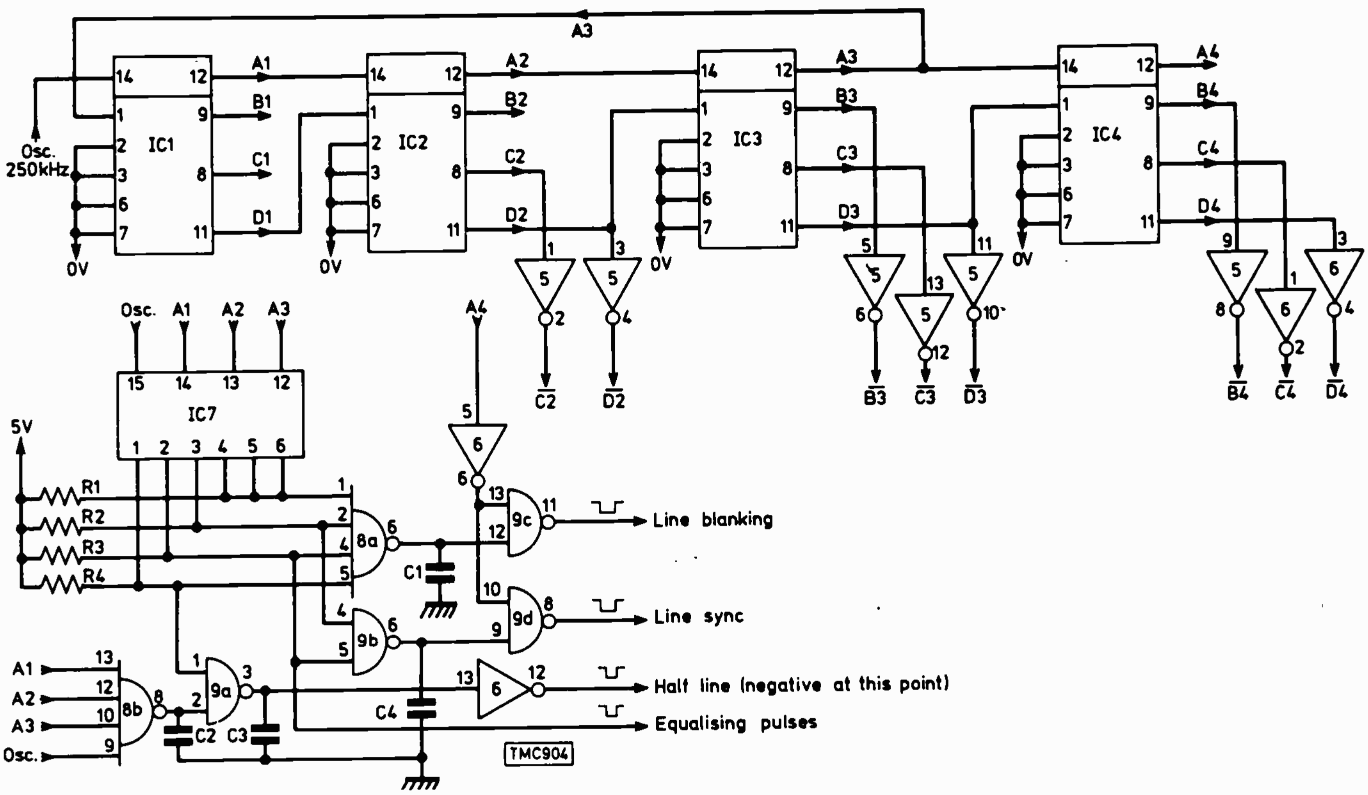


Fig. 5: Basic counter chain and line waveform logic.

by-two stage and a divide-by-five stage. In normal use these are connected to give a decade (divide-by-ten) stage, but we shall use them separately.

The divide-by-two stage is labelled A, and the three parts of the divide-by-five are labelled B, C, and D. Hence the labelling used earlier. By a stroke of luck we need four divide-by-two and four divide-by-five stages, hence four 7490s will complete the whole chain.

The practical counter chain is shown in Fig. 5. IC1-4 are the 7490s. IC5 and IC6 invert the counter outputs to give complements which are used later. Pins 2, 3, 6 and 7 are the external reset pins which are not used and are thus wired to 0V.

Also shown in Fig. 5 is the line waveform logic. The selection of the 2μs slots is done by IC7, a 7445 decoder. The actual "decoding" of the slots is shown on Fig. 4(b). It can be seen for example that line blanking occurs for slots 0 to 5 inclusive. IC8a performs this function. Although IC8 is a NAND gate it's used here as a form of OR gate. The outputs of IC7 go to 0V, hence the output of IC8 will be at a 1 for any input going to a 0. This type of inverted logic is used in several places. Because the outputs of IC7 are also open-collector, the outputs can be tied together (e.g. pins 4, 5 and 6) providing they are not used individually elsewhere. Note that somewhat confusingly output 0 of IC7 is at pin 1, output 1 at pin 2 etc.

The line sync pulses are similarly produced by IC9b, the output going high at slots 1 and 2. Capacitors C1 etc. remove the "glitch" formed when a positive and negative edge are gated together (e.g. at the transition from slot 0 to 1 to 2 etc.).

Because IC7 is working on the first three stages of the binary counter, the line sync and blanking from IC9b and IC8a will occur every 32μs. They are gated with A4 therefore to give a sync pulse and a blanking signal every 64μs.

The equalising pulses are simply slot 1 (17), and come from IC7 direct. The half-line pulses for insertion into the field sync pulse occur at slots 15 or 16 (31 or 0). Slot 15 (31) is given by IC8b and slot 16 (0) by IC7 direct. IC9a performs the OR function. Equalising and half-line pulses are not gated by A4 as these signals are required every 32μs.

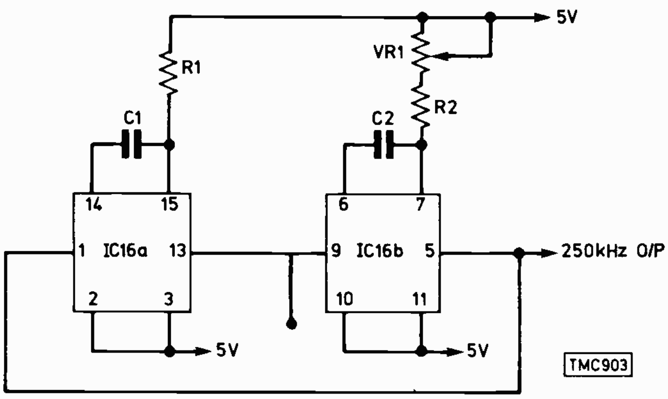


Fig. 6(a): Simple monostable 250kHz oscillator.

The field logic is shown on Fig. 8. This drawing contains the common blanking waveforms and the two sync options A and B. The blanking waveform is a simple gating of counter chains. The field blanking is gated with the line blanking from Fig. 5 to give the mixed blanking signal.

Field sync A is produced by IC13 which selects the counter waveforms to give the necessary five line output. IC10b adds the line sync, with output to IC11d which adds the half-line pulses to give mixed sync A.

Field sync B is a little more complicated. Output B2 from the counter chain is $2\frac{1}{2}$ lines long. Field sync A is gated with B2 to give field sync B – $2\frac{1}{2}$ lines long delayed by $2\frac{1}{2}$ lines.

The equalising pulses are gated for $7\frac{1}{2}$ lines. A flip-flop (IC15a and b) is set by field sync A and reset by B2 and C2 which occur at $7\frac{1}{2}$ lines. The output of the flip-flop gates the equalising pulses via IC10c.

There's a small difference of opinion on the make up of the $2\frac{1}{2}$ lines of equalising pulses. Some manufacturers go "4μs sync, 2μs equalise, 4μs sync, 2μs equalise etc.", and some go "equalise, equalise, equalise, etc." As drawn, Fig. 8

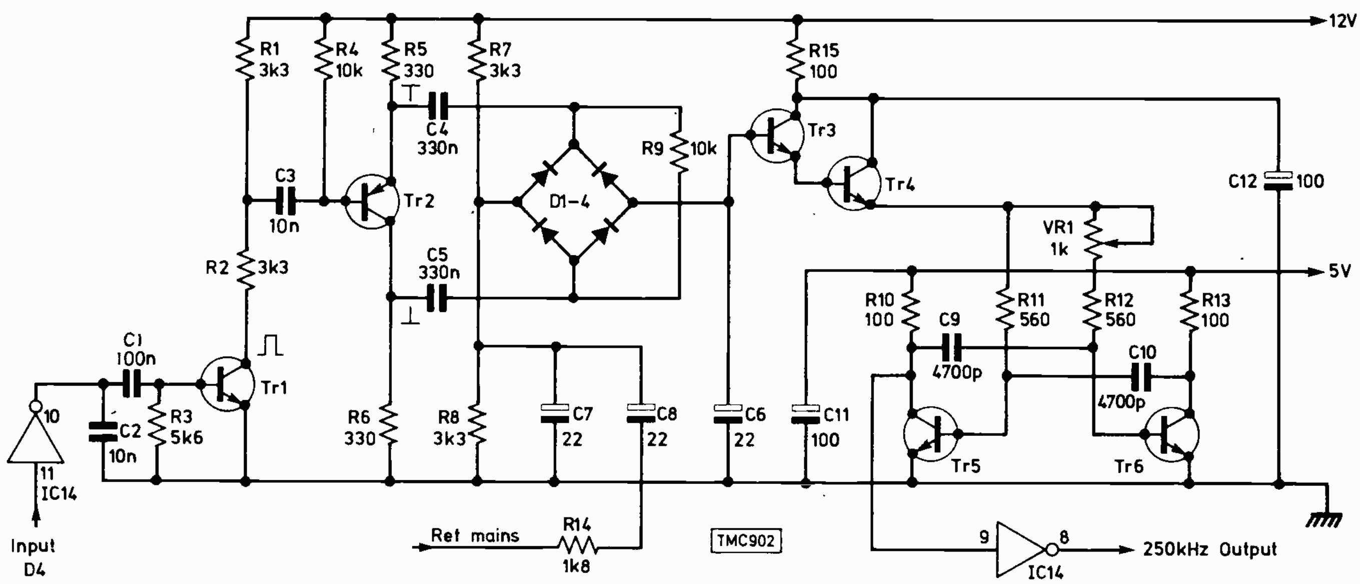


Fig. 6(b): Mains locked oscillator circuit.

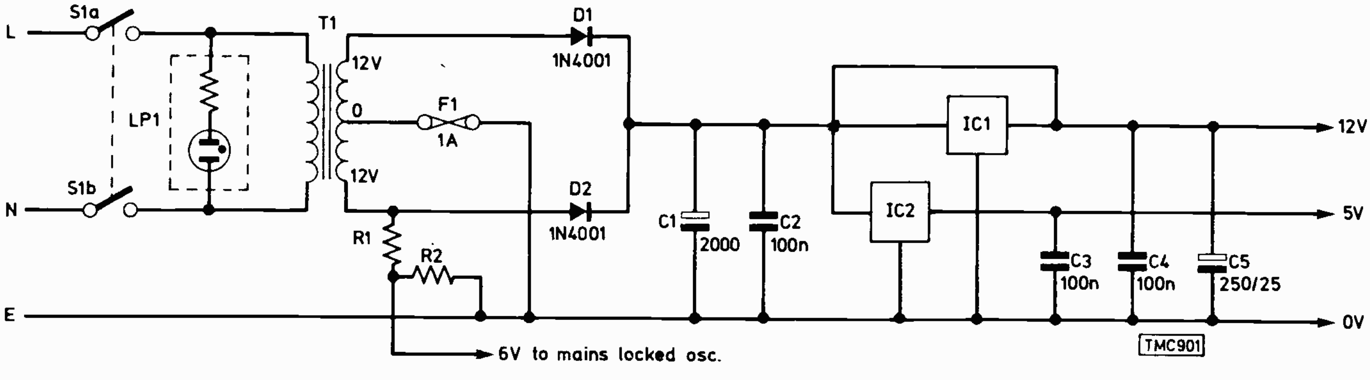


Fig. 7: Power supply circuit.

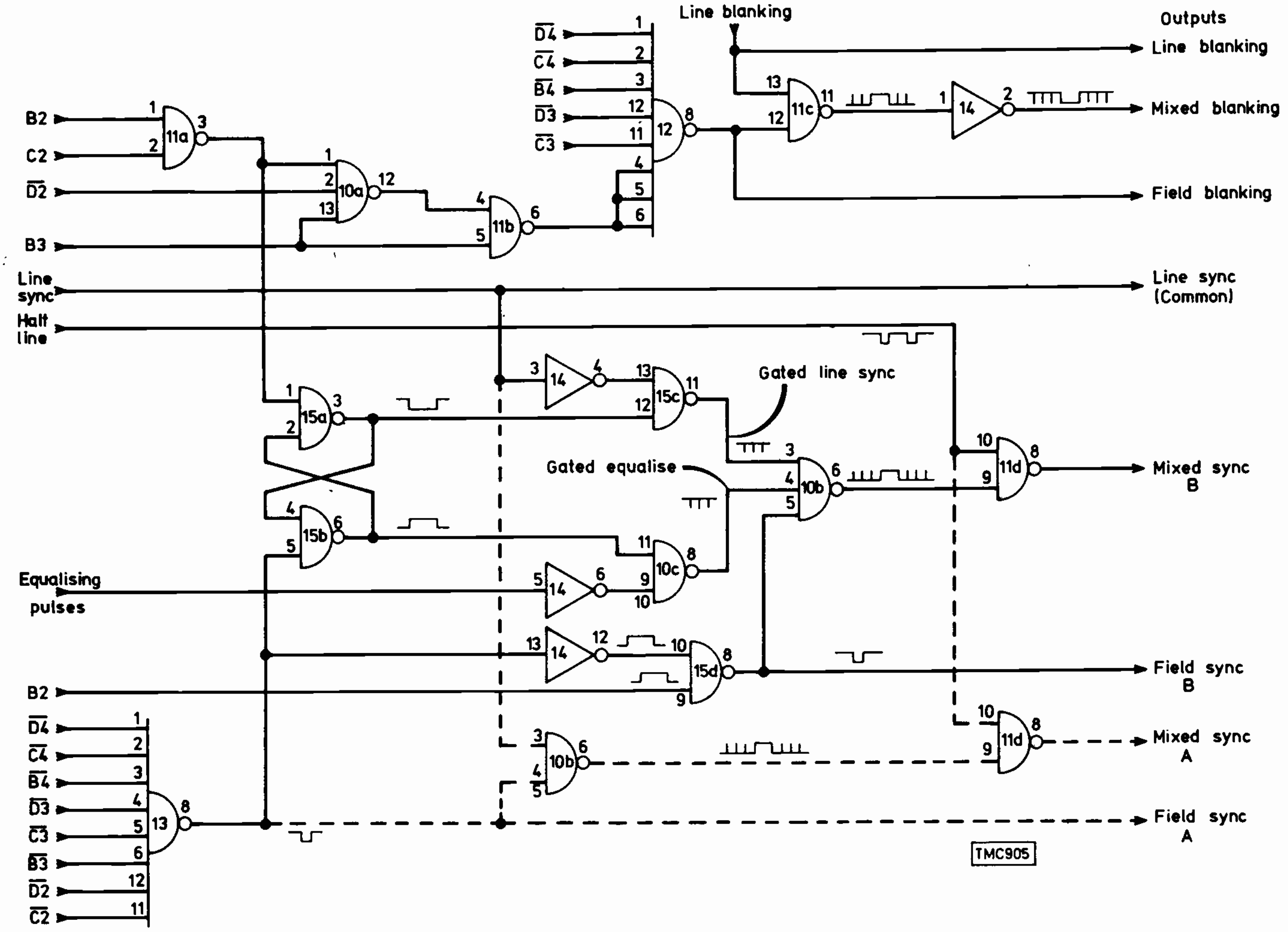


Fig. 8: Field logic – blanking and sync A and B.

does the latter. To give the former, IC10b pin 3 should be connected direct to the line syncs.

IC10b mixes the field sync B with the gated line and equalising pulses, and IC11d adds the half-line pulses to give mixed sync B.

Note that IC11d and IC10b are used in both the field sync A and B logic, as it's unlikely that anyone would wish to construct both circuits at the same time (although it was done in the prototype, to test the circuit).

The oscillator can take many forms. All that is required is an output at 250kHz. Two forms are described, a free-running oscillator using the 74123 dual monostable, and an oscillator controlled by the error signal between D4 and the mains. This gives mains-locked field.

The version using the 74123 is shown on Fig. 6(a). The operation is straightforward, the two monostables triggering each other. VR1 should be adjusted to give the 50Hz period for D4.

The mains-locked oscillator is shown in Fig. 6(b). Output D4 (nominally 50Hz) is buffered by IC14. Tr2 produces antiphase equal-amplitude pulses which are applied to the bridge Rec 1-4. The pulses sample the incoming mains waveform and increase or decrease the voltage on C6. This voltage is buffered by emitter-followers Tr3 and Tr4 and used to control the frequency of the multivibrator constructed of Tr5 and Tr6.

This multivibrator runs at a nominal 250kHz, and produces the 50Hz waveform D4. The frequency of the multivibrator is controlled by the circuit so that D4 follows the mains input. VR1 is the mains lock control, and should be adjusted until D4 locks with the mains.

Mains-locked field sync has advantages in some applications. If there is mains borne interference or ripple on the supplies the resultant noise or hum bars remain stationary and do not drift about the screen.

The logic requires a 5V rail at 0·5A, and the mains-locked oscillator a 12V rail. These are provided by i.c. regulators as shown in Fig. 7.

Construction and Use

The prototype was built on RS i.c. stripboard. The type used will take 16 i.c. plugs which will accommodate all the counter and decoding logic.

No layout drawings are shown but all the pin numbers and wiring details are contained in the logic diagrams.

The logic contains counters and one flip-flop. It's *essential* that each i.c. is decoupled with one 0·01μF capacitor: TTL is notorious for generating spikes on the supply rail, and it should be given no chance of causing trouble.

Supply connections to the i.c.s are as follows:

7490	5V pin 10	0V pin 5
7445	5V pin 16	0V pin 8
74123	5V pin 16	0V pin 8
All others	5V pin 14	0V pin 7

The outputs as given are at TTL levels (0V and 3·5V). Different cameras have different requirements for sync drives. For some cameras this may have to be increased by a simple one transistor stage or provided at a low impedance by an emitter-follower. ■

COMPONENTS LIST: SEE PAGE 417.

