JUNE 1980

Australia $1.50; Malaysia $5.10; New Zealand $1.60

60p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS

COMPONENTS FOR TV

SERVICING THE KUBA FLORENCE

VCR MUTING CIRCUITS

CLASS AB VIDEO CIRCUITS

TELEVISION

June 1980

Vol. 30, No. 8
Issue 356

this month

SEE NOTE ON PAGE 411 REGARDING LATE PUBLICATION

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

SUBSCRIPTIONS
An annual subscription costs £10 in the UK, £11 overseas ($24.20 Canada or USA). Send orders with payment to IPC Services, Oakfield House, Perrymount Road, Haywards Heath, Sussex.

BINDERS AND INDEXES
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Some back issues are available from the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF at 75p inclusive of postage and packing.

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 "Service Bureau". Send to the address given above (see "correspondence").

THE PROFESSIONAL CHOICE. NATIONWIDE

NEW SPARES

TYPE	PRICE £
AC107	0.20
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	0.30
AC188K	0.30
AD130	0.50
AD140	0.65
AD142	0.73
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.40
AD162	0.40
AD161 } AD162 }	1.30
AF106	0.42
AF114	0.23
AF115	0.22
AF116	0.22
AF117	0.30
AF118	0.40
AF121	0.33
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24

TYPE	PRICE £
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	0.08
BAX13	0.05
BAX16	0.08
BC107	0.10
BC108	0.10
BC109	0.10
BC113	0.09
BC114	0.12
BC115	0.10
BC116	0.10
BC117	0.11
BC119	0.22
BC125	0.12
BC126	0.09
BC136	0.12
BC137	0.12
BC138	0.21
BC139	0.21
BC140	0.24
BC141	0.22
BC142	0.19
BC143	0.19
BC147	0.07
BC148	0.07
BC149	0.07
BC153	0.12
BC154	0.12
BC157	0.10
BC158	0.11
BC159	0.11
BC160	0.22
BC161	0.22
BC167	0.09
BC168	0.09
BC169C	0.09
BC171	0.08

TYPE	PRICE £
BC172	0.08
BC173	0.12
BC177	0.12
BC178	0.12
BC179	0.12
BC182L	0.09
BC183L	0.09
BC184L	0.09
BC186	0.18
BC187	0.18
BC209	0.11
BC212	0.09
BC213L	0.09
BC214L	0.09
BC237	0.07
BC240	0.31
BC281	0.24
BC262	0.18
BC263B	0.20
BC267	0.19
BC301	0.22
BC302	0.30
BC307	0.10
BC337	0.11
BC338	0.09
BC307A	0.10
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	0.30
BD116	0.47
BD124	1.30
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	0.50

TYPE	PRICE £
BD222/T1P31A	0.37
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	0.12
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	0.11
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	0.28
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	0.15
BFY51	0.15
BFY52	0.15
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	1.23
BU105/02	1.50
BU105/04	2.00
BU126	1.40
BU205	1.20
BU208	1.60
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

TYPE	PRICE £
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	0.65
R2008B	1.50
R2010B	1.50
R2305	0.38
R2305/BD222	0.37
SCR957	0.65
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
T1590	0.19
T1591	0.19
TV106	1.09

SPECIAL OFFER

SL901B	3.50
SL917B	5.00

DIODES

1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.03
1N4751A	0.11
1N5401	0.12
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
PCC189	0.65
PCF80	0.70
PCF86	0.68
PCF801	0.70
PCF802	0.74
PCL82	0.67
PCL84	0.75
PCL86	0.78
PCL805	0.75
PLF200	1.00
PL36	0.90
PL84	0.74
PL504	1.10
PL509	2.45
PY88	0.63
PY500A	1.60
PY81/800	0.57

SPECIAL OFFER

Philips PL802 2.55

E.H.T. TRAYS MONO

950 MK2 1400	2.00
1500 18" 19" stick	2.37
1500 24" 5 stick	2.48
Single stick Thorn TV 11.16K 70V	0.75
TV20 2 MT	0.75
TV20 16K 1BV	0.75

IC's

SN76013N	1.20
SN76013ND	1.00
SN76023N	1.20
SN76023ND	1.00
SN76226DN	1.50
SN76227N	1.20
TBA341	0.97
TBA520Q	1.10
TBA530Q	1.10
TBA540Q	1.45
TBA550Q	1.40
TBA560CQ	1.50
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920Q	1.50
TBA990Q	1.50
TCA270SQ	1.45
TCA270SA	1.45
TCA1327B	1.00

E.H.T. TRAYS COLOUR

Pye 731	5.20
Pye 691/693	4.50
Decca (large screen) CS2030/2232/2630/2632/2230/2233/2631	5.00
Philips G8 520/40	5.30
Philips 550	5.30
GEC C2110	5.50
GEC Hybrid CTV	5.10
Thorn 3000/3500	5.00
Thorn 8000	2.42
Thorn 8500	4.75
Thorn 9000	5.50
GEC TVM 25	2.50
ITT/KB CVC 5/7/8/9	5.10
RRI (RBM) A823	5.00
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

P & P 75p per order.

All transistors, IC's offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc. Please add 15% VAT to all items and overseas at cost P & P U.K. 50p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

TELEVISION SALE
DISCOUNT FOR QUANTITY

Colour sets sold with good c.r.t.'s 100% complete. Working colour £15.00 per set. In batches of ten.

GEC 2040 – £20.00 BUSH/MURPHY S/C – £30.00
PYE G91 – £20.00 THORN 25" 3000 – £30.00
PYE G97 26" – £25.00

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	40	40	40	40
Philips	—	—	40	40	40
Thorn	55	—	60	45	65
Korting	—	—	55	—	60
Pye Mechanical	40	—	40	40	40
Pye Varicap	45	—	45	45	45

MAINS DROPPERS

Mono

Bush 161	60p
Philips 210 30+125+2K85	50p
Philips 210 118R+148R	48p
Thorn 1400	75p
GEC 2018	58p
Thorn 1500	70p

Colour

Bush A823	72p
Pye 723 27Ω+56Ω	57p
GEC 2110 –41Ω	45p
GEC 2110 –12R5+12R5	47p
GEC2110 –27R5	45p
Thorn 3500	58p
Thorn 8000	58p
Thorn 8500	54p
Philips G8 47R	30p
Philips G8 2.2+68	42p

All plus VAT at 15%

WHY NOT TRY OUR EXPRESS MAIL ORDER ON ANY OF THE ITEMS LISTED.

EXPORT COLOUR & MONO T.V.s AVAILABLE READY FOR USE OVERSEAS

TELEVISION

Briarwood House Preston Street
Bradford West Yorkshire BD7 1NS
Tel. Bradford 306018 (STD code 0274)

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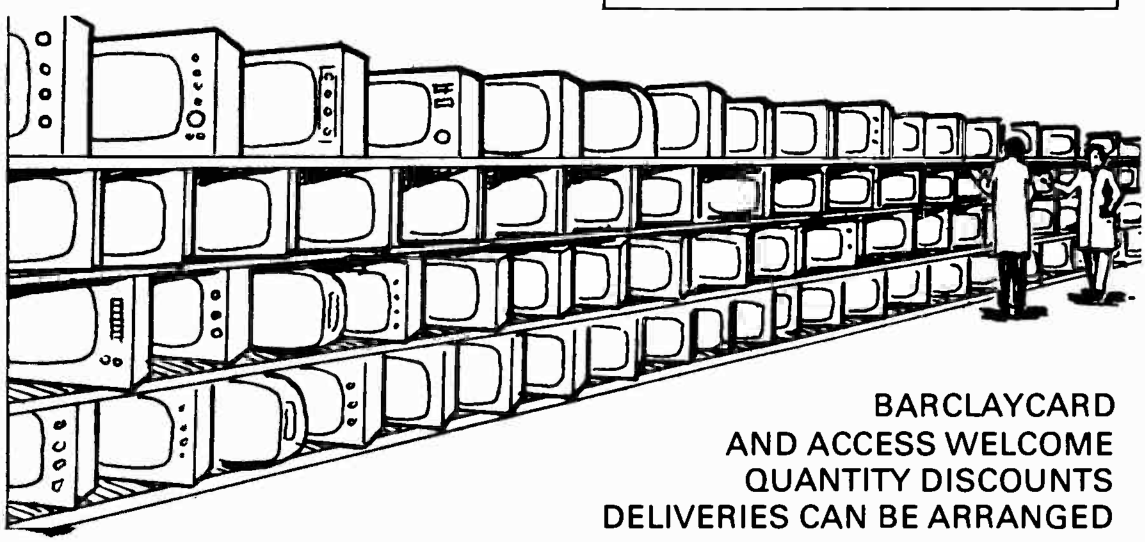
ALWAYS A HUGE SELECTION OF PART-EXCHANGED COLOUR TV'S.