Never tap an Aerial with a Two Penny Piece

Les Lawry-Johns

SOME very queer things have been happening lately.

Take the other day for instance. In walked this young chap carrying a white portable TV set of doubtful origin: you know the type, made in Korea or somewhere and obtained through a club (the set not the chap).

"I'd like you to look at this set for me."

So I stared at it hard for quite a while, which didn't seem to do very much except that I get spots before the eyes if I look at white things too long.

"I don't mean look at it, I mean tell me what's wrong with it," he said.

Not wishing to be awkward, we plugged it into our ever ready, cater for everything, multisocket. Its own aerial didn't do much at all, and an outdoor aerial produced only a very noisy picture and hissy sound.

We pronounced our judgement: "It doesn't work very well."

"I know that" he said impatiently, "I'd like to know why it gave a perfectly good picture on its own aerial until I tapped it with a coin."

Working at fantastic speed, our computer brain added up the possibilities and came up with the probabilities.

"We hope it was a copper coin sir. Could be nasty had it been silver."

"It was a two-penny piece, but what difference could that make?"

"Well, considering the conductivity difference between copper and silver, plus other things, a ten penny piece could have had five times the effect."

He looked at me icily. "I have never understood currency fluctuations, but I still cannot see how this affects my television."

Sherlock Holmes took over.

"I should imagine you were wearing some sort of man-made fibre attire, had been engaging in an energetic pursuit, or had been driving a car, wearing gloves and rubber-soled shoes."

That did it. "Well I never" he said, or words to that effect. "I had been out running in my track suit."

"Ah well Mr Watson, you had charged up to a very high potential, and tapping the aerial, as you did, discharged you through the set you see."

"Well I never" he repeated. "I hope I haven't caused too much damage."

"Leave it with us and we'll see what can be done. Look in tomorrow."

So off he went and, rather intrigued, we had a look at the set. The aerial socket was not isolated and was directly coupled to the tuner. Oh dear, the tuner. Most inaccessible. We were finally able to undo the front fixing nut after removing the tuning knob, and with some difficulty extracted the tuner to the extent of the leads.

The cover was secured by a wire clip in the shape of a sawtooth waveform. Removing this didn't really help, so the leads had to come off. The tuner was then placed on the operating table.

We were interested in the r.f. amplifier transistor. Where was it? Where it should have been there was a pinhead with four tiny connections, one leading through into the next compartment. We concluded that this was the collector. The base leads (two) were joined and the emitter went to earth via a 1kΩ resistor. Open-circuit base-emitter.

We had nothing like this except some much larger types used in varicap tuners (and you think these are small?). Viewing the space available however, it seemed possible to use a larger transistor. So we went from the sublime to the ridiculous and selected from the transistor stock a BF180 with nice long legs. Leaving the collector long and cutting the others shorter, we were able carefully to fit it in with the able assistance of the full nursing staff. Connecting up confirmed that the masterly surgery had not been in vain.

Getting the tuner fully back into position was another story, but a dull one.

Mr Watson was very pleased and rather relieved, since he'd borrowed the set from a friend.

Mrs. Smallpiece's Green G8

It was getting near the end of a very frustrating day. Almost everything that could go wrong had. We were just finishing off an Indesit T24 with the left hand, whilst the right was engaged in cleaning the head of a cassette recorder, and at the same time we were telling a chap how to fit a cartridge to the playing deck he had just purchased from a discount warehouse because they couldn't tell him.

The phone rang. It was Mrs. Smallpiece. We had fitted a regunned tube in her G8 (Philips colour) about eighteen months earlier and only the previous day had put in a new tripler, so she'd paid out a bob or two.

"It's gone all bright green and that seems to fade away" she said in her low, seductive voice – the kind that makes you think X certificate thoughts.

"I'll be there before you can say no" I assured her as different possibilities (fault ones of course) cascaded through my mind.

Finally managing to fit the back on the Indesit (no mean feat), and disposing of the remainder of the peasants, we put "closed" on the door and prepared to kill the dragon that was troubling Mrs. Smallpiece.

"Now what are you up to?" enquired my little prairie flower.

"I've got to have a look at Mrs. G8's smallpiece" I stammered. "It's gone all green."

"You went there yesterday, didn't you?"

"Yes, it's a pity last thing like this but I can't leave it love."

"Well it's time Ben had his run. We'll come with you and I'll read the evening paper while you're in the house."

"Right-ho precious, glad of a bit of company really."

So we packed all the gear in our ageing estate car, including the dog and the first G8 signal panel that came to hand, and off we went.

Mrs. Smallpiece answered the door and ushered me into the room where the sick G8 lived.

"Thank you for coming so quickly" she murmured. "You must be very busy."

"I have a fair bit to do" I admitted, looking at her long dark hair. She said the set had made a sparking noise and the screen had then flashed up bright green. Whilst I moved the set out and removed the rear cover, she sat in an armchair opposite and presented a very pretty picture herself.

Switching on the set produced a heavy spark across the focus spark gap on the tube base socket, heavier than 5kV could have done. A new tripler yesterday, intermittently excessive focus potential today. There was no more discharge however, so for the moment we concentrated on the green screen which the beam limiter was trying to cope with.

As expected, voltage tests revealed a very low voltage at the collector of the green output transistor, only about 50V instead of well over 100V as on the red and blue output transistors. We concluded (wrongly) that the spark had damaged the green output transistor, and to hurry things up a bit we whipped out the signal panel and slipped in the replacement. This was the third mistake in as many minutes, surely our darkest hour.

Switching on again I raised my head over the top and looked at Mrs. Smallpiece (legs first frankly). "Better now?"

"No dear, it's still green."

So was I. Head down, no more would our concentration wander. Green collector just as low as before. Remove green flylead from panel, voltage much higher. Oh dear, what could be pulling the voltage down on the tube base socket . . . or in the tube?

With the green lead reconnected but the tube base socket off the tube the voltage remained higher, but still not as high as red and blue. With the tube base on, the voltage on the green cathode fell dramatically. Clearly the tube had suffered as the result of the discharge across the focus gap, or across the tube base socket.

Green gun, grid-to-cathode or heater-to-cathode. Grid-to-cathode leakage didn't bear thinking about. We could cope with a heater-to-cathode leak however.

Switch off set, take off tube base socket. No readable leaks on tube pins. Think carefully. Heater is supplied by a transformer, and the supply is not earthed at the transformer end (see Fig. 1). Check tube base print. One heater pin print goes to chassis. Cut through print, leaving heater connections intact but not earthed.

Right leg getting cramped. Move leg out and tread on removed signal panel. Crunch. Try not to panic. Will repair panel later. Fit tube base socket. Check leads. O.K. Switch on.

"How's that?"

"Still green."

Anguish. *Panic.* No, wait. Wait just a second. Look at screen. Green yes, but not brilliant. Check output transistor

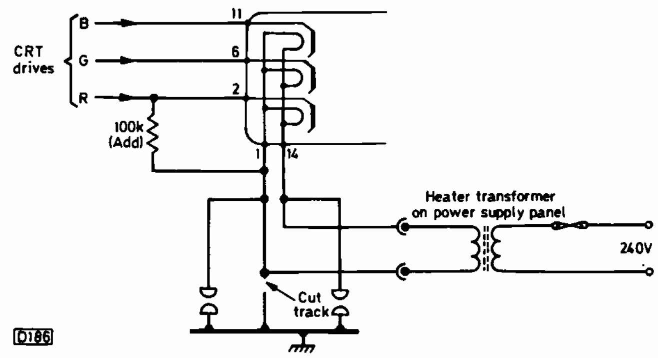


Fig. 1: Dealing with a heater-cathode short on the Philips G8 chassis.

collector voltages. Green lower than the other two. Remember. The panel we picked up was the one which hadn't been checked. The only one not checked, you fool. Why did you have to go and tread on the one you took out?

Checking showed only a crumpled preset. Delve in tool box. Got one. Plug in soldering gun. Out preset, in new one. Change panels. All cathodes now at same potential. Plug in aerial. Lovely, but hang on. The new but suspect tripler is still in and the tube heater is still floating. Stagger out to car.

"Having trouble love?"

"Won't be long now. Once more into the breach dear friends."

In went another tripler. In went a 100kΩ resistor from the heater to the nearby red cathode to keep the potentials just about even.

Clear up and engage in small talk with Mrs. Smallpiece. Just getting down to the nitty gritty when a large young man enters. Must be six feet four, about twenty I'd say.

"Everything all right mum?" "Yes love", says Mrs. S. "Les says it wasn't much really". "Made him sweat though, didn't it?" It did, it did.

So this is a clear example of blundering inefficiency. My inefficiency. *Item one:* The spare panel should not have been taken out unless it had been proved good. *Item two:* The fact that the green output transistor's collector voltage was low did not necessarily mean that the transistor or its operating conditions were wrong. The first move should have been to remove the flylead from the panel to the c.r.t. base and if the voltages on the panel returned to normal there would have been no need to let loose wild geese. *Item three:* Concentrate on what you are doing, not on what you might be doing.

SYNC PULSE GENERATOR

Parts List

Counter Chain and Logic:

IC1 – IC4	7490
IC5, IC6, IC14	7404
IC7	7445
IC8	7420
IC9, IC11, IC15	7400
IC10	7410
IC12, IC13	7430
R1 – R4	4·7kΩ
C1 – C4	330pF ceramic plate
16 off 0·01μF	disc ceramic decoupling capacitors

Power Supply:

T1	12-0-12V secondary at 1A. Marshall's MT213
IC1	7812 regulator
IC2	7805 regulator
D1, D2	1N4001
C1	2,000μF 25V electrolytic
C2, C3, C4	0·1μF polyester
C5	250μF 25V electrolytic
R1, R2	470Ω
F1	1A plus holder
LP1	Mains neon
S1	Mains switch d.p.d.t.
Two five-pin DIN sockets	

Monostable Oscillator:

IC16	74123
R1, R2	4·7kΩ
C1, C2	1000pF ceramic plate
VR1	10kΩ trimpot

Mains Locked Oscillator:

R1, R2, R7, R8	3·3kΩ
R3	5·6kΩ
R4, R9	10kΩ
R5, R6	330Ω
R10, R13	100Ω
R11, R12	560Ω
R14	1·8kΩ
R15	100Ω
VR1	1kΩ trimpot
C1	0·1μF polyester
C2, C3	0·01μF polyester
C4, C5	0·47μF polyester
C6, C7, C8	22μF/16V electrolytic
C9, C10	4,700pF ceramic plate
C11, C12	100μF/16V electrolytic
Tr1, Tr3 – Tr6	BC107 etc.
Tr2	2N3702 etc.
D1 – 4	1N4148

Video Distribution Amplifiers

David K. Matthewson, B.Sc.

THE video signal produced by most CCTV cameras and recorders is a 1V peak-to-peak, low-impedance one which is normally carried from the camera to the monitor etc. by 75Ω coaxial cable. When several monitors are being fed with a signal from one camera or recorder, it's the normal practice to link the monitors in a chain, as shown in Fig. 1.

The first three sets in the chain present the low driving impedance with about 15kΩ input impedance. This enables the sets to "tap off" a signal without seriously degrading the signal passed to the next monitor. The last set must present the cable with a matching impedance – normally 75Ω. Most commercial monitors have two video sockets, one "video in" and the other "video out", and a switch marked "terminate" and "bridge" (or "loop") which places a 75Ω resistor in or out of circuit. Thus a monitor can be used either as an intermediate or final set in a chain by appropriate use of this switch.

It's interesting to note that if a 75Ω line is left unterminated the measured signal on it will be 2V p-p (as opposed to 1V p-p on a terminated line), and that the set will display an overmodulated picture, probably with several ghosts.

If more than about five monitors are to be used, then some sort of amplification will be needed to maintain a suitable signal strength. See Fig. 2.

There is of course a limit to the number of sets and amplifiers that can be cascaded in this fashion without resulting in unacceptable picture degradation. If a large number of monitors, say more than ten, is going to be driven by one signal source, or if the signal source is in the "middle" of a chain of monitors (say a small system distributing signals to three different buildings), then another solution is needed.

This problem cannot be overcome simply by splitting the cable – low-impedance cable cannot be spliced without running into complex matching problems (as all aerial riggers will testify!!). Neither can a passive impedance matching network of the "star" resistor kind be employed, as the losses incurred would be too great for a CCTV system. The only practical answer is to insert a video distribution amplifier (VDA) at the output of the camera, as shown in Fig. 3.

Such an amplifier should have unity voltage gain but a large enough current gain to drive the required number of 75Ω loads. Several commercial units are available to drive either three or six separate video lines.

The design specification for such an amplifier is quite exacting, as it must be capable of accepting a 1V 75Ω signal, amplifying it and making it available to several separate outputs. These outputs must be totally isolated from each other, so that any faults on one line will not affect the whole system. The frequency response and phase distortion characteristics must be such that a colour signal can be handled with no appreciable loss, which means a response of ±1dB or so from d.c. to 10MHz and less than 0·5% phase distortion at 4·43MHz.

As noted previously, several commercial firms manufacture VDAs, either as rack mounting or stand alone units. An alternative to an off-the-shelf product is to design and construct one, and with the increased availability of suitable integrated circuits in recent years this has become a relatively easy task. The following design was constructed to provide a one-in, four-out VDA to drive studio and

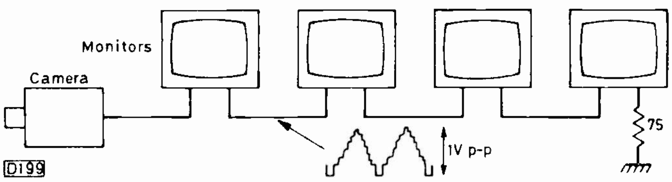


Fig. 1: CCTV camera feeding four monitors.

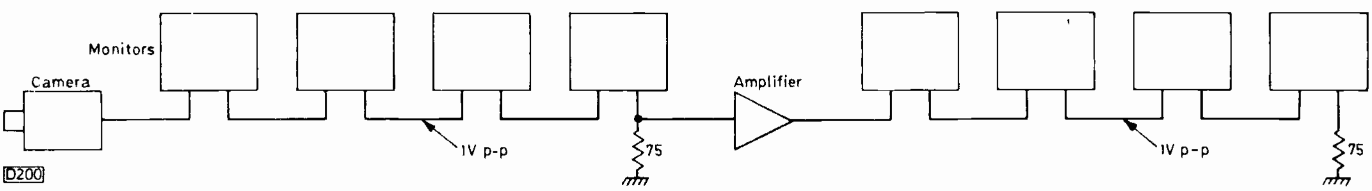


Fig. 2: CCTV camera feeding eight monitors, with an amplifier in cascade.

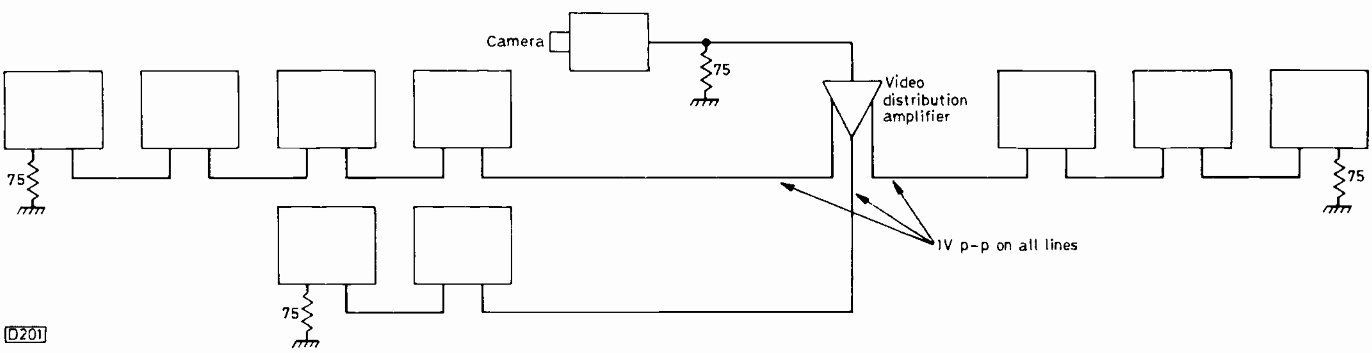


Fig. 3: CCTV camera feeding a video distribution amplifier which in turn drives three isolated lines.

dressing room preview monitors from a transmission mixer output.

The VDA is built around an interesting thick-film circuit which is made by ITT to a BBC design. The internal circuit of the i.c. is shown in Fig. 4. It will be seen that there are two gain stages followed by an emitter-follower to match the amplifier to the low-impedance cable it is intended to drive. Negative feedback can be applied via pins 10-20, enabling the user to vary the gain. When these two pins are linked together a maximum of 30dB feedback will be obtained and the overall gain of the i.c. will be 0dB. The gain can be altered by inserting a resistor between the two feedback points – a 500Ω potentiometer is suitable. The polarity of the signal at the input and the output is the same, and the device is designed to accept a 1V p-p signal and give the same output.

A power supply of +12V at 40mA is required – ITT suggest using +8·5V and −4·5V, to give an output with a d.c. level of 0V, but for many applications this is not essential. Although a split supply removes the need for a large capacitor at the output, it will make the input terminal about +4V, thus necessitating a d.c. blocking capacitor at the input. If required, a supply of up to +18V can be used – indeed such a supply will enable the VDA to drive five separate 75Ω outputs without clipping occurring.

The final design for a one-in, four-out VDA is shown in Fig. 5. The output impedance of the device is about 0·2Ω, and to match 75Ω cable a 75Ω resistor is needed in each output line.

The amplifier is easily assembled on a piece of Veroboard and the accompanying photograph shows the finished prototype. The only setting up required is that of the gain potentiometer. This can be done either by using an oscilloscope or, less satisfactorily, by watching the output picture on a monitor. The unused outputs should not be terminated.

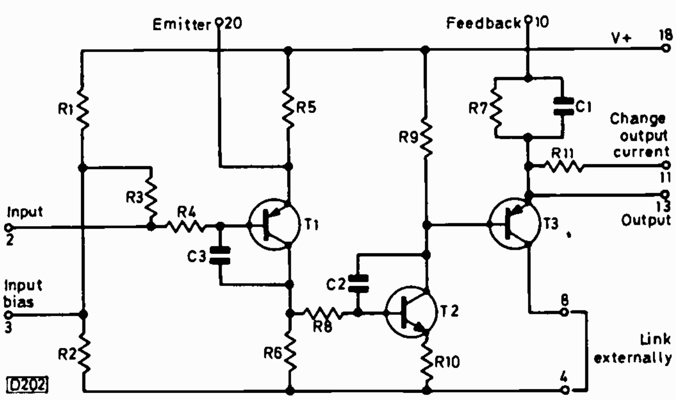


Fig. 4: Thick-film video amplifier type 58CPX00 233BAA.