THIS MONTHS SPECIAL OFFER

10 ASSORTED SINGLE STANDARD COLOUR TV'S (Slightly sub-standard)	**£100** PLUS VAT

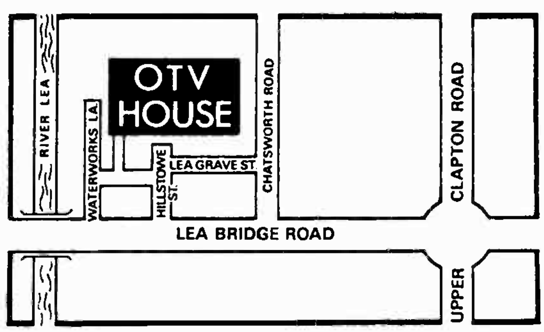
10 ASSORTED DUAL STANDARD COLOUR TV'S	**£50** PLUS VAT



BARCLAYCARD
AND ACCESS WELCOME
QUANTITY DISCOUNTS
DELIVERIES CAN BE ARRANGED

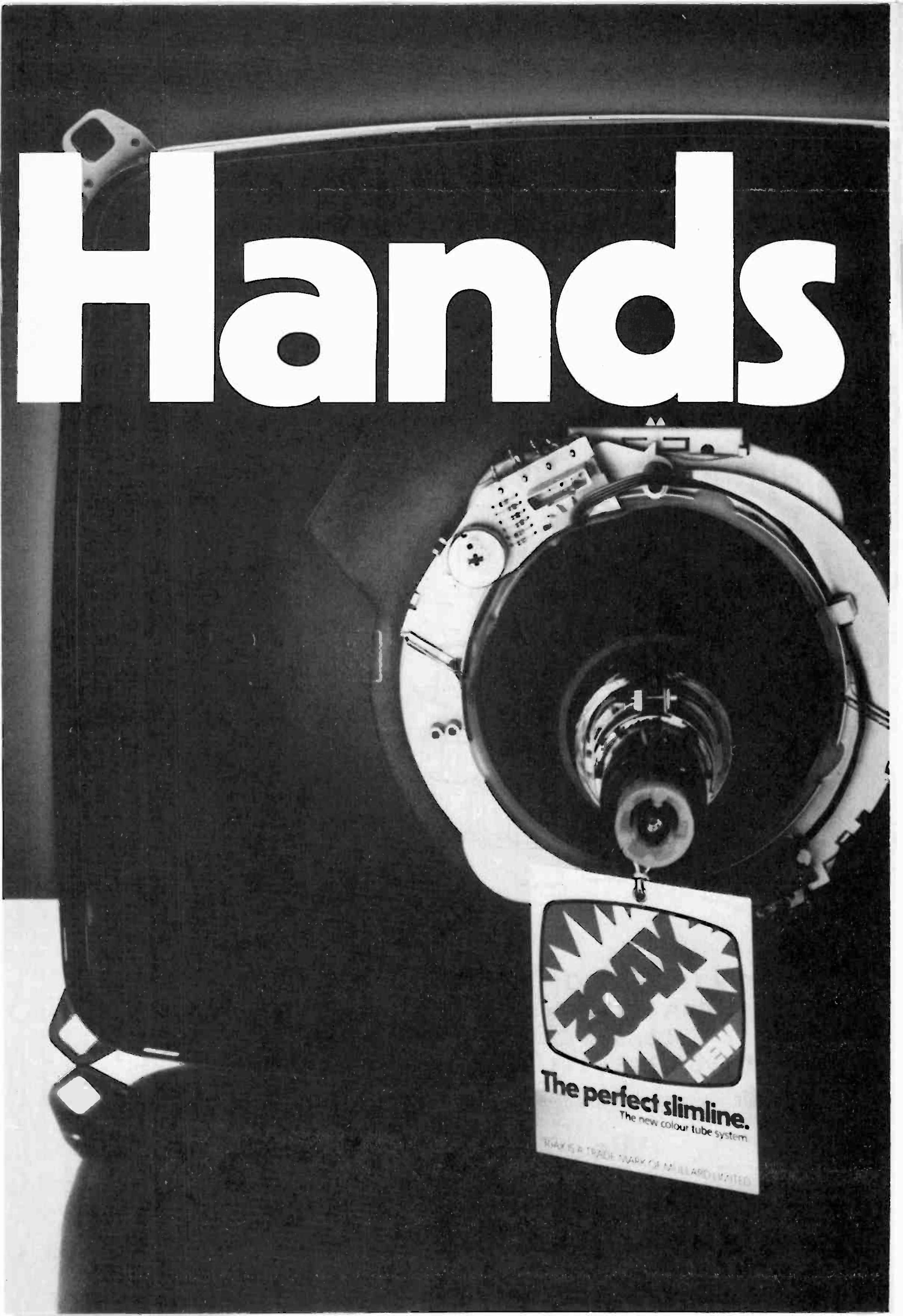
OTV TELEVISION LTD,
144A Lea Bridge Rd,
London E5 9RB.
Tel: 01-985 6111/8687