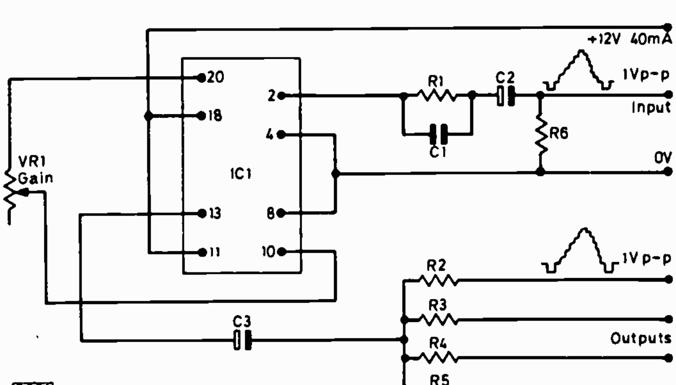
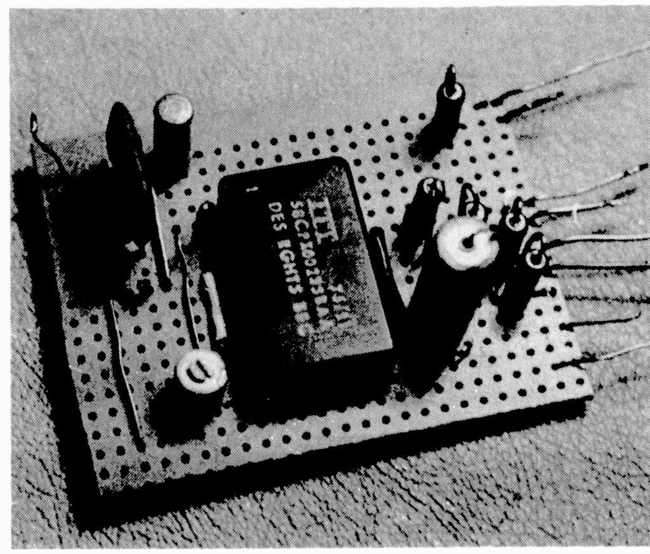


Fig. 5: Final VDA circuit using the 58CPX00 233BAA.



The completed unit, assembled on Veroboard.

In practice the VDA has been found to pass quite acceptable colour signals over several hundred meters of coaxial cable. ■

★ Components list

IC1	58CPX00 233BAA
C1	100pF ceramic
C2	2·2μF 16V tantalum
C3	220μF 16V electrolytic
R1	5·6kΩ ¼W
R2-6	75Ω ¼W
VR1	500Ω cermet trimmer

Editorial note: The 58CPX00 233BAA thick film video amplifier is available to the trade from ITT Component Group Europe, Film Circuit Division, Brixham Road, Paignton, Devon. Minimum quantity is 25, trade price £31.02 each for orders of 25-49. Delivery is 15-20 weeks. If a sufficient number of readers write in we will see whether a stockist is prepared to supply them.

Servicing the Philips G8 Chassis

Part 1

M. Phelan

THE Philips G8 chassis, the first all solid-state chassis to be introduced by this manufacturer, has been with us since 1970. In this time it has undergone many changes, although all the panels are interchangeable. On the whole it has proved very reliable and capable of excellent results.

The G8 uses a thyristor to supply the h.t., all other supplies except for the c.r.t. heaters being derived from the line output stage. It has a varicap tuner, and the i.f. strip consists of prealigned modules. The decoder uses transistors and either one or two i.c.s – or in later models is of the standard four i.c. type. All have primary colour output.

Power Supply Circuit

The power supply circuit follows the normal arrangement for a thyristor power supply, and is very similar to those used in other makes. The following description applies to the earliest version: modifications are discussed at the end.

The mains supply comes from the switch to the two-pin plug at the bottom of the panel, then to the anode of the thyristor SCR1379 via a 3·15A fuse, the 2·2Ω dropper section, and the filter circuit consisting of L1378 and C1366.

The mains waveform is also fed via R1386 and R1373 in parallel to C1376, the waveform across the latter lagging behind that of the mains. When the charge on C1376 reaches the breakover voltage of diac D1377 (approximately 33V) – this happens during the second quadrant of each mains cycle – the diac conducts and discharges C1376 across R1384. The positive spike thus produced across R1384 is limited by zener D1363 and applied to the gate of SCR1379 by C1383. As the gate is at cathode potential due to R1380, the pulse drives the gate positive with respect to the cathode and the thyristor conducts. On reversal of the mains polarity, it turns off again.

Control is achieved by putting a variable leak, in the form of a transistor, across C1376. The base of the transistor (T1374) is fed with forward bias via R1372 and D1371 from the h.t. rail. If the h.t. tends to rise therefore, the transistor conducts more, the charging of C1376 is delayed and SCR1379 is fired later – the converse applies of course if the h.t. falls. R1368 feeds a.c. to the base of T1374 to correct for variations in the mains voltage by the same method.

R1370 forms an adjustment for the h.t. voltage, and the zener diode D1371 in the base circuit is included to cancel out the temperature coefficient of the transistor's base-emitter junction.

A similar circuit, based around T1399, is also connected across C1376 and serves as an over-voltage protection system in the following way. T1399 is normally without forward bias, but if the h.t. rises, due to a fault, it starts to conduct – the h.t. voltage at which it does so depends on the setting of R1396. When T1399 conducts, D1398 is forward biased and the conduction angle of the thyristor becomes less, due to the extra "leak" across C1376. The h.t. then falls as C1385 is discharged, until T1399 cuts off again. The cycle repeats if the fault is still present, causing the picture to "flutter" rhythmically.

Most of the modifications to this panel concern the arrangement of the components in the stabilisation circuit. Very early panels did not have D1363 fitted. Later ones have D1371 in the emitter circuit of T1374. Also a diode D1357 is connected in parallel with C1376 to discharge it fully on the negative half cycles of the mains, otherwise the charge remaining depends on the point at which the diac stops conducting – any charge remaining can cause the circuit to trigger early on the next half cycle. This modification is worth carrying out on earlier panels, as is the reduction of R1384 to 4·7kΩ for the same reason.

The greatest difference between different versions of this panel has been the different types of thyristors and the amazing variety of different shaped heatsinks fitted. Earlier ones used a BT106 in a U-shaped heatsink. Then came a long alloy stem and a short alloy collar – both got very hot, as did the BT116 with a large alloy washer for cooling. Then came the BT106 with a disc type cooling fin mounted on the print side of the panel, with an extra nut on the thyristor. Latest panels use an OT112, which seems to be very reliable.

The degaussing circuit has been modified by omitting the v.d.r. R1361, and feeding in the c.r.t. heater supply to cancel out the small residual current in the degaussing coils when R1362 is hot. R1358, 1·5Ω or 1Ω, acts as a fuse.

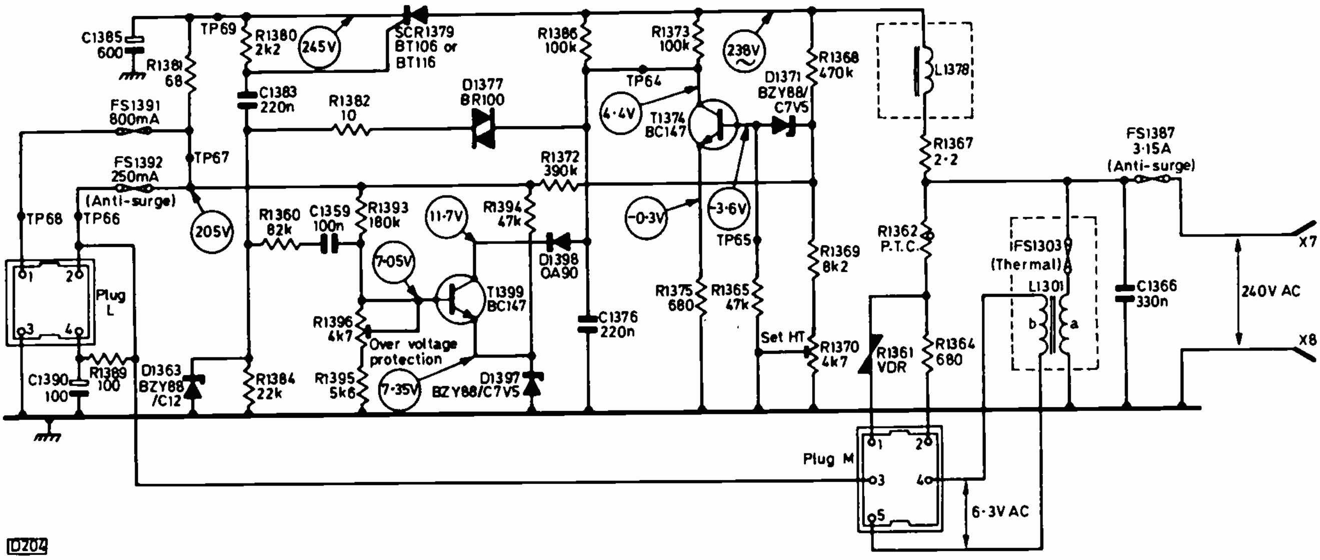
Apart from the dropper R1367/R1381 going open-circuit, most faults on this panel are semiconductor failures. The mains fuse often shatters at switch on due to the absence of a slow-start circuit, but sometimes due to SCR1379 or C1366 being short-circuit. More rarely the 600μF reservoir capacitor C1385 goes short-circuit, or the dropper resistor develops a conductive path between the top connection and the holding lug. L1378 is prone to buzzing (soak in epoxy resin) and dry-joints.

If C1385 loses capacitance the h.t. falls, with a slight hum bar. Sometimes after the BT106 has been replaced no results are forthcoming when the set is switched on. If you are lucky you will see that the piece of print along the bottom of the panel has disappeared. It forms the main earth between the chassis and the power supply. If you are unlucky, you will find you have 240V a.c. at the anode of the thyristor but nothing at its cathode – here fault-finding begins in earnest!

First check that the thyristor hasn't gone open-circuit by applying your meter prods on the lowest resistance range to the cathode and gate terminals, with the set switched on. If the set comes on, remove the prods *immediately* – or the h.t. will rise to some 300V. If nothing then happens, the thyristor is sound and the fault lies in the control circuitry.

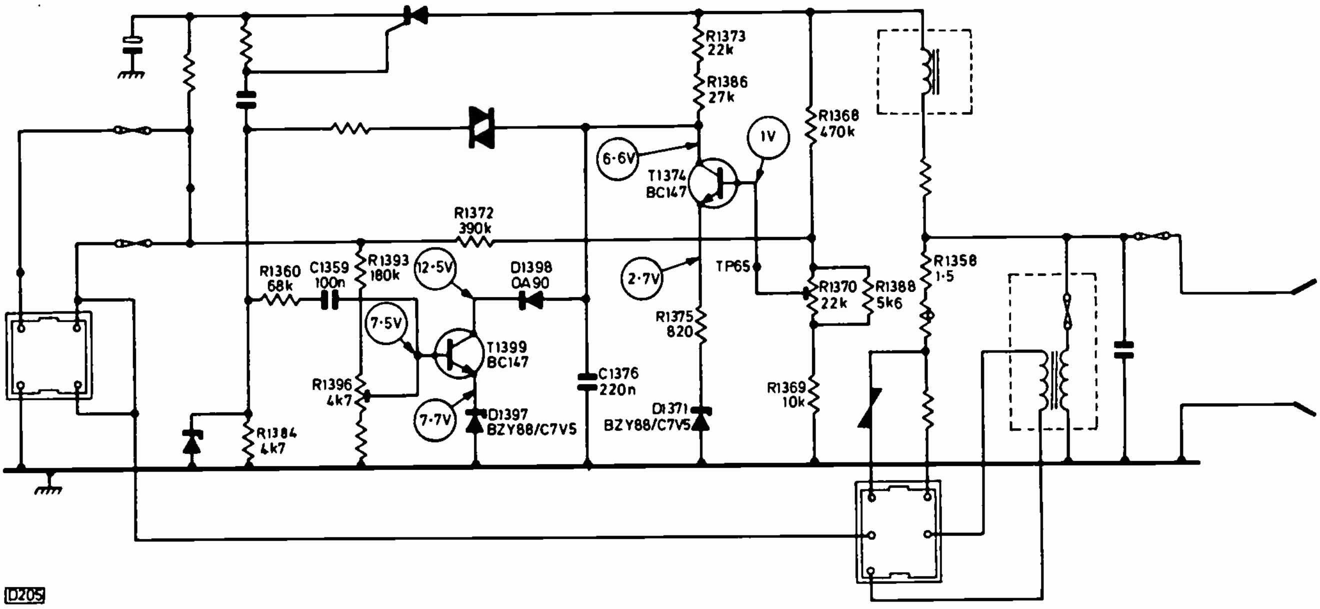
If so, disconnect D1398 to isolate the overvoltage circuit. If the set then works, probably D1398, T1399 or D1397 is faulty. If it doesn't, remove T1374, switch on momentarily and if the set works T1374 is faulty or D1371 is short-circuit. If the set is still dead, the diac is probably short-circuit or D1363 if fitted is short-circuit. The passive components in this circuit give very little trouble.

Apart from a "dead" set (which can be caused by a line timebase failure) most of the other power supply faults cause a fluttering picture, due to the fluctuating h.t. The main culprit is the thyristor whose leakage increases, causing the



D204

Fig. 1: Power supply circuit – early version.



D205

Fig. 2: Modifications to the power supply circuit. Unlettered components as in Fig. 1.

h.t. to rise and fluctuate. Under these conditions the overvoltage protection circuit doesn't operate as the thyristor is fired by its own internal leakage, not by the gate pulse.

The thyristor should show no measurable leakage between its anode and cathode either way when out of circuit. Even a leakage of 15MΩ, measured on an Avo 8, will cause fluttering when the set gets really hot. The diac can also cause flutter, but of a more irregular nature. A clue to this is that the h.t. voltage will *fall* if the diac is leaky and *rise* if the thyristor is.

In an emergency the diac can be reversed and will work providing one junction only is leaky. The earlier panels used green BR100s which were moderately reliable, then came large glass ones which weren't, then small orange glass ones which are fairly good. A diac should measure open-circuit both ways.

D1363 if open-circuit produces no noticeable difference: if leaky it can give rise to fluttering and reduced h.t. Don't forget to check the setting of R1396 however before becoming involved.

To adjust the power supply, turn R1396 fully anti-clockwise to disable the overvoltage circuit, set R1370 for 220V, then turn R1396 clockwise until the picture starts to flutter, finally adjusting R1370 for 205V or for greater reliability 200V. Voltages are measured on either fuse.

The degaussing circuit does not cause many problems. The 680Ω resistor R1364 sometimes goes open-circuit so that the degaussing remains on all the time. Replace with a wirewound component. R1358 on later panels goes open-circuit for no apparent reason. Replace with the same type of resistor as it's a safety component with no other circuit function.

There is a thermal fuse in the mains transformer. This rarely fails, no c.r.t. heaters being alight usually being due to the base itself or badly crimped pins in the plug or on the power supply.

Line Scan Unit

The line scan unit contains the line driver and output stages, l.t. and boost supplies and the beam current limiter. The following description applies to the earliest version: modifications will be discussed later. Each section of this

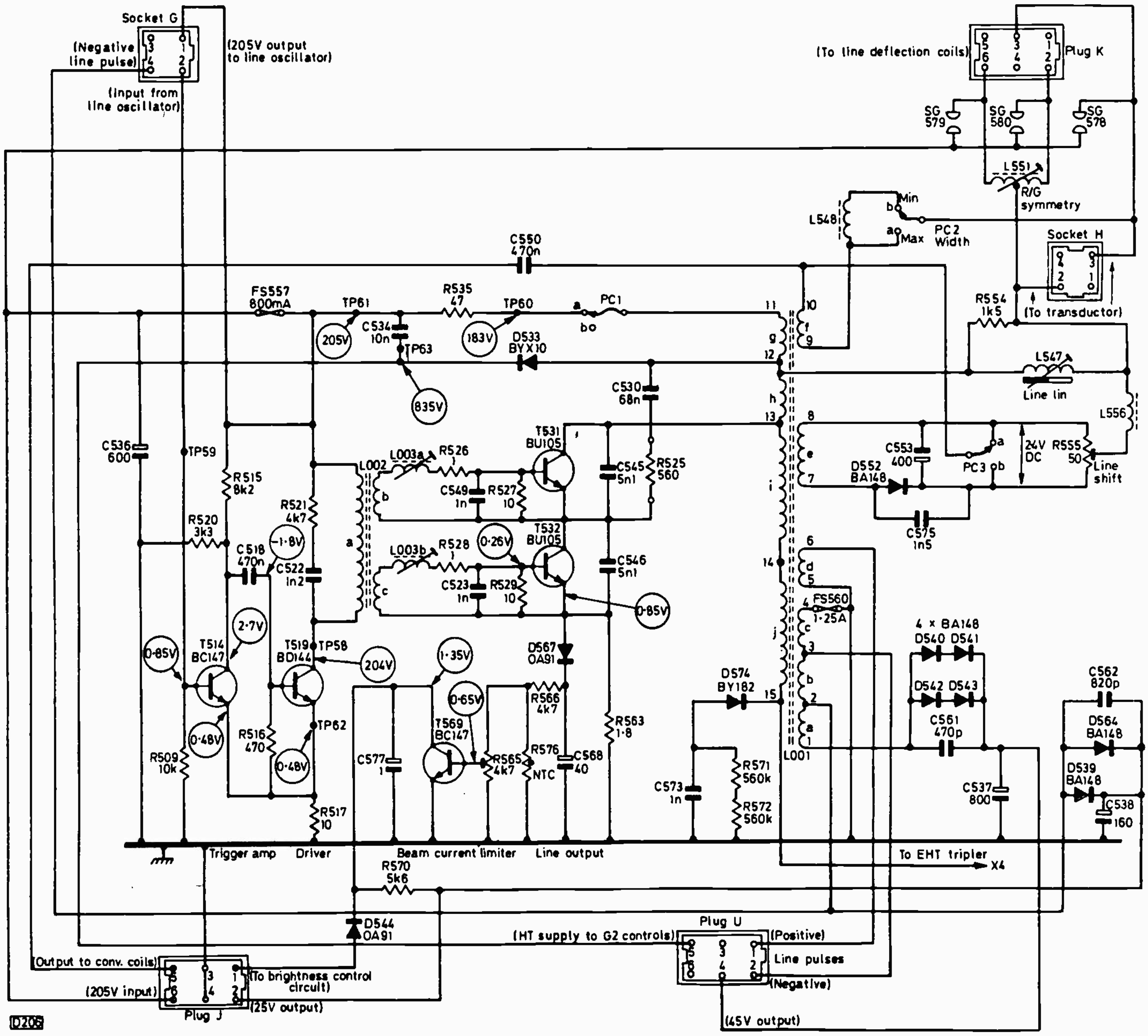


Fig. 3: Line driver and output stages with beam limiter – early version.

article will be thus given to make reference easier.