OPEN MON.-SAT. 9.30 a.m.-5.30 p.m.

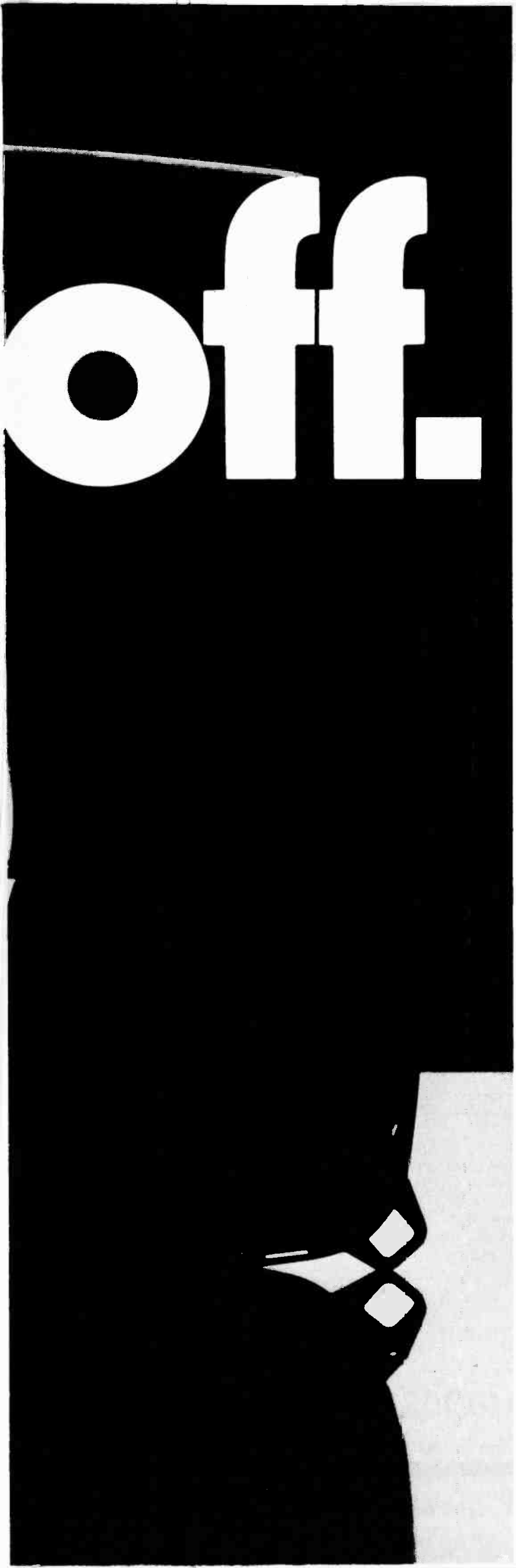


We specialise in Export

Enquiries invited from the Middle East and Third World Countries.