T5514 and T5519 form a Schmitt trigger, which converts the incoming waveform from the line oscillator to a squarewave with a fast rise time. The sinewave input is applied to the base of T5514, whose emitter is connected, together with that of T5519, to earth via R5517. When T5514 is "off" and T5519 "on", the emitters are at a higher potential than when T5514 is "on", due to the much larger emitter current of T5519. With T5519 "on" and T5514 "off", the rising sinewave turns T5514 on slightly and its falling collector voltage is fed via C5518 to the base of the driver, turning it off. The emitter voltages fall, increasing the base current of T5514, which turns on harder. This regenerative action results in T5514 being saturated and T5519 biased off (due to the large value of C5518, the charge on it remains fairly constant, so it can be imagined to act as a resistor).

When the negative-going part of the sinewave starts to turn T5514 off, the collector voltage rises, T5519 starts to conduct, and the rising emitter voltage switches T5514 rapidly off. Thus the current flowing through the driver transformer L5002 is a squarewave. R5521 and C5522 across the primary damp out any rings.

This chassis has two line output transistors in series and these have to be driven on simultaneously and switched off likewise. It is the switching off that presents the problem, as these large transistors have fairly low gain and high hole storage times. This means that not only has the base current to be cut off, but also stored charges have to be extracted from the base-emitter junction. The two coils L5003A and B on the same former provide an adjustment for simultaneous switch-off. R5526 and R5528 limit the base current, R5527 and R5529 provide a low-impedance path for stored charges. The tuning of the line flyback time is done by C5545 and C5546 in series. They are of equal value to give the same flyback pulse amplitude across each transistor.

Various tappings on the output transformer give outputs required for various parts of the set. There are two l.t. supplies, 45V for the field timebase and sound output stage, rectified by D5540, D5541, D5542 and D5543 in series-parallel and smoothed by C5537, and 25V for the tuner, line oscillator, i.f. strip and decoder, rectified by D5539 and D5564 and smoothed by C5538. A fuse is fitted in the

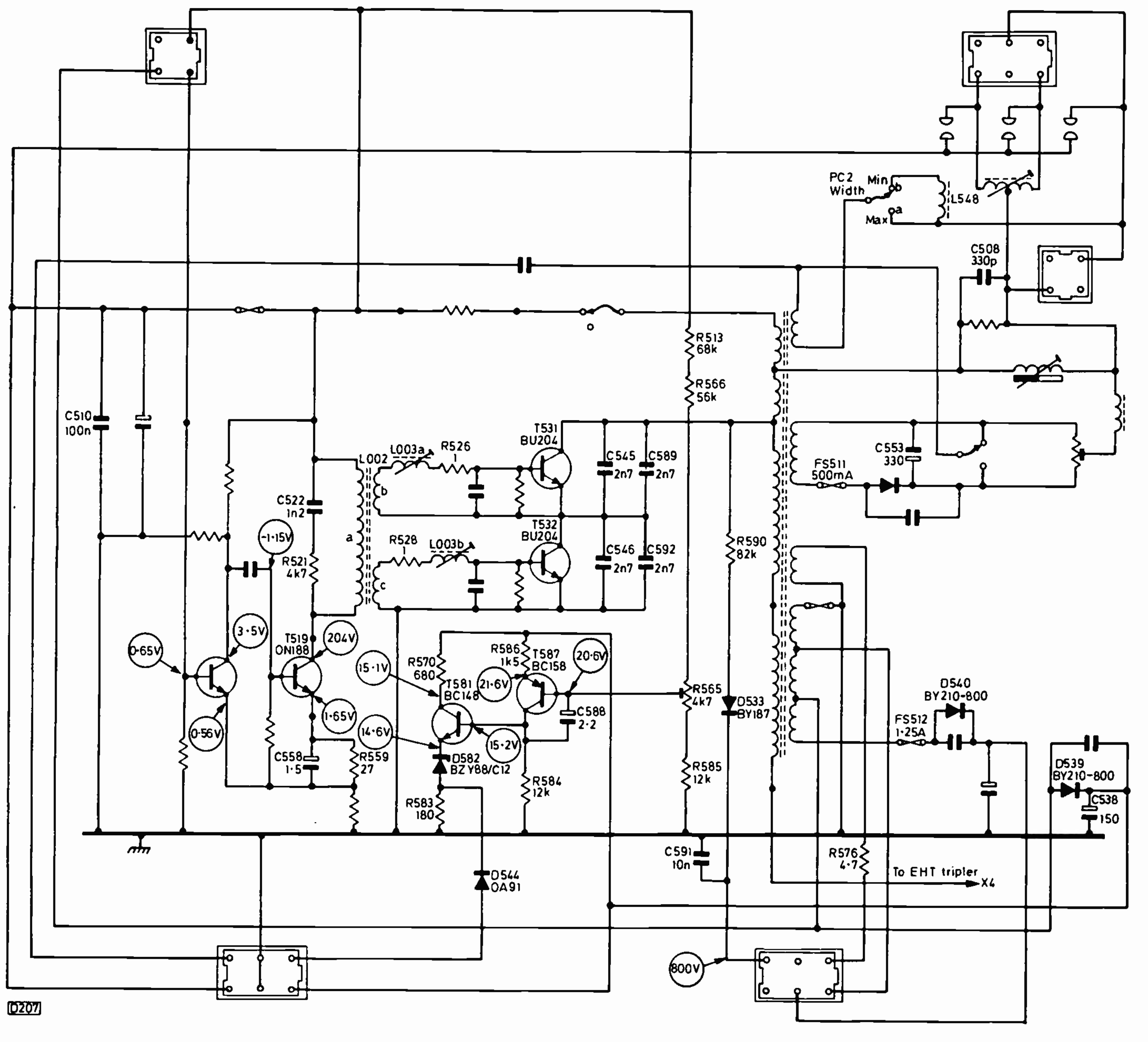


Fig. 4: Later version of the line driver and output circuits. Unlettered components as in Fig. 3.

earthy end of the l.t. winding.

The line output transistors are supplied from the 205V h.t. rail via the 47Ω "anti-breathing" resistor R5535. D5533 and C5534 supply the c.r.t. first anodes. The shift circuit is conventional, injecting a variable positive or negative d.c. into the scanning circuit through L5556. Two positions of width adjustment are provided by inserting a choke L5548 in series with the scan coils by means of flying lead PC2.

The input to the tripler is also fed to D5574, which passes any negative overshoots on the flyback pulse to R5571, R5572 and C5573. This network absorbs the overshoots, improving the e.h.t. regulation and providing a measure of protection against c.r.t. flashovers.

The output stage current flows through R5563, developing a voltage which is proportional to beam current. A fraction of this voltage is used to forward bias T5569, the beam current limiter. D5544, whose anode is connected to the brightness control slider, is normally reverse biased by R5570, but when T5569 saturates, the bias is removed and D5544 conducts earthing the brightness control voltage.

The later type of beam limiter differs completely in its method of operation and a description will be given here. It works by comparing the stabilised 205V rail and the 25V rail, the latter falling slightly under high beam current. T5581 and T5587 are a directly coupled pair, and R5565 is adjusted so that under normal conditions they are both saturated. Consequently zener diode D5582 is conductive, and the voltage developed across R5583 biases off D5544. When the beam current becomes excessive, the emitter voltage of T5587 falls, its base voltage remaining constant. T5587 and T5581 turn off therefore, and when the emitter of T5581 falls below 12V, D5582 becomes non-conductive. The reverse bias is then removed from D5544 as in the earlier circuit.

The first panels had a 560Ω resistor and an 0·068μF capacitor connected between the junction of the output transistors and tag 12 of the line output transformer. These components were deleted, as was the network D5574 etc. These components can be removed in the interests of greater reliability. Later panels have the improved beam limiter described above, also a 27Ω resistor and 1·5μF capacitor in parallel in the emitter of the driver transistor. The latest issue has two 0·0027μF capacitors in parallel instead of an 0·0051μF for each of the flyback tuning

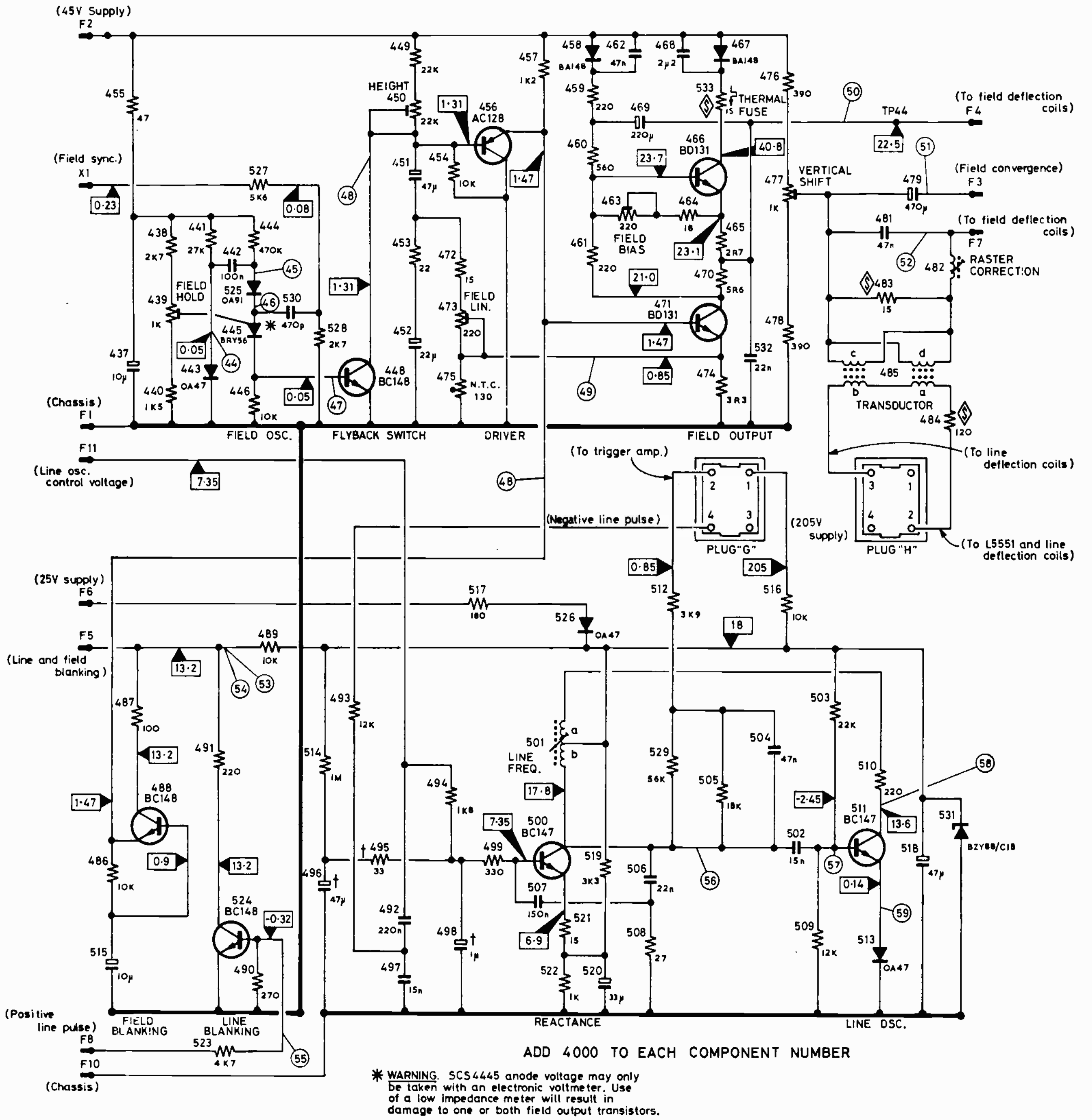


Fig. 5: Later version of the timebase panel. In early versions type BD124 field output transistors were used. Components marked with a dagger can be altered to obtain VCR compatible operation – see text.

capacitors, the l.t. rectifiers are single diodes, there is an extra fuse in the 45V rail and one in the shift circuit.

This panel is responsible for a number of faults, but is very easy to service. A blown 800mA fuse (F5557) should be replaced and PC1 disconnected to remove the supply to the output stage. Switch on: if the fuse blows the fault is in the driver stage – it is sometimes fairly obvious, as R5517, R5559 and sometimes R5516 are burnt up and C5558 has melted. If this is the case, the driver transistor will be found to be short-circuit and probably the transformer as well. The primary should measure 28Ω. If this sort of thing happens fairly often, check the value of R5520 (3·3kΩ).

If the fuse remains intact with PC1 off, reconnect it and remove the tripler input lead. If the fuse blows, then either both line output transistors or both tuning capacitors are leaky (the green type of capacitor is more reliable than the earlier blue ones) or the transformer is faulty – not very common. The mica washer under the output pair sometimes develops a hole. D5574 will blow the fuse if short-circuit, but it's usually obviously burnt, as sometimes are R5571 and R5572. Discard D5574 if fitted.

If the fuse has still not blown again, then of course the tripler is faulty.

If the pincushion correction transductor has shorted turns (it's not on this panel) then the fuse will blow, usually accompanied by large volumes of smoke from the said component (check by removing plug H).

When replacing this, the tripler or the field or line output pairs, check the h.t. voltage and check the thyristor in the power supply for leakage (see power supply) as quite often this is the original cause of the trouble.

A blown l.t. fuse gives no field scan and no sound – the cause will be elsewhere. If C5538 (160μF) goes open-circuit it gives rise to some really perplexing symptoms. The brightness and colour controls interact, and the picture has a band of no chroma down the left-hand side, followed by a band of Hanover blinds.

C5536 (600μF) if open-circuit gives rise to a similar fluttering effect to a power supply fault. Lack of c.r.t. first anode voltages should lead one to D5533 or more likely to the charred blob where D5533 was! Replace C5534 if necessary, and check that no one has dropped any nuts or screws into the convergence panel if it is of the front mounted type.

If h.t. is present on the 800mA fuse, the fuse is intact, yet the set is dead, check for h.t. at the collectors of the output pair. No h.t., and the 47Ω wirewound resistor R5535 is probably open-circuit. H.T. on one transistor and no voltage on the other indicates no drive to one or both transistors. First check at TP59 to see if there is input from the oscillator (should be less than 2V and more than 0·6V). If this is o.k., which it probably will be, check for negative voltage at the base of the driver transistor and 0·5V or so at its emitter. If these voltages are absent T5514 is probably faulty, or R5515 open-circuit.

R5559 (27Ω – on later panels) sometimes goes open-circuit or high, giving lack of width.

If no h.t. is present on the collector of the driver transistor then the hank bushes to which it's screwed are probably dry-jointed – a large iron is needed here.

Both T5514 and T5519 can go intermittently open-circuit – "the picture went into a vertical line, then the set went off".

The panel at the top, carrying the tuning capacitors, is prone to dry-joints, causing no drive.

Excessive width should lead one to check the collector voltages on the output pair (some meters object to this – I use an Avo 8). One should be exactly half the other. If the lower transistor has either full h.t. or nothing on its collector, then one of the transistors or tuning capacitors is short-circuit. Adjust the equalising coil L5003 (if the core isn't stuck) for minimum width. Usually the core has to be soaked in oil or the coil replaced before adjustment is possible.

The earlier beam limiter circuit is fairly reliable, but R5563 sometimes burns up, the line output stage current then flowing through the beam limiter stage, obliterating it. The later beam limiter circuit gives trouble with intermittent low brightness, usually caused by the 12V zener diode D5582 going open-circuit. Replace with a BZX61 type and check that R5570 is 680Ω, not 68Ω as it was on some panels. Both the beam limiter transistors can be intermittent too. For other causes of brightness variations, see the decoder section later.

Panels coded BY25 or later sometimes give a single striation down the left-hand side of the raster. This can be eliminated by fitting a 3·3Ω 3W resistor in series with FS5511, the fuse in the shift circuit.

Timebase Panel

The timebase panel contains the entire field timebase, the line oscillator, raster-correction and blanking circuits. The operation of the s.c.s. field oscillator will not be explained in detail as there have been several excellent articles in this magazine in the past describing it fully. Suffice it to say that positive-going pulses are produced across R4446. These pulses turn on T4448, which discharges C4451 and C4452 to give the flyback period. During the scan, these two capacitors charge towards 45V through R4449 and the height control R4450. The sawtooth voltage is fed to the base of the emitter-follower T4456, progressively turning it off during scan and on during flyback.

The output stage, which at first glance looks like a class B one, is actually class A. T4471 is the output transistor proper, with T4466 acting as its load. It can be looked upon as a constant-current source. At the beginning of the scan, T4471 is off and T4466 is saturated due to the bias from R4459, R4460 and D4458. As the scan progresses,T4471's conduction increases, the midpoint voltage falls, and due to the potential developed across R4465 and R4470 T4466 is progressively turned off.

When the flyback occurs, T4471 is turned off, the mid-point voltage rises, and T4466, which is saturated, conducts in reverse. Due to the inductance of the scan coils resonating with C4468, the voltage at the cathode of D4467 rises above h.t. biasing it off. D4458 is also biased off, so the scanning circuit is free to undergo a half cycle of oscillation until D4467 is forward biased again and the stored energy is returned to the h.t. supply. C4469 feeds part of the scan waveform back to the base of T4466, increasing the gain of the output pair. The return from the scan coils goes to the shift control slider which is at approximately half the supply voltage. The field convergence circuits are fed through C4479 which blocks d.c. but acts as a very low-impedance at field frequency.

The transductor has one set of windings in series with the field scan circuit, L4482 and C4481 forming a tuned circuit resonant at line frequency. L4482 is adjustable to alter the phase of the correction waveform. R4483 damps the transductor to prevent it ringing. The other set of windings on the transductor is fed with line pulses through R4484.

T4500 and T4511 form the line oscillator circuit. T4511 is a Hartley oscillator, the coil being connected between its collector and base. T4500 functions as a reactance stage, the feedback from its collector to base being phase-shifted through C4506, C4507 and R4508. C4496, R4495 and C4498 form the time-constant filter.

As the line oscillator is supplied from the 25V rail from the line output stage, means must be provided to start it. This is carried out by R4516 which supplies a reduced voltage to the oscillator to start it. D4526 is reverse biased until the 25V rail is established, so that R4516 supplies only the line oscillator and not everything else fed by the 25V rail.

The sinewave at the collector of T4500 is fed to the line scan panel via the network C4504, R4505, R4529 and R4512.

Line pulses are fed back to the i.f. panel on the same lead that carries the control voltage to the reactance stage. T4488 and T4524 amplify the field and line frequency pulses respectively to give a composite blanking waveform.

Not many modifications have been made to this panel. A 15Ω wirewound resistor, R4453, was added between the junction of C4468/D4467 and T4466's collector. On later panels this is a fusible resistor, and the output devices are type BD131.

The latest panels have the flywheel sync time-constant altered as follows to make them VCR compatible. This modification can be carried out on all panels. R4495 changed from 33Ω to 47Ω; C4496 from 47μF to 10μF; and C4498 deleted. Another component addition is necessary on the i.f. panel, and will be mentioned in that section.

If a panel thus modified gives poor line sync under very noisy signal conditions on off-air transmissions, it will be necessary to restore it to the original circuit.

The latest panels have a three-position switch in place of the field shift potentiometer.

This panel gives rise to a fair proportion of the faults on this chassis. Apart from the usual adjustments the only extra one is the output stage bias adjustment R4463, which should be set for 23·5V at TP44, or 22·5V on panels with R4533 fitted. The line hold set-up will be covered under the i.f. panel adjustments.

The most common fault is failure of the field output pair, blowing the 1·25A fuse on the line scan unit. Before replacing them, check that the oscillator is running by measuring the voltage at TP52 (T4448 collector) – if more than 1·5V, the oscillator has stopped, usually because of dry-joints around the field hold control. Be careful when replacing the back cover on these sets, as it can easily press on the contrast and field hold controls and crack the print around them. Also check the thyristor in the power supply for leakage.

Other causes of repeated failure of the output transistors are c.r.t. flashovers and a noisy or dry-jointed bias potentiometer. Replace R4465, R4470 and R4474 if they are visibly burnt. With the earlier BD124 type transistors the hank bushes to which they are screwed are often dry-jointed. On later panels the collector connections are made by separate leads.

Lack of height when warm is usually either a faulty transductor or a leaky AC128 driver transistor. For greater reliability replace with a silicon device (BC143, BC126, BFX88 etc.) and insert a silicon diode (1N914, BA148, BY127 etc.) between the emitter of T4471 and R4474/R4475 (anode to the transistor's emitter of course).

If the midpoint voltage (TP44) is correct, then field collapse will probably be due to a fault on the convergence panel. This can be checked by earthing pin 3 on the edge connector, and also checking for continuity of the scanning circuit between pins 4 and 7, with the panel removed (should read approximately 15Ω).

On later panels, failure of the 15Ω fusible resistor after prolonged operation is usually due to excessive h.t. or occasionally leaky BD131s which can also give intermittent field collapse.

The s.c.s. rarely fails but can be responsible for poor interlace or gradual closing up of the field scan. Do not try to measure any voltages on the s.c.s. – this will stop the oscillator and destroy the output transistors.

The transductor often goes up in smoke, taking R4483 and R4484 with it. These resistors must be replaced with the same types, and mounted clear of the panel. If a transductor is not to hand, plug "H" (the red one behind it) can be temporarily left out. Again, *check the power supply.*

Severely reduced field scan occurs when C4479 goes open-circuit.

The line oscillator is extremely trouble-free, the only components giving trouble being C4520, the emitter decoupler in the reactance stage – it goes open-circuit to give no line sync – and the 18V zener D4531 which goes open-circuit to give line drift. Like most of the faults caused by zener diodes on this chassis, it usually clears when the set is warm. Also, for each fault symptom there are usually two zeners which can be responsible on different panels! For the other line drift one, see the i.f. panel section.

A rather puzzling fault occurs if the start-up resistor R4516 becomes dry-jointed, as it often does. The set is dead until the cabinet is tapped, then no amount of tapping will make it go off again as once the line oscillator has started R4516 is no longer required.

The blanking circuit is also very reliable, but on the later G8 chassis with the combined i.f. and chroma panel blanking failure will give a bright raster with no information on it.

CONTINUED NEXT MONTH

HOW TO USE A SCOPE

– *continued from page 407*

The Art of Alingment). The basic idea is to feed the sweep generator with the scope's timebase output, and to display the detected result on the scope's screen. This gives a "map" of the receiver's response over the swept range. By injecting a "birdie" marker (nothing to do with golf, a birdie in this case being a signal of known frequency displayed as a pip on the screen, thus giving an otherwise arbitrary curve a reference point) along with the sweep output the response at any particular frequency can be seen. This display is repeated each time the scope traces its screen.

Conclusion

If you're now prompted to rush out and buy a scope and are lucky enough to have that sort of money laying around bear in mind that for most purposes a simple scope will do.

For amateur use where all that's required is to supplement meter readings with waveshapes – as opposed to accurate high-output workshop testing – a simple home built scope will do. Many years ago I built and used a scope designed by André Haas in about 1950. Although the bandwidth was probably only around 500kHz, it served me for a few years until I started professional TV servicing.

No scope is useless provided it's complete and gives a display on the screen. Lack of gain at the higher frequencies must be taken into account however. A scope with a bandwidth of say 1MHz at 0·1V/cm will give a reduced display at say 5MHz. This must be allowed for where for example a decoder reference oscillator output should be 5V p-p. On a wideband scope this will be displayed as 5V p-p., but on a narrow-band scope of say 10Hz-100kHz perhaps only 0·1V p-p will register. Very awkward that. The moral here is to know your scope, and see what it records when the circuit under test is working correctly.

In conclusion, wherever possible use setmakers' oscillograms, do not use earthed equipment with TV sets (especially half-mains chassis types), and try to use the scope objectively. If using a dual-trace scope to compare the same waveform on two different sets ensure that the chassis are at the same potential before connecting the probes, and never connect the earth leads to points at different potentials. When, for example, comparing the convergence waveforms on two sets, make allowance for production tolerances. And remember that control settings can vary waveforms enormously.

The aim should be to make the fullest possible use of the scope. There's no harm in checking the waveforms after a repair. Amplifier checks can be easily made (see Fig. 10), stage gain measured by comparing the input and output, decoupling capacitors checked (there should be no signal across them), hum bars hunted – the list is endless! ■

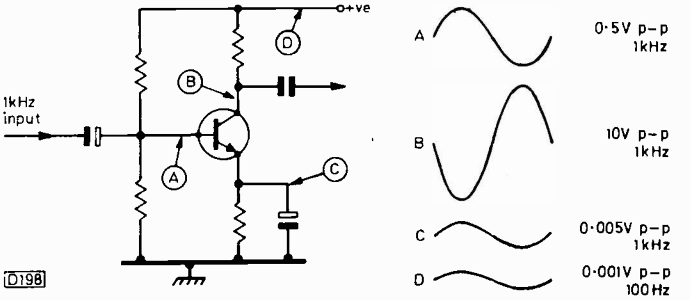


Fig. 10: Amplifier checks

Simple Test Card Generator

Part 2

Malcolm Burrell

Frequency Gratings

IC22 is a dual Schmitt oscillator (7413) whilst IC23 is a quad nand-gate with open collector outputs.

Half of IC22 is the 3MHz oscillator, synchronised by the line drive via IC23 to form a gated Schmitt circuit. The other half is similar, with larger timing components and the shaping network R27/D1 to ensure a 1:1 mark-space ratio squarewave. R27 can be adjusted if necessary to compensate for component tolerances.

One output from IC22 is applied to IC24 pin 1, and waveform C is fed to pin 2. An output of 3MHz frequency gratings results at pin 3. Similarly 1MHz from the other half of IC22 is connected to IC24 pin 4, whilst waveform A goes to pin 5. Pin 6 is strapped to pin 3, so we have two sets of frequency gratings separated by the space created by waveform B. The test pattern from pin 6, IC25, goes to IC25 pin 10 whilst the frequency gratings go to pin 9. The output from pin 8 is the complete test card, requiring only the grey scale to be added. Since this latter signal is an analogue waveform however it cannot be added at this stage. The black centre portion already exists for final superimposition.

Vision/Sync Mixer

The output stage is a variation on that in the Black/White Video Slicer in the January 1977 issue of *Television*. It is necessary to clean up the edges of the vision signal by reducing these to black level during the blanking period. Video input to IC30 is a.c. coupled via C22 whilst R24 ensures the nand-gate conducts during video. Blanking fed into pin 1 clips the video which is passed via R29 to the output. Mixed sync pulses are applied to pin 13 and subsequently mixed with the video signal. Clamping is provided by D2. The composite video signal is then applied to the u.h.f. modulator.

Step Wedge

A simple step wedge is formed by driving the three monostables, IC27, IC28, IC29, with the trailing edge of waveform A, adjusting each to produce a pulse three quarters the length of rectangle B from IC27, half the length from IC28, and one quarter from IC29. Fig. 6 shows the principle and the resultant grey scale after summing, the outputs having passed through inverter IC26. Four steps are provided with peak white on the left, the final step being the black level background of the card. Mixing with the video signal is simply carried out via R21 which is set to ensure that peak white on the wedge is of equal level to the white levels on the rest of the card.

Sync Pulse Generator

The circuit shown in the May 1977 issue of *Television* was chosen for its simplicity and very pleasing results. The ZNA134 i.c. features automatic interlace and specification very close to broadcast standards.

If desired, the buffer stages shown in that article can be incorporated, enabling the pattern generator to double as an s.p.g. to drive other video sources as well. The unit would remain portable and the provision of other sync output sockets could also be useful for triggering an oscilloscope. This facility is not, however, incorporated in the present p.c.b. design.

An external pulse generator could be used to drive the test card generator if the ZNA134 is omitted. It should have good frequency stability however if the results are to be consistent. Even a random interlace unit will work. See Fig. 8.

Power Supply

Total l.t. current consumption is about 550mA measured on an Avo 9. The mains transformer is an RS Components type 207-510 which provides 9V at 2A. After rectification, the +5V rail is derived from a fixed 5V regulator. Despite minimal decoupling employed, the circuit is very stable and free from the false triggering sometimes caused when pulses of a reasonable amplitude appear on the supply rail.

Construction

Virtually all the components are mounted on the p.c.b. and assembly is very straightforward. I.C. sockets are recommended, but may be omitted in the interests of economy. There is nothing particularly critical outside the p.c.b. but it is worth reminding the constructor to use good quality u.h.f. cable to connect the output from the modulator to the socket.

Setting Up

Using an ordinary receiver adjusted so that the edges are visible, the output from the generator should be applied and all pots turned anticlockwise (minimum resistance). The effect on a monitor would be a section of crosshatch with the greater part of the screen covered in black squares on a white background.

VR1 is adjusted to move these squares to the right and it is possible that squares will appear on the left of the screen.

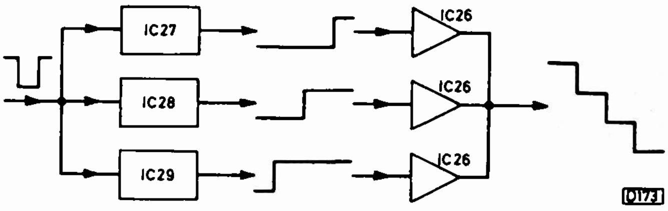


Fig. 6: Generating the step wedge for the grey scale.

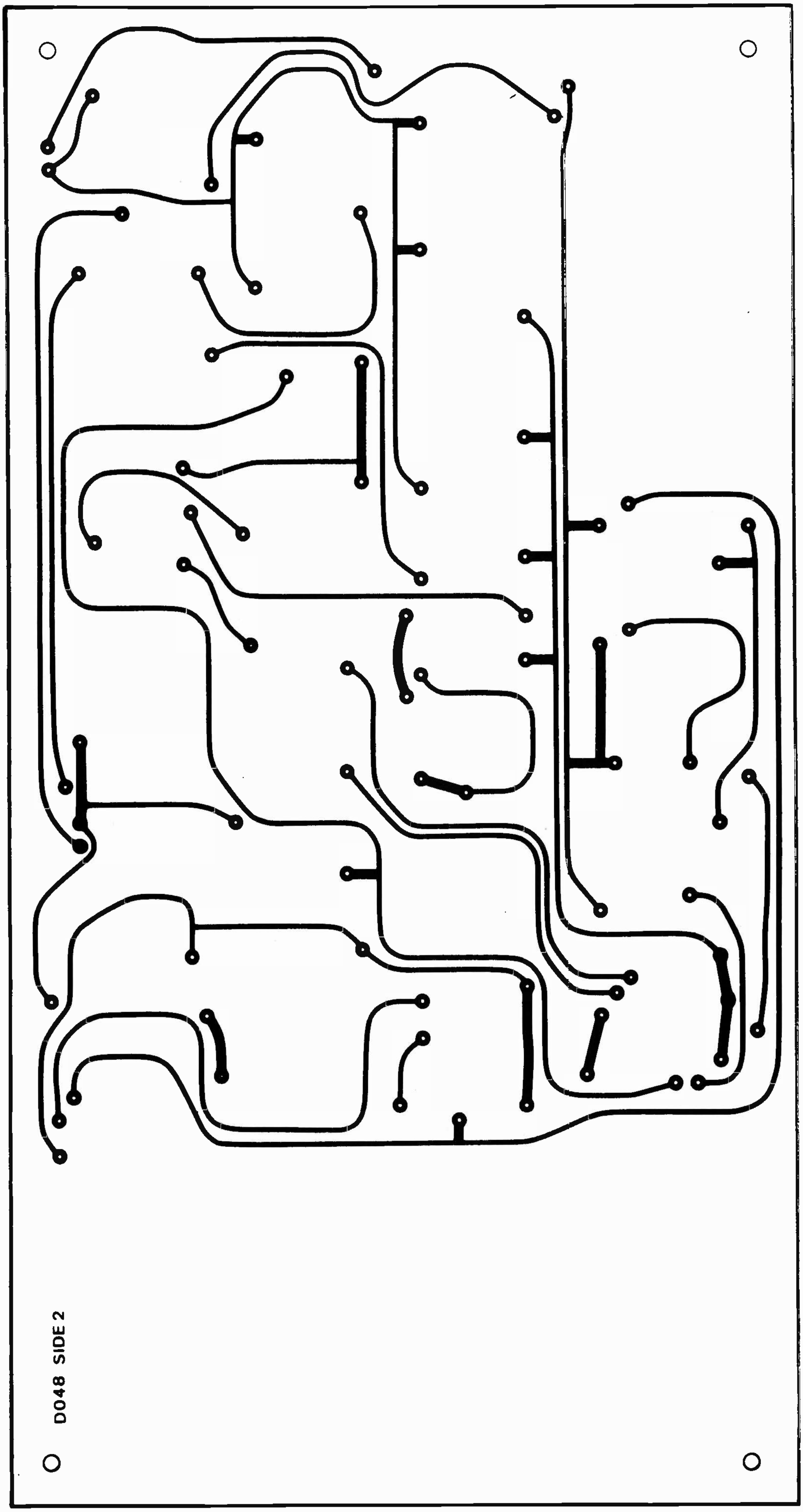


Fig. 7: Print pattern on the top of the board. Scale 1:1. There are printed patterns on both sides of the board – see Fig. 4 last month.

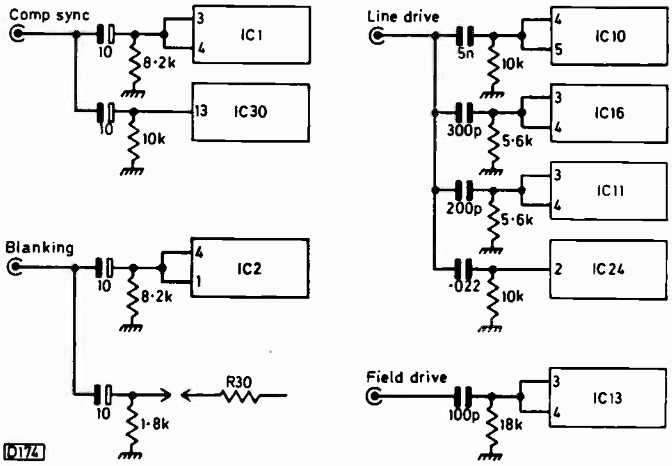


Fig. 8: Circuit connections for use when an external sync pulse generator is used to drive the test card generator.

Probably the bottom of the picture will be undisturbed at this point. VR2 is adjusted to give approximately an equal border at each side. Both these controls are interdependent.

Turn VR3 until the squares move down the raster and begin to appear at the top. Turn VR4 in conjunction with VR3 to give an even display of border pattern top and bottom but note that if advanced too far, so that the border disappears off the bottom, the circuit will become unstable causing the appearance of rapidly flickering squares on the whole picture. If this happens, back off the control and adjust more carefully. Fine adjustment can be made to give an even width border all round. If difficulty is found in getting the desired border width on each side, R6 can be altered slightly in value since the border pattern is derived from the grill signal.

Grey Scale Adjustment

Adjust VR7 first for a pulse half the width of the centre rectangle. VR6 is then adjusted for a pulse three quarters the length and it will be noted on a monitor that the left hand portion will increase in brightness. Finally, adjust VR8 for a pulse one quarter the width of the rectangle and it will be seen on a monitor that there now exists a four step wedge.

Conclusion

The unit has proved very useful considering the basic circuitry employed.

Improvements and additional facilities in the form of more complex patterns are being investigated, but it is hoped that this article will stimulate more interest in the diminishing use of one of the TV technician's most basic tools, the test card.

TV Servicing: Beginners Start Here...

Part 9

S. Simon

CAPACITORS are made in various types for various purposes, and it's most essential to understand which type to use in which application. For example, we have already mentioned that the capacitor fitted to the top of the line output transformer in the Thorn 1500 chassis and actually connected from the PY801 cathode to chassis should not only be of the right capacitance value and voltage rating but should also be of the disc type rather than a tubular one, the better to stand up to the pulse conditions it's subjected to in this application.