Hands
30AX
NEW
The perfect slimline.
The new colour tube system



We mean it.

The new 30AX colour tube system from Mullard doesn't need innumerable twists and turns of a screwdriver to set it up.

It needs no adjustments at all. Because every one has been 'designed out'.

Every tube that leaves our factory is completely pre-adjusted by us. Leaving only the turn of one screw to affix or remove the coil.

No dynamic convergence adjustments.

No colour purity adjustments.

And no raster orientation adjustment.

As for what it has to offer, the 30AX's focus is sharper and its definition greatly improved.

Its in-line guns and specially built coil provide the best picture shape yet.

And rest assured it'll stay that way. In a slim 110° package that trims about 3" off conventional 22" 90° TV cabinet depths.

Some features of the 30AX however, are a little more established.

Like its excellent colour registration. High brightness. Soft flash protection. Fast warm-up. And of course, greater overall reliability. This is the new 30AX colour tube system.

For more information just write your name and address on this page and send it to Dept. MCG, Mullard Ltd., Mullard House, Torrington Place, London WC1E 7HD.

30AX is a trademark of Mullard Ltd.

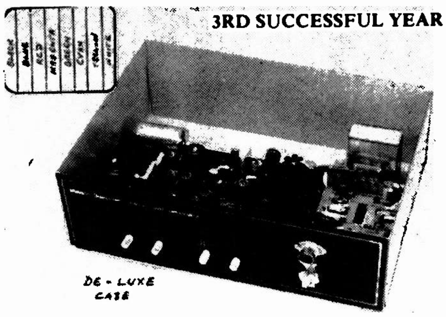
Mullard

30AX. The perfect slimline.

MANOR SUPPLIES

PAL COLOUR BAR GENERATOR

plus CROSS HATCH KIT (Mk. 4)



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

PRICE OF MK4 COLOUR BAR & CROSS HATCH KIT £40.25 + £1.40 P/Packing. DE-LUXE CASE £5.95. ALUMINIUM CASE £3.30, BATT HOLDERS £1.70, ALTERNATIVE STAB. MAINS SUPPLY KIT £5.55.

ALSO THE MK3 COLOUR BAR GENERATOR KIT FOR ADDITION TO MANOR SUPPLIES CROSS HATCH UNITS. £28.75 + £1.15 p.p. CASE EXTRA £2.00. BATT. HOLDERS £1.70.

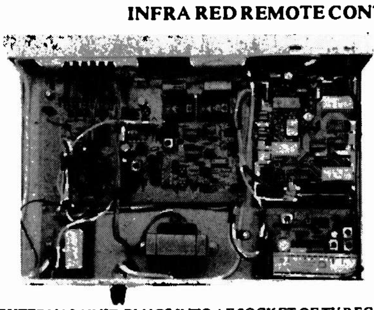
- ★★ Kits include drilled P.C. board, with full circuit data, assembly and setting up instructions.
- ★★ All special parts such as coils and modulator supplied complete and tested, ready for use.
- ★★ Designed to professional standards.
- ★★ Demonstration models at 172 West End Lane, NW6.
- ★★ Every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

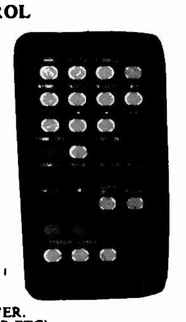
MK4 DE LUXE (BATTERY) BUILT & TESTED £66.70 + £1.35 P&P.
VHF MODULATOR (CHI to 4) FOR OVERSEAS £4.60.
INFORMATION ON VIDEO TAKE-OFF FOR C.C.T.V.
(ALL PRICES INCLUDE 15% VAT)