Equally with electrolytic capacitors, which have a high capacitance value for their size, the voltage rating must be observed. It is easy to see why this is so at the upper voltage limit. For example, one would not fit a capacitor rated at 275V in a circuit where it would be subjected to a potential of say 400V. To say the least, it would not last long and would come to a violent and messy end to the detriment of the surrounding circuitry.

What is less easy to appreciate however is that electrolytic capacitors must have a polarising voltage applied to them before they can perform (charge and discharge) properly. In circuits where very small potentials are involved therefore the use of a capacitor designed to work at a much higher voltage may result in the circuit not functioning correctly as the voltage present is insufficient to "form" the capacitor, which would work perfectly at a higher voltage. The rule here is to fit replacements of the same type and rating if these are known to be reliable. We will enlarge upon this reservation as we go along.

From time to time contributors to this magazine mention in servicing articles that this or that capacitor in a certain position is more liable to break down than others are. These hints should be noted and remembered, as they are the result of practical experience and can save much time and trouble. In particular, we would mention capacitors associated with line output transistors and those used as filter capacitors in mains input circuitry.

Mains Filter Capacitors

It's a fact that mains filter capacitors give rise to a fair percentage of receiver failures. In the average type of TV receiver, the mains supply lead is coded brown and blue (except in the case of certain imported equipment). If the receiver is isolated from the mains by a double-wound transformer, as in the case of a mains-battery portable for example, the correct identification of these leads is of little importance. The majority of receivers have no mains transformer that isolates the receiver completely however. Mains transformers are often employed to obtain l.t. supplies for transistor lines and for the c.r.t. heaters in some colour sets for example, but the h.t. supplies may still have a direct connection to the mains via a rectifier or rectifiers.

This implies that the metalwork of the receiver may also have a direct connection to the mains, and it's important therefore to see that the brown lead (red on older sets) is connected to the live and preferably fused side of the mains plug and that the blue (previously black) lead is connected to the neutral side. If there is a third lead it should be coloured yellow and green and is the earth connection. In the majority of receivers likely to be encountered there will be no earth connection.

In the receiver the brown lead will be taken either to a fuse and from the fuse to the on/off switch, or straight to the switch and then to the fuse. The ideal is that the fuse should come first, so that the entire receiver, including the on/off switch, is protected. The choice sometimes determines the location of the mains filter capacitor or capacitors. On some receivers the capacitor is actually soldered to or is close to the on/off switch, on others it's on a separate power panel or adjacent to the fuse, whilst on some it may be on the main panel.

If the mains fuse is found shattered or badly blackened, the filter capacitor (see for example, C84, Fig. 1 last month) must be the first suspect. This is not to say that it is the only suspect. A short-circuit h.t. rectifier will often produce the same effect or at least a similar one, though the presence of a surge limiting resistor limits the severity to a "blow" rather than a "shatter". Whilst a short-circuit rectifier diode remains shorted and can be easily checked with a meter, a filter capacitor will often show no short on an ohmmeter (which after all is powered only by a low-voltage battery) but will break down again when the mains is applied.

If there is doubt therefore and no shorts can be read, it's prudent to replace the capacitor. The ones which are most common are coloured blue and white and are rated at 600V d.c., 300V a.c. This rating is on the face of it perfectly adequate, but in fact the casualty rate suggests that replacements should be rated higher for better reliability. We suggest replacements rated at 1250V d.c., 400V a.c., of the polypropylene type for lasting reliability.

As far as capacitance value is concerned, the average monochrome set is fitted with an 0·1μF capacitor in this position but, depending on the model, 0·22μF or 0·33μF may be found. Some models employ two capacitors for this

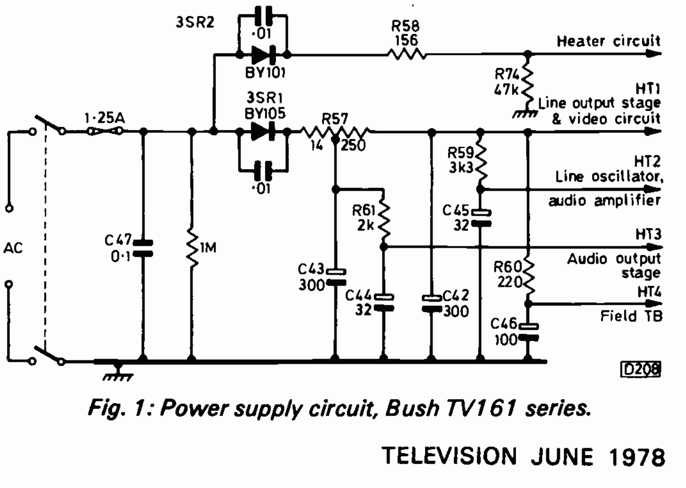


Fig. 1: Power supply circuit, Bush TV161 series.

purpose, but as these are usually side by side there is little chance of confusion. The purpose of the capacitor incidentally is to absorb the transient "spikes" which appear on the mains supply from time to time, and it's most important that these capacitors are fitted. They are also there to stop interference from the set being fed back into the mains supply.

Capacitor Faults

As a practical example of faults due to defective capacitors let us consider the Bush dual-standard and single-standard models using two separate panels (vertical, either side of the tube neck), such as the TV161, TV175, TV191D, TV193D etc. The mains filter capacitor C47 (see Fig. 1) is situated at the bottom left and connects to the fuse holder and chassis. Over to the left are the two metal cans of the main electrolytics, the larger twin unit at the bottom being the reservoir and main smoother (C43/C42), the upper triple unit the additional smoothers (C44/5/6) for the separate h.t. lines.

Several things can go wrong in this assembly. Probably the most common complaint is "background hum" on the sound, persisting with the volume control in the minimum position. The upper triple unit is made up of two 32μF and one 100μF section. The left hand tag is that of 3C44, the 32μF smoother for the PCL82 sound output valve's supply. It's fed from the lower left reservoir capacitor tag via a 2kΩ wirewound resistor. The hum is due to 3C44 drying up, or to improper contact between the rivet and the soldering tag. There's no reason why a separate electrolytic of from 16μF to 50μF (say) rated at 300V or more should not be fitted in a convenient position from the tag to chassis (bottom centre) in order to avoid replacement of the triple unit which can go on functioning for years just "firing on two" as it were.

A more urgent cause for concern is when there's not only a hum on the sound but also a distinct "hum bar" on the picture. A hum bar usually shows up as an even ripple of the picture moving up the screen and probably triggering off the vertical hold when it reaches the top, all in a very regular manner. The condition can worsen so that one could well be looking at one of those distorting mirrors at a seaside amusement arcade. This is severe loss of smoothing, which could well be due to one of the lower 300μF sections losing capacitance. There's no possibility of adding on an extra capacitor if this is so. A new unit is necessary and cannot be avoided – if in fact the unit has dried up.

It should be appreciated however that an electrolytic capacitor is only as good as its connections, and that the necessary use of dissimilar materials (rivet to tag, or to wire with other types) often results in a high-resistance joint which gives rise to precisely the described conditions. The sharp edge of a screwdriver applied to the edge of the rivet will often bed the soft rivet into the tag and restore proper contact.

In one or two cases, the metal braid which connects the earth tag of the capacitor to chassis may be found to be improperly soldered. A similar condition often happens on the Philips G6 series of colour receivers, a moving bar slowly travelling up the picture, sometimes kinking the verticals. Usually no capacitor is at fault, the trouble being that the clamping bands are making poor contact with the capacitor cans. On some other receivers such a condition may be due to no more than an insufficiently tightened screw not clamping the earthing tracks on a panel to the metal frame of the chassis.

A common cause of "hum" on the picture – where the verticals are severely bent – is not faulty electrolytics or their connections but a defective bridge rectifier. This is extremely common in many monochrome portables and in some colour sets where the l.t. lines are derived from a transformer via a bridge rectifier.

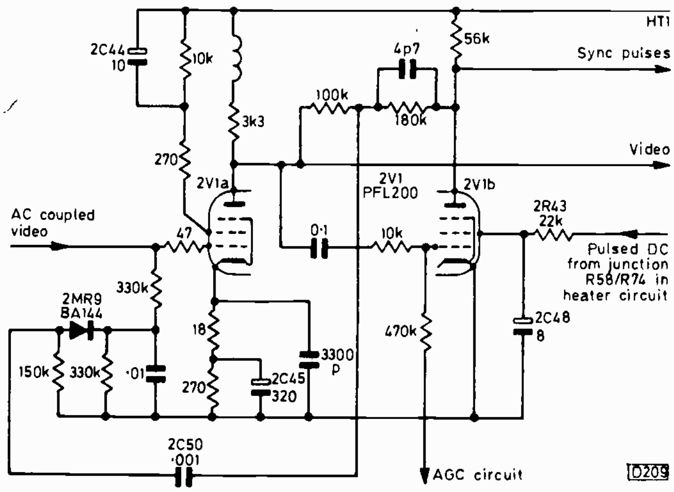


Fig. 2: Video/sync circuits, Bush TV161 series.

Reverting to the Rank TV161 series, a common complaint is lack of sync (no solid field hold and the line hold unstable). This should call attention to the smaller electrolytics associated with the PFL200 video amplifier and sync separator valve, particularly the 8μF capacitor 2C48 just below the valve. This smooths the supply to pin 3 (sync separator screen grid) of the PFL200, the supply being derived from the heater line so that in the event of the heater circuit diode 3SR2 (Fig. 1) going short-circuit this point would be at an a.c. potential: the 8μF capacitor would thus become a virtual short, depriving the PFL200 of its sync section screen grid feed and thus calling attention to the fact that the heaters are being overrun (to the rapid detriment of the valves and tube). It is in the nature of things of course that the diode rarely shorts while the capacitor dries up causing weak sync because the 50Hz ripple is no longer being smoothed out, i.e. although the heater line is still d.c. it's an unsmoothed d.c. consisting of a series of "humps". We've already seen that this is due to the a.c. supply being "chopped" by the heater circuit diode in order to reduce the voltage applied to the heater line.

If an electrolytic capacitor was connected to this line directly, the voltage would rise and the object would be defeated. This is why a 22kΩ resistor is included in the supply to pin 3 of the PFL200 where the 8μF capacitor is connected (to divorce it from the heater line). See Fig. 2.

Incidentally, the rippled d.c. on the heater line means that a voltage reading taken by an ordinary moving-coil meter is highly inaccurate. For example, the voltage across the heater pins of say a c.r.t. rated at 6·3V will appear as 4V on an ordinary moving-coil voltmeter.

Most of the other capacitors in this part of the circuit seem to hold up well but should be checked if the sync is at all impaired.

Moving over to the other side of the receiver, the other common fault due to an electrolytic is sudden compression of the picture height, the loss being more drastic over the lower half. This happens when 3C35, which is 500μF, dries up or has a poor connection. It's the cathode decoupler of the PCL805 field timebase valve. It will be appreciated that the varying current in the valve (sawtooth, rising slowly, falling quickly) will result in a varying voltage drop across the cathode bias resistor unless this is adequately decoupled. A varying voltage will vary the grid bias, and will tend to cancel the normal current flow (this is termed negative current feedback). Such feedback can be desirable in some applications but is certainly not wanted in our field timebase which requires all the gain it can get. Therefore the large-value electrolytic is connected across the resistor, charging and discharging as the voltage tries to rise and fall, thus ironing out the variations and keeping the cathode bias level steady to maintain efficiency. As the capacitor loses its efficiency, current feedback starts and the bottom of the picture rises. This is a very common fault affecting most makes and models. We have referred to it previously in this series (valves as amplifiers) and make no apology for repeating it here, in the belief that reading a thing once makes only a certain impression, reading it again later multiplies the probability of retention. This works for us, anyway.

From these few comments upon the behaviour and employment of electrolytic capacitors we can briefly summarise their advantages and disadvantages. An electrolytic capacitor offers very high capacitance in relation to size once a polarising voltage has been applied to it. The capacitance and working voltage are clearly marked and the latter must not be exceeded (peak voltage may also be marked) in normal operation. If the voltage specified is exceeded, there is a distinct probability of breakdown: the insulation may fail and the resultant flow of current may heat the interior causing rapid expansion, blowing off the end cap and depositing the "innards" over a wide area.

Alternatively a connection may be broken internally and the capacitor may thus be rendered inoperative.

Except in a few specialised cases therefore, electrolytics can be used only in d.c. circuits of known maximum voltage, and must be connected only as indicated (reversal will constitute a direct short).

When these points are observed, the only disadvantages are their tendency to dry up and become inoperative or to develop poor connections at their lead out tags.

Mixed Dielectric Capacitors

Mixed dielectric capacitors are the modern equivalent of the old paper types, which consisted of strips of tin foil separated by waxed paper. The paper is now impregnated polyester. This makes them suitable for most applications where the frequency is not too high. They may be found working as filter capacitors (previously referred to) and as decouplers and smoothers in high-impedance circuits. The situations where they are often found to be short-circuit include boost line supplies where the voltage is normally high and peaky.

A typical fault condition which is still often encountered is one of "no picture" with perhaps a slight amount of overheating in the line output stage. There is no e.h.t. or other sign of normal working until the top cap (cathode) of the efficiency diode (PY800, PY88 etc.) is removed. There is then a certain degree of line output stage operation and some e.h.t., and if a valve e.h.t. rectifier is fitted this may glow as the heater is supplied where previously it was not.

If the circuit is consulted (see Figs. 1 and 3, pages 146-9, January), it may be seen that with the efficiency diode disconnected there should be no h.t. supply to the line output valve. The fact that it is working to some extent however means that there is in fact a d.c. path where there should be none. This is often due to a short-circuit boost line capacitor (typically 0·1μF, 1kV working) where this capacitor is returned to the h.t. line and not to a chassis connected winding on the output transformer. Obviously if the latter was the case the efficiency diode would be connected between the h.t. line and chassis and a very heavy current would flow, blowing the supply fuse or/and the valve. The fact that the boost capacitor is usually returned to the h.t. line means that this disaster is less common but does introduce an element of doubt as to the exact cause of the trouble.

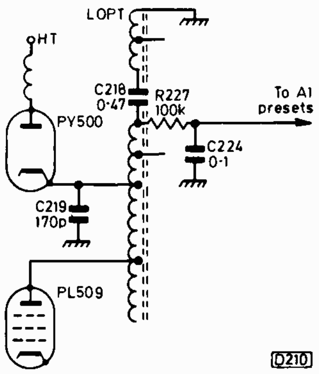


Fig. 3: C218 and C224 are common causes of a blown mains fuse in the Pye 691, 693 and 697 chassis.

As we have said, removal of the efficiency diode top cap may restore timebase working. But even then there's another possibility. Whilst the boost capacitor may be shorted, it's not necessarily so. It's a sad fact that there is another fault condition which can provide a path between the h.t. line and the boost line when the only route should be through the efficiency diode. This is a breakdown of the insulation between the windings of the line output transformer. Probably the receivers which suffered from this more than most were the Philips 170 and 210 series. This is another story however and we must not be sidetracked from the subject of capacitors.

Taking another popular range of receivers, this time the Pye hybrid colour series from the CT70 through the 691 chassis (CT152, Ekco CT105, Invicta CT7051, Dynatron etc.) to the 697 chassis with the right-side vertical panel, we cast a wide net to embrace almost too many models to list. Suffice it to say that if the model has valves in it, the following notes will apply. The vast majority of set failures that involve capacitor breakdown in these receivers occur on the right-side power/timebase unit. A minority concern the high-voltage pulse-type capacitors associated with the line output transformer and the electrolytics associated with the line oscillator stage or the power supply.

The chances of the failure of two of the mixed dielectric capacitors are far higher however. These are the 0·1μF 1kV one that decouples the boost line feed to the c.r.t. first anode presets (C224, see Fig. 3) and the boost capacitor itself, C218, which is an 0·47μF 1kV type wired into the line output transformer assembly. The failure of either can result in a blown mains supply fuse.

If C224 fails, the full boost line voltage is placed across the associated 100kΩ resistor R227 and this is quite unable to carry the resultant heavy current. It rapidly overheats ("there was a smell of burning") and its resistance value drops from 100kΩ to a very low figure, subjecting the PY500 and the h.t. supply to an intolerable strain resulting in the failure of the supply fuse. It's easy when this condition is suspected to check the resistance from the PY500's top cap (or the PL509's top cap) to chassis. If the resistance reading is very low, either R227 will be found discoloured and C224 short-circuit, or if R227 appears normal (brown-black-yellow) C218 on the side of the transformer will instead be the culprit. This quick check can save a lot of time. There is the odd occasion of course when neither capacitor will be found at fault, but this will be an event rather than an even bet.

We mentioned another fairly common occurrence last month, a coupling capacitor becoming leaky thereby removing the bias from an amplifier stage. This sort of thing can also stop an oscillator working or upset the field linearity where the capacitor is part of a feedback linearity correction loop. To sum up however the troubles with capacitors generally boil down to open-circuits (loss of capacitance), short-circuits and leaks (partial shorting).

Service Notebook

G. R. Wilding

Varying Signal

The owner of a colour set fitted with the ITT CVC5 chassis reported that for some time the picture would occasionally suddenly go weak and grainey. Switching the set off and on again would usually restore the picture to normal. For the last day or so however the contrast and graininess had been constantly varying.

Intermittent graininess implies variations in aerial input signal strength or r.f. gain, and is usually due to a defective aerial connection. On this occasion however the fact that the trouble could often be cleared by switching off and on again suggested a tuner or a.g.c. fault. We nevertheless checked the aerial connections just in case, also the set tuner a.g.c. control R118 since there could be a bad spot on the track where the slider was set. Nothing doing however so voltage checks were made at the tuner under the normal and grainey reception conditions. This revealed that the tuner a.g.c. voltage was varying, falling to a very low figure when the graininess was most severe.

The trouble could have been in the tuner or in the a.g.c. circuit, so the lead to the tuner was disconnected. The a.g.c. voltage measured at the collector of the preceding a.g.c. inverter transistor T14 was still varying, clearing the tuner. There's a smoothing electrolytic at this point, a miniature 15μF component, so suspicion centred on this. Disconnecting it produced an increased, constant a.g.c. potential, and on test it was found to have a severe leak. Replacing it and readjusting the set tuner a.g.c. control restored normal results.

No Sound

The trouble with a Mitsubishi Model CT200B colour receiver was normal picture but no sound. The two-transistor audio output circuit is on a small plug-in printed board, and on removing the input plug and contacting the live pin there was no response from the loudspeaker. Clearly therefore the fault was on this board rather than the one with the sound i.f. amplifiers etc. Checking at the case (collector) of the output transistor revealed absence of voltage, though the voltage at the input plug was ample. The supply is smoothed by an *RC* network, and on checking here the resistor was found to be intact though its Systoflex sleeving was badly discoloured. Continuing with our ohmmeter checks, no short was discovered from the collector of the output transistor to chassis when checking at the nut of one of the securing screws, but when checked from the other nut and with a fair amount of pressure applied there was a complete short. This suggested that the transistor's mica insulating washer was defective, and on removing the transistor the hole surrounding the screw where the short had been read was found to be flaking away.

The transistor itself was o.k., and though the supply resistor measured close to its correct resistance we thought it best to replace this. Switching the set on again produced sound, though at low volume. The voltages in the audio circuit read correctly, so we decided that the problem was probably excessive feedback due to defective decoupling electrolytics – there's one in the emitter circuit of both the amplifier and the output stage. Replacing both restored the sound to the normal level.

Red Picture

After a few short-term red flashes the picture on a set fitted with the ITT CVC5 chassis went completely red. As expected, the red output transistor's collector voltage was low while the other voltages in the d.c. coupled red channel were also incorrect. The input to this section of the receiver is a.c. coupled, with a feedback clamp. We've known the feedback resistor in these RGB circuits go open-circuit on a number of occasions, causing flooding of the relevant colour due to the excessive bias at the base of the driver stage. On this occasion however the resistor was intact, the trouble being due to the clamp diode being open-circuit.

Low Line Output

The raster displayed by a Philips hybrid monochrome set took much longer than normal to appear, was of low brightness, ballooned easily, and was of greatly reduced size in both directions, with the line linearity being particularly bad. The fault was clearly in the line output stage, the low boost voltage, since it supplies the field charging circuit, causing the reduced height.

Our first move was to disconnect the top cap (cathode) of the PY800 boost diode – for if h.t. is still present at the anode of the PL509 line output valve under these conditions the boost capacitor is almost certainly short-circuit or, if not, there's a short-circuit between the primary and one of the secondary windings on this line output transformer. This action removed the h.t. however, so we next checked the high-value (8·2MΩ) resistors in the width circuit–they quite often go high resistance or open-circuit on this chassis. These and the associated resistors were o.k. however – simply checked by shunting the meter, set to a high-voltage range, across each in turn. The line output transformer in these sets is fairly prone to breakdown after some years' service, so this was a distinct possibility. First however we decided to shunt an 0·1μF capacitor across the boost capacitor. This action restored a normal picture, and the set continued to work normally on removing the capacitor. Temporarily soldering an equivalent across the boost capacitor had almost certainly cured a bad dry-joint, but to be on the safe side we fitted the replacement.

Lack of Field Sync

Lack of field sync was the trouble with an ITT colour receiver fitted with the CVC5 chassis. When first switched on, the picture would roll continuously for a minute or more. The first action of course was to fit a new PCL805 field timebase valve. This made a considerable improvement, but the fault still persisted. The picture could be locked by adjusting the field hold control, but further adjustment would be necessary when the set had warmed up.

The field sync pulses are fed to the cathode of the triode section of the valve, where they reverse bias an OA91 diode which is in series with the cathode. This diode gives a lot of trouble, causing field collapse when open-circuit and loss of field sync when short-circuit, so the forward and reverse resistances were checked on the meter. The diode read o.k., but nevertheless fitting a new one cleared the fault, the picture locking firmly as soon as it came on.

Long-Distance Television

Roger Bunney

The headline in the Pretoria News for 6th March 1978 dramatically announced "alarm as swarthy senors gatecrash Rhodesian TV". Well I never: a DX-TV phenomenon once again gets into the news! The article beneath described the concern of the Rhodesian Broadcasting Corporation, which went so far as to carry a sixteen minute peaktime programme in which Professor Louis Meggleton of the University of Rhodesia explained the cause of the signals from Spanish television (Madrid ch. E2) reaching Rhodesia. The signal strengths were apparently such that the local service was completely broken up and at times dominated by the Spanish signals. It seems that a new transmitter is being built in the Rhodesian midlands to avoid the problem.

That's certainly a good introduction to the main talking point this month – the rapidly increasing sunspot count and the related increase of the m.u.f. (maximum usable frequency) into the low v.h.f. spectrum, producing some quite startling F2 reception – including the Rhodesian experiences mentioned above. Fortunately these conditions have also been experienced in the UK. Hugh Cocks near Honiton in Devon has noticed signals that certainly originated from Africa.

His first report is of a ch. E2 signal on February 27th, from towards the SSE with video very blurry, strong at times and slow fading. The time (1745 GMT) indicates that the signal was propagated by transequatorial skip. Next, on March 4th, came signals on ch. E2 and E3, during the 1440-1530 period. Apparently a test pattern, not unlike a line sawtooth, again with the characteristic "ghostly" appearance and from the south. On the 10th and 12th there was further signal activity during the same periods, with at times various SW harmonics and morse code signals in the lower section of Band I.

David Martin at Shaftesbury also monitored some of these signals and confirms that it was very difficult to resolve any detail due to the multiple images. I too logged weak ch. E2 signals from the south on the 9th, at 1600, again too weak for identification. So with solar activity increasing (the count exceeded 160 in February) it's worth looking towards the south during the mid-afternoon and early evening periods.

Such signals can be irritating, often being present on Friday and Monday though not over the weekend, which is rather frustrating for those of us who work a five day week... I've been monitoring the low v.h.f. spectrum during the period with the Hallicrafters receiver previously mentioned, and most days the m.u.f. has exceeded 30MHz – on some days I've logged signals up to 38MHz.

Our Australian contact Anthony Mann has been similarly busy and has noted some quite remarkable conditions. During February the m.u.f. at Perth rose to the low forties, with transpacific reception of US paging stations and TE reception from Vladivostok ch. R1 (USSR) over many hours. The distances involved suggest that BBC-1 ch. B1 must soon be received there – at some 12,000 miles. In addition, Anthony has received Korean radio links, low-power medical pagers and 50MHz radio amateurs. The other TV station that's been logged at Perth via TE/F2 is the ch. E2 Sempah outlet in Malaya, on test card G.

Back in the UK Brian Fitch has noted strange signals on his TV set. This suggests that the present conditions have been sufficient to cause i.f. breakthrough. Brian noticed American voices and associated air control signals. No amplifier was in use, which doesn't suggest overload from a nearby transmitter. Locations mentioned include Maryland and Boston.

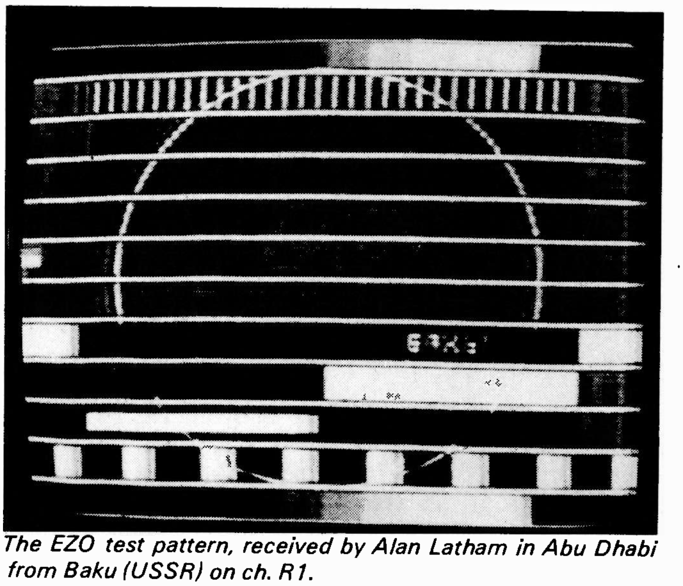
Conventional DX

The above F2 conditions have overshadowed the more conventional TV-DXing activities – such as have been allowed by the weather! The tropospherics improved on the 5/6th March, giving low-level West German u.h.f. reception in the UK and various RTVE (Spanish) signals in Eire. The 12th produced some excellent morning MS (Meteor Scatter) signals. For seekers of "new" TV signals, Paul Duggan mentions that the ch. E40/43 800kW signals from the new RTE (Eire) transmitter at Longford are being test transmitted between 1000-1600 local time. It seems that the Ruiselede ch. E2 BRT (Belgian) transmitter didn't close at the end of 1977 but has continued at a lower e.r.p. (20kW). The final close down was on April 1st.

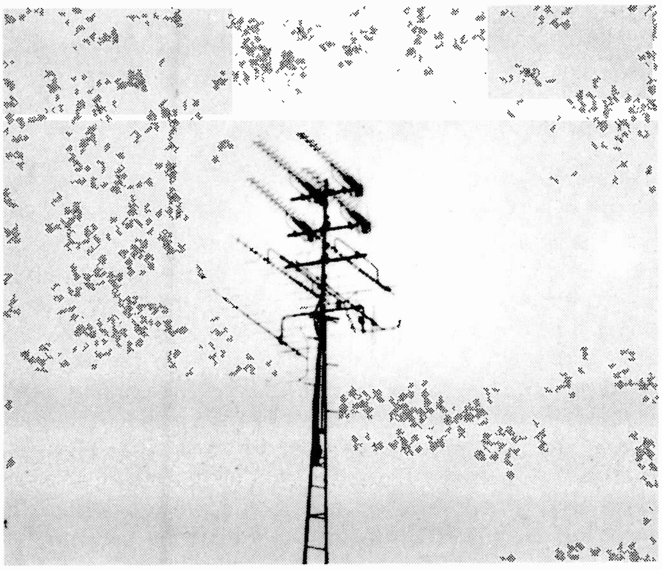
News

Scandinavia: The Swedish government has announced that a further study into the feasibility of a Nordic satellite is to be carried out by the participating members – Sweden, Norway, Denmark, Finland and Iceland. A proposed terrestrial Nordic Network with the same members is to be initiated.

Spain: There is a plan for RTVE to use a satellite to provide



The EZO test pattern, received by Alan Latham in Abu Dhabi from Baku (USSR) on ch. R1.



Ryn Muntjewerff's aerial system in Holland.

a television service for the Iberian Peninsula within the next three years (possibly part of the Arienne experiment?).

Saudia Arabia: I. Boatman reports from Abu Dhabi a rumour that the ch. A2 HZ22 Dahran transmitter (now on system M) may be converted to the PAL standard and that system B may be adopted. This station is operated by the Aramco group, mainly for its local employees.

Latest EBU Listings

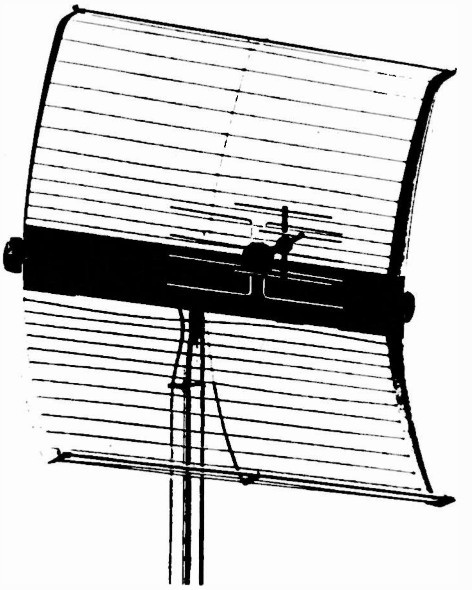
West Germany: Hoher Bogen ch. E28 reduced to 200kW e.r.p. from 240kW.
Belgium: Oostvleteren BRT-2 ch. E55 – 20kW – vertical.
Cyprus: Kalokhorio CBC-1 ch. E35 – 100kW – horizontal.
Spain: Lierganes RTVE1/2 chs. E40/46 – 100kW – horizontal.
Switzerland: Bantiger ch. E2 reduced to 50kW e.r.p. from 100kW.

Sporadic E

In the April, 1978 *Wireless World,* E. B. Dorling of the Mullard Space Science Laboratory commented on newly discovered aspects of Sporadic E. There's a close association between the very thin intensely ionised layers and sharp reversals in the wind direction at high altitudes. These winds, at some 150km height, provide shearing movements downwards, fading away at 100km. The wind shears tend to move the ions and electrons within the Earth's magnetic field, squeezing the plasma into a thin concentrated layer in a downwards direction. The layer consists of ionised atoms (mainly magnesium and silicon), probably from burnt-up meteorites. "Sporadic E owes its transient character to interaction between atmospheric waves, the ionospheric E layer, and magnetic and electric fields. All but the magnetic field are constantly changing, so that the right conditions for layer formation occur – well, sporadically."

Aerial Notes

Audio Workshops (33 London Road, Southborough, Tunbridge Wells, Kent), report that Fuba have introduced a new wideband u.h.f. array, the DOU45. It appears to be of the short-backfire variety (see photograph). The gain is quoted at 13dB maximum and an integral amplifier can be fitted. Audio Workshops are looking into the possibility of a stacked system using this array in either ×2, ×4, ×8 groups.



The new Fuba DOU45 wideband u.h.f. aerial.

At the time of writing no details on availibility or price are available. Any enquiries should be sent to Audio Workshops with an SAE.

A wideband Band I array is now available from Premier Industries (Cheltenham) Ltd., 343-345 High Street, Cheltenham, Glos. GL50 3HS. The five-element system, called type 1/5WB/H, uses ½in. elements, a 1in. boom and a folded dipole, and is the first commercially available in the UK giving wideband Band I coverage. The retail price (assuming that it's obtained from a dealer) is around £30, but for the TV-DX enthusiast I'm sure it could be obtained more cheaply through an aerial rigging firm – assuming that the enthusiast is rigging it himself. Any enquiries about this aerial should be sent to Premier with an SAE.

From Our Correspondents . . .

In a recent letter Ryn Muntjewerff (Holland) described the quite incredible tropospheric conditions on 18th October, 1977. Ryn logged a u.h.f. transmitter operating in the North of Sweden, close to the Finnish border, and at some 1,850km probably a record! The signal, from Pajala ch.E34, was of a local regional news programme "Nordnytt". It seems that both TV1 and TV2 carry regional programmes at times, and unfortunately a neighbouring region can carry the same regional programme. The signals on ch.E34 were good and only at times with slight snow.

Gosta van der Linden (Rotterdam) reports that RTB is using a new identification on the PM5544 test pattern. The ch.E8 outlet at Wavre has "Wavre Canal 8" at the top and "RTBF" at the bottom; the E42 outlet has "Liege Canal 42" at the top and "RTBF" at the bottom.

Barry Williams (Ballina, Eire) has written in about aerial mast construction using 2in. scaffolding. It seems that in the West of Eire such masts reach to 150ft! The method of construction is initially to erect and guy the first 20ft section: this is then climbed and an outrigger mast with integral pulley is clamped to the top. A rope – via the pulley – is then tied to the next 20ft section at its mid-point. This is hoisted to the top of the first 20ft section, the second section then being bolted and guyed – the guys are fitted prior to hoisting. When guyed, the new section is scaled, the outrigger reclamped and so on. The outrigger is about 10ft long. Incidentally, I have noticed professional (telecommunication) riggers use a 20ft section with long bolts fixed as steps. The section is tied to the mast being erected, with extensions of this "ladder" being fitted as the mast progresses in height.

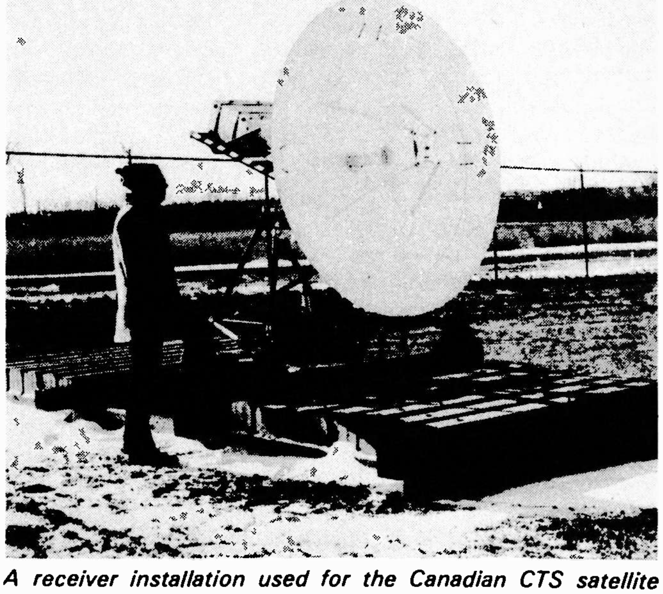
Satellites and TV

In the twenty years or so since Sputnik went into orbit, communication via satellite has revolutionised the field of programme distribution. Previously, network programme exchange relied largely on land-based microwave links, using line-of-sight operation. By its very nature, this restricted international live transmissions. In the early 60s however Telstar came on the scene. Like many other enthusiastic viewers I remember watching into the early hours the activities at Goonhilly and the first live transmissions across the Atlantic. The results on the first night were poor however, due to the polarisation of the receiving aerial being incorrect. Following adjustments however the second night's results were excellent.

In those days satellites didn't orbit the Earth synchronously, and the period during which Telstar was in sight of both Goonhilly (UK) and Andover (Maine) was limited, if I recall correctly, to about twenty minutes. As a result of advances in space technology however there is now a large number of synchronous satellites in orbit high over the Equator, providing high-quality sound/vision circuits for telephone and television use.

The ATS-6 satellite's experimental SITE transmissions to the Indian subcontinent will be familiar to readers of this column. The experiment started on August 1st, 1975 and ended on July 31st, 1976, with daily educational, instructional and entertainment programmes beamed down to the landmass of India, centred on Nagpur. The uplink transmissions were from Ahmedabad. Reception was technically a success, using modified domestic receivers fed from 10ft diameter parabolic arrays. The 860MHz signals were transmitted with right-hand circular polarisation, using wideband f.m. video, from an orbit at 35°E. As readers will recall, several UK enthusiasts successfully received these signals. Others on the continent were also successful.

The USSR's Statsionar T satellite, in synchronous orbit at 99°E, is currently transmitting in the u.h.f. band to ground stations in Siberia and other remote parts of the USSR. Unfortunately its position is such that it's well



A receiver installation used for the Canadian CTS satellite experiment, with a 2m. dish aerial.