MANOR SUPPLIES
TELETEXT KIT (MK2)

(INCORPORATING MULLARD DECODER 6101VML)

INFRA RED REMOTE CONTROL





- EXTERNAL UNIT. PLUGS INTO AE SOCKET OF TV RECEIVER.
- LATER SPEC (DOUBLE HEIGHT. BACKGROUND COLOUR ETC).
- INFRA-RED REMOTE CONTROL (MULLARD 5000 SYSTEM) STATION SELECTION, TEXT. MIX, TIME, DOUBLE HEIGHT, HOLD, CLOCK, REVEAL RESET ETC, ETC.
- INCLUDES COMPLETE & TESTED 6101 VML (MULLARD) DECODER, SAW FILTER IF PANEL & 32 BUTTON REMOTE CONTROL HANDSET.
- SUITABLE FOR BBC DEAF SUB-TITLE TRANSMISSIONS-REMODULATES PICTURE.
- CONVERTS ANY UHF RECEIVER TO STATION SELECTION REMOTE CONTROL AND TELETEXT.
- EVERY KIT EASY TO ASSEMBLE & FULLY GUARANTEED.
- DE-LUXE CASE MEASUREMENTS APPROX. $15\frac{1}{4} \times 10\frac{1}{4} \times 3\frac{1}{4}$.
- WORKING MODEL AT 172 WEST END LANE, N.W.6.

FURTHER DETAILS ON REQUEST

ALSO, MANOR SUPPLIES TELETEXT MK1 KIT (TEXAS) STILL AVAILABLE, SPECIAL OFFER PRICE £193.20 P/P £2.80.