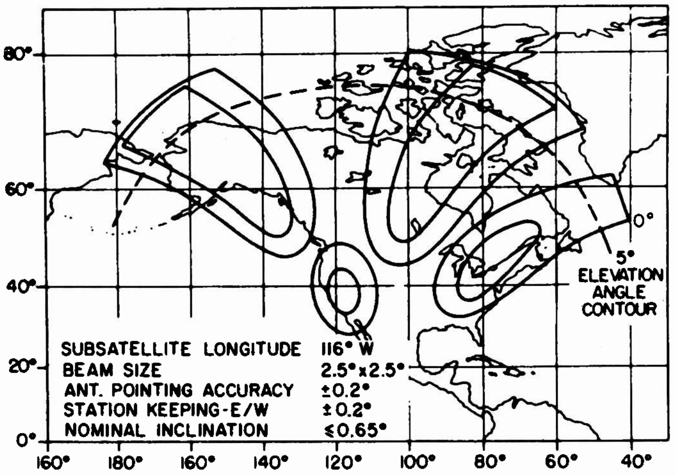


Fig. 1: Examples of "footprints" produced by the Canadian Hermes CTS satellite.

beyond UK reception. The carrier frequency is 714MHz, the 200W transmitter feeding an aerial with a gain of 33·5dB. The f.m. video bandwidth is 24MHz. There are two types of receiving station, the smaller having an equivalent noise temperature of 1,200°K, a receiving aerial gain of 23dB and signal/noise ratio of 48dB at the output of the video channel. Reports from the USSR claim that reception is highly successful.

SHF Transmissions

The first 12GHz transmissions intended for small, low-cost terminals have been in operation since May 20th, 1976 from the Canadian Hermes satellite. Successful reception experiments have been carried out with dish diameters as small as 60cm. Hermes is also known as CTS – the Canadian Technology Satellite – and orbits at 116°W. There are two steerable aerials, while an extremely high-power travelling-wave tube provides some 200W r.f. output at 50 per cent efficiency. The beamwidth of 2·5° is such that an e.r.p. of some 800kW is reached. The f.m. video bandwidth is 12·038-12·123GHz, with the sound carrier 5·14MHz away. Additional sound subcarriers for other services are spaced at 5·41 and 5·79GHz from the vision carrier. Experiments with 1·6, 1·2, 1m and 60cm dishes show that excellent results can be obtained on inexpensive TV receivers, with the f.m. video after demodulation being remodulated back to v.h.f. using a.m.

The second experimental 12GHz satellite is the Japanese BSE one. This has been in operation for a month at the time of writing. I personally feel that if the Japanese electronics industry makes a success of this they will be well ahead with mass produced inexpensive 12GHz receiving systems by the time such transmissions start in Europe.

The satellite has two TWT amplifiers giving 100W of r.f. which is fed to an aerial with a gain of 58dBw. The two f.m. video channels (with colour) occupy a 25MHz bandwidth with several sound channels. Detailed information on this satellite was given in the August 1976 *Wireless World*.

For the European satellite service the spectrum 11·7-12·5GHz will be used, giving forty channels. Unlike the SITE experiment which required coverage of large areas, transmissions to Europe need strict control to avoid overlaps between the relatively small landmasses of some states – with beamwidths of perhaps 1°. The satellite will orbit at 31°W.

A satellite transmitter's service area is referred to as its footprint. Australia plans to have three footprints, one for each timezone. Next month I'll be looking more closely at the European plans.

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 440 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.

GEC C2110 SERIES

The thyristor in the h.t. supply circuit lasts only about six-eight weeks. It's been replaced three times so far! The diac which triggers it was replaced, but this has made no difference. Before the thyristor goes, it produces picture jitter. R601 which feeds the 12V supply stabilising zener diode occasionally goes open-circuit. The h.t. voltage is correct, and the thyristor snubber protection network has been added.

The usual cause of picture jitter on these sets is indeed the BT106 thyristor. It's important that the set h.t. control is adjusted so that the h.t. voltage is not excessive. We suggest setting it for 39-40V across C601 in the line output transistor's emitter circuit. If the voltage at this point is excessive, the power supply will be overloaded. Suspects are the 47V zener diode D51 and the line flyback tuning capacitor C52.

BAIRD M620 CHASSIS

The trouble is lack of height. With the height control at maximum, there's still a gap of about an inch at the top and bottom of the screen, though there's a good picture on both systems. The h.t. is correct and a new field timebase valve has been fitted. The output pentode's cathode components have also been renewed.

The problem is usually due to low boost voltage on these sets, due in turn to the focus control changing value. You may well find that adding a 1MΩ resistor in series between the control and chassis will effect a cure. If this is not effective, check the value of the field charging resistor R195 (820kΩ).

INDESIT T12LGB

The 250mA h.t. fuse F902 keeps blowing. The AU110 line output transistor was found to be short-circuit, but a replacement met the same fate. The BU111Y h.t. supply pump transistor reads o.k. on an ohmmeter, and the h.t. reservoir capacitor and the associated diodes have been replaced. Disconnecting the line driver transformer restores normal sound, but of course there's no line drive.

The normal sound when the line drive is disabled does suggest that the fault is in the line output stage. We suggest you proceed as follows. Replace the h.t. fuse with a 600-700Ω high-wattage resistor and monitor the 12V line while disconnecting in turn the e.h.t. stick, the 240V rectifier and the line scan coils. If the voltage rises when any of these are disconnected you've found the source of the trouble.

DECCA CTV22

The fault is no raster, sound o.k. All the line timebase valves have been changed. R412 in series with C418 is burning up, but there is no other sign of damage. C418 checks o.k. on a meter, but I'm trying to get a replacement.

C418, though external to the tripler, is actually the first capacitor in the voltage multiplier chain. It's returned via R412 to chassis or a tap on the line output transformer to provide a form of e.h.t. control – common with early triplers. It's unlikely that replacing C418 will make any difference since the tripler itself appears to have failed. You can confirm this by removing the tripler's input lead from the e.h.t. overwinding on the line output transformer. The voltage at the screen grid of the PL509 (pin 6) and the c.r.t. first anode voltages should then increase markedly.

PHILIPS G8 CHASSIS

The verticals on the right-hand side fall to the left as the brightness control is advanced. They also pull or bend when the picture content is light. The raster remains stationary however. The amount of pulling decreases across the screen towards the left-hand side.

This effect is often symptomatic of poor earth contact to the c.r.t.'s aquadag coating. Check that the contact springs inside the degaussing shield are in firm contact with the flare of the c.r.t. Other possibilities are overdriving the c.r.t. due to misadjustment of the beam limiter control, or a faulty 18V zener (D5531) which stabilises the line oscillator supply.

GEC 2018DST

The thermistor in the h.t. supply circuit has disintegrated, but although I have a manual no component type is specified.

The thermistor acts as a surge limiter and can be replaced with a 4·7Ω 5W resistor.

THORN 8500 CHASSIS

Immediately the e.h.t. has built up there is a flash across the collector-emitter of the line output transistor, followed by a "bacon frying" sound which seems to come from the lead inside the e.h.t. stick. The fault does not affect the linearity, brilliance or colour however. Am I correct in suspecting a break in the e.h.t. stick? The line output transistor and its associated components have been tested and appear to be in order.

We suggest you first check by substitution C406 which is in parallel with the line output transistor and provides the flyback tuning. It's a specially rated component, so must be ordered through a dealer. If the results are the same, check for arcing in the e.h.t. overwinding output socket before condemning the e.h.t. rectifier stick itself.

GEC SERIES 2 CHASSIS

There's lack of width and from time to time the picture moves sideways. The line timebase valves have been renewed but the trouble persists.

Insufficient width is usually due to the 10MΩ resistor R228 between the width circuit and the boost line changing value. For the line drift problem check the line oscillator tuning capacitor C215, the feedback capacitor C217, the cathode resistor R221, the flywheel sync discriminator load resistors R213/4 and if necessary the other components in the discriminator circuit.

RANK A823AV CHASSIS

When the set is first switched on, sound and vision are usually normal. After a period of time varying from a few seconds to half an hour however the picture will suddenly change to look like a dull colour negative. In this state the brightness, contrast and colour controls have no effect whatever, though changing to another channel will restore the picture to normal, if not at the first attempt then at some subsequent try. If this fails, switching the set off and on restores a perfect picture for an indeterminate time. The sound remains o.k. at all times.

The description you give suggests that the colour remains but the luminance falls to a very low level. The trouble is likely to be on the decoder/RGB panel and is probably due to a dry joint, most likely on the luminance delay line or around the following emitter-follower 3VT3. The SL901B demodulator/matrix i.c. could be responsible, but this is unlikely.

TELETON VX1110

The picture on this set has an overall red to magenta cast. Suspecting that the G – Y colour-difference output triode V3A was losing emission this valve was replaced. This has made no difference, and the voltages around the valve and at the c.r.t. first anodes are all roughly correct. A fairly dim green picture can be obtained by removing the drives to the red and blue cathodes of the tube.

The G – Y signal is recovered by matrixing proportions of the outputs at the anodes of the R – Y and B – Y output triodes, so there's not much to suspect. Checking the control grid coupling capacitor C559 (0·01μF) and the associated grid leak resistor R570 (1MΩ) should reveal the cause of the trouble.

THORN 2000 CHASSIS

The fault is ripple on both sides of the screen, resulting in a wavy picture. Is this power supply or timebase trouble?

We suggest you first check the smoothing electrolytic C31 (10μF) on the line timebase panel. Then if necessary check the 2,000μF 73V supply reservoir capacitor C6 on the power supply board and the 1μF 50V line smoothing electrolytic on the regulator board.

GEC 2114 PORTABLE

The mains fuse blew but after replacement I've been unable to reduce the stabilised rail to 11V – it remains high at roughly 13·5V. The two transistors and the zener diode in the series regulator circuit have been replaced but this hasn't helped.

Ripple is fed to the emitter of the error sensing transistor Tr402 via the 220μF electrolytic C403. This could be leaky, increasing the voltage at the emitter or Tr402. Alternatively there could be a changed value resistor. Check Tr402's emitter resistor R403, and the resistors in series with the set 11V control – also the control itself if necessary.

DROPPER RESISTOR SECTIONS

Several of the wirewound resistors in the mains dropper need replacement in this set. My service sheet gives only the resistance values however, not the wattage ratings.

Such resistors are normally replaced by "sections" which are marketed for this purpose by RS Components and others. They are readily available in the values required for TV sets and are rated at 0·3A. This is adequate and renders wattage calculations unnecessary.

ITT CVC5 CHASSIS

There is excessive colour on this set, and the colour control has no effect. The picture appears to be badly out of focus, and is unviewable.

The fault is not uncommon on this chassis, and is caused by either the varicap diodes D23/D24 in the colour control circuit being defective or the associated trimmer C160 being faulty. Check these and replace as necessary. Finally, adjust C160 for zero colour at the minimum setting of the saturation control.

GRUNDIG 717GB

The trouble is black lines across the screen, a sort of smearing starting from the edge of a profile or image on the screen – especially when the image or lettering is white. It's as if the picture is trying to go negative at the parts affected. The lines are not always there, and the fault disappears if the aerial is disconnected for a few seconds.

We have experienced this sort of trouble on more than one occasion. It's usually due to one of two things, either the luminance output transistor Tr375 (BF258), or bad joints within the i.f. amplifier module, especially around the chokes associated with the vision detector diode Di335.

GEC 2038

The problem is reduced width. The set boost control P11 was found to be defective (broken track) and this and the boost diode were replaced. On carrying out the width adjustment as given in the manual however the boost voltage was found to be well over 1kV and could not be reduced to the correct 770V by P11. In addition, the brilliance control has to be turned right down. The picture quality is good however, so the set was left in use for some time. Now the line output valve has failed. What is the cause of the high boost voltage?

The first thing to do is to check the value of R133 (470kΩ) which is in series with the set boost control. Also check the values of the other two resistors in the width circuit (R129 3·3MΩ, R134 1MΩ). The problem could be due to a defective line output transformer, but other possibilities are the v.d.r. in the width circuit (VDR3) and L68. The latter is a desaturation choke and is mounted on the line output transformer.

DECCA GYPSY

There's a raster but no sound or vision. There are no markings on R10, R13 and R14 associated with the i.f. i.c. (MC1352). By shorting pins 13 and 14 of this i.c. I obtained a vague picture and sound at almost full volume.

R10 is 220kΩ, R13 180Ω and R14 3·3kΩ. If you are suspicious about these resistors, check them. The fault is most likely to be due to the following MC1330 demodulator i.c. however – it's notorious for this. You might require a new MC1352, but change the MC1330 first.

TELETON 20RT

The trouble with this hybrid 20in. colour set is that the picture is rather dim, despite the brightness control being set at maximum and the colours being turned up. There's also some blurring on distant pictures.

Colour-difference drive is used in these sets, with the c.r.t. cathodes driven by a 10GK6 output pentode. This is the first suspect. If a replacement doesn't improve matters, check voltages (210V at anode pin 7, 170V at screen grid pin 8 and 6·5V at cathode pin 1) and associated components as necessary.

PHILIPS 320 CHASSIS

The original problem was no picture, due to a line output stage fault. This was put right by replacing the defective components, but the fault now is sound and just a vertical white line across the screen. The upper transistor (BD131) in the field output stage was found to be short-circuit, but a replacement didn't last long. With the BD131 removed, the voltages in the other stages in the field timebase are normal except for the driver transistor's collector voltage which is low at about 5·5V instead of 11V.

It seems that the driver transistor is being turned on too hard, probably due to leakage through its base input coupling electrolytic C2537 (47μF). The field output current is fed back to the base circuit via C2539 (1,500μF) and R2547 (1·2Ω): if necessary, check these components.

GEC C2110 SERIES

The trouble with this set is that the 3·15A mains fuse keeps blowing. I suspect the thyristor rectifier but don't know how to check it.

If the mains fuse has blown and the fusible resistor R60 in the h.t. line is intact the power thyristor is probably defective. There's no simple and reliable method of checking it however, so a replacement will have to be tried. The 600μF reservoir/smoothing electrolytics C702/C701 are also suspect.

TEST CASE

186

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

A KB Model CK701 hybrid colour receiver (fitted with the CVC5 chassis) first developed the fault of cramping at the bottom of the picture, accompanied by unstable field lock. This symptom was intermittent, and when the bottom cramping did occur field stability could be achieved by critical adjustment to the vertical hold control. The customer used the receiver in this condition for several months. Some while later however the stability of the field locking diminished further, it being impossible to hold the picture at all. On test it was found that the bottom cramping appeared to have no link with the locking problem.

As this chassis employs a PCL805 triode-pentode vertical oscillator/output stage, this valve was immediately suspected. Replacement failed to correct the condition however. Since the line timebase was well locked, trouble in the sync separator was discounted. A check was made of the field sync feed, and it was found that the sync signal is coupled to the cathode of PCL805 triode section via a low-pass filter integrator and an 0·0047μF coupling capacitor. These components were carefully checked after appropriate disconnection but no definite fault was exposed.

It was also noticed that the cathode of the triode is returned to chassis through an OA91 diode (D46f – anode of the diode to the cathode of the valve). This diode was removed and tested for forward and reverse conduction with a high-resistance ohmmeter. A reading was obtained in both directions, indicating a short-circuit. The diode was replaced, restoring the field lock, but during a soak test it was found that the original intermittent symptom of bottom cramping persisted.

What was the most likely cause of this trouble and what is the purpose of the OA91 in the cathode circuit of the triode? See next month's Television for the answers and for a further item in the test case series.

SOLUTION TO TEST CASE 185

– Page 386 last month –

Since the Pye hybrid colour receiver in last month's test case produced a good monochrome picture with the colour turned down a clued up technician would have known immediately that the three PCL84 triode clamp stages were working correctly, and also that the c.r.t. biasing was pretty well correct, eliminating any suspicion of incorrect c.r.t. potentials. With PCL84s it's virtually impossible to detect emission imbalance merely by endeavouring to judge envelope temperatures with a finger! Voltage checks would have shown that the potentials at the valve electrodes were reasonably normal.

Attention would thus have been quickly focused on the transistor colour-difference preamplifier stages, starting with the R – Y one since the display was apparently lacking in red. The biasing of these stages can be quickly checked by measuring the emitter voltages relative to chassis, using a sensitive meter. All stages except the R – Y one were found to be correct at approximately 0·7V. The voltage at the emitter of the R – Y preamplifier transistor was much lower however. This was found to be due to a fall in the insulation resistance of the 25μF electrolytic C358 in the frequency-selective decoupling network and a rise in the value of the 12kΩ emitter feed resistor R371. Replacing these components cleared the symptom.

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TELEVISION JUNE 1978

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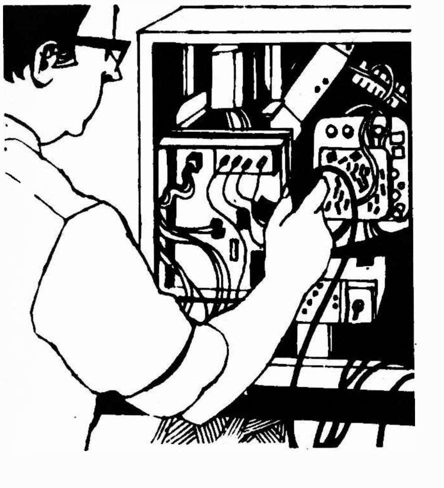

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100+200M 325v 30p
200+200+100+32M 350v 70p
150+200+200M 300v 50p
800M 250v 20p
600M 300v £1.00
400M 400v £1.00
800+800M 250v 60p
300+300+100+32+32 300v £1
200+100+100M 350v 70p
100M 450v 25p
33/450v 25p
47M 450v 25p
680M 100v 25p
6800M 40v 35p
100M 350v 20p
22M 350v 20p
33000 10v 30p
15000 40v 50p

2·2/63v 10M 40v
220M 10v
2·2M 100v
22M 100v 5p
4·7M 63v 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 12½p
1000M 40v 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
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x80/150 12p
CSD118xMH EACH
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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 100M 50v
270PF 8Kv 330M 10v
1000PF 10Kv 330M 25v
1200PF 10Kv 330M 35v
1000PF 12Kv 330M 50v
160M 25v 330M 63v
220M 25v 470M 25v
1000M 16v 470M 35v
220M 35v 470M 40v
220M 40v 47/63
220M 50v
470M 25v 10p
22M 315v EACH

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2 WOOD GRANGE CLOSE, THORPE BAY, ESSEX.

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