COLOUR. UHF & TELEVISION SPARES

SPECIAL OFFER TEXAS XMII TELETEXT MODULE NEW & TESTED, LIMITED QUANTITY AT HALF PRICE **£75.00** p.p. £1.40.
NEW 'TELEVISION' COLOUR RECEIVER PROJECT ALL PARTS AVAILABLE AT PRESENT. POWER, SIGNAL & TIMEBASE. SEND OR PHONE FOR LIST. WORKING DEMONSTRATION SET NOW ON SHOW WITH TELETEXT.
NEW SAW FILTER IF AMPLIFIER PLUS TUNER COMPLETE AND TESTED FOR T.V. SOUND & VISION **£32.80** p.p. £1.10.
TELETEXT 5V STABILISED MAINS POWER SUPPLY (FOR TEXAS OR MULLARD DECODERS) **£6.70** p.p. £1.00.
TEXAS XM11 INTERFACE PANEL (THORN) **£2.10** p.p. 75p.
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 **£12.65** p.p. 50p. (ALUM CASE **£2.60** p.p. 80p.) COMPLETE TESTED UNITS READY FOR USE (DE LUXE CASE) **£26.00** p.p. £1.25.
ADDITIONAL GREY SCALE KIT **£3.35** p.p. 35p.
UHF SIGNAL STRENGTH METER KIT £20.00
ALUM CASE **£2.00** DE LUXE CASE **£5.95** p.p. £1.60.
CRT TESTER & REACTIVATOR PROJECT KIT FOR COLOUR & MONO £25.80 p.p. £1.80.
"TELEVISION" COLOUR SET (1974) SPARE PARTS AVAILABLE
THORN 9000 TOUCH TUNE, REMOTE CONTROL RECEIVER UNIT PLUS TRANSMITTER HANDSET **£18.40** p.p. £1.40.
THORN 9000 FASCIA INCL. CHANNEL SELECTOR, INDICATOR SET CONTROLS, SPEAKER **£6.90** p.p. £1.60.
PHILIPS 210, 300 Series Frame T.B. Panels **£1.15** p.p. 75p.
BUSH Z718, BC6100 SERIES SURPLUS LINE T.B. PANEL Z904, INCL. LOPT, EHT STICK, FOCUS ETC, 18" or 22" **£17.25** p.p. £1.80.
BUSH A823 (A807) Decoder Panel **£8.65** p.p. £1.35.
BUSH A823 IF PANEL (EXPORT VERSION) **£3.25** p.p. 95p.
BUSH Z718 BC6100 SERIES IF PANEL **£5.75** p.p. 80p.
BUSH A816 IF PANEL (SURPLUS) **£1.90** p.p. 80p.
BUSH 161 TIMEBASE PANEL A634 **£4.40** p.p. £1.25.
GEC 2010 SERIES TIMEBASE PANEL **£1.15** p.p. 95p.
DECCA Colour T.V. Thyristor Power Supply. HT, LT etc. **£4.40** p.p. £1.40.
BUSH TV 312 IF Panel (Single I.C.) incl. circuit **£5.75** p.p. 75p.
BUSH TV Portable Eleven Volt Stab. Power Supply Unit **£4.40** p.p. £1.10.
PYE 697 Line T.B. P.C.B. salvaged **£4.80** p.p. £1.50.
THORN 3000 IF Panel **£9.78** p.p. £1.00.
THORN 3000 LINE TB PCB **£5.75 each** p.p. 85p.
THORN 3000 VID, IF, DEC, Ex Rental **£5.75 each** p.p. £1.20.
THORN 8000/8500 POWER/SALV. SPARES **£2.88** p.p. 60p.
THORN 8000/8500 TIME BASE, SALV., SPARES **£5.52** p.p. £1.00.
THORN 9000 LINE T.B. SALV., SPARES **£8.62** p.p. £1.60.
MULLARD AT1022 Colour Scan Coils **£6.90** p.p. £1.60, AT1023/05 Convergence Yoke **£2.90** p.p. 95p, AT1025/06 Blue Lat. **90p** p.p. 40p.
PHILIPS G9 Signal Board Panels for small spares **£4.80** p.p. £1.00.
PHILIPS G6 Single standard convergence panels **£2.90** p.p. £1.20.
G8 Decoder panels salvaged **£4.25.** Decoder panels for spares **£2.00** p.p. £1.15.
VARICAP UHF MULLARD U321 **£8.97,** ELC1043/05 **£6.35** p.p. 40p., G.I. type (equiv. 1043/05) **£4.00** p.p. 40p. Control units, 3PSN **£1.40,** 4PSN **£1.75,** 5PSN **£2.00,** 6PSN **£2.10, Special Offer** 6PSN **£1.15** p.p. 40p.
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BUSH 145 to 186SS series	£8.50
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TRANSISTORS, ETC.

Type	Price (£)
AC107	0.48
AC117	0.38
AC126	0.36
AC127	0.54
AC128	0.46
AC128K	0.55
AC141	0.65
AC141K	0.70
AC142	0.60
AC142K	0.65
AC151	0.31
AC152	0.36
AC153	0.42
AC153K	0.52
AC154	0.41
AC176	0.45
AC178	0.51
AC179	0.55
AC187	0.56
AC187K	0.65
AC188	0.52
AC188K	0.61
AC193K	0.70
AC194K	0.74
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.02
AD140	1.79
AD142	1.90
AD143	1.78
AD149	1.42
AD161	0.66
AD161/162	1.22
AD162	0.71
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.42
AF118	0.98
AF121	0.68
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.86
AF139	0.58
AF147	0.52
AF149	0.45
AF178	1.35
AF179	1.36
AF180	1.35
AF181	1.33
AF186	1.48
AF202	0.27
AF239	0.73
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.58

Type	Price (£)
AU103	2.40
AU107	2.75
AU110	2.40
AU113	2.60
BC107*	0.16
BC108*	0.15
BC109*	0.16
BC113	0.22
BC114	0.22
BC115	0.24
BC116*	0.25
BC117	0.30
BC118	0.24
BC119	0.34
BC125*	0.30
BC126	0.30
BC132	0.20
BC134	0.22
BC135	0.21
BC136	0.22
BC137	0.30
BC138	0.35
BC140	0.36
BC141	0.44
BC142	0.35
BC143	0.38
BC147*	0.12
BC148*	0.12
BC149*	0.13
BC152	0.42
BC153	0.38
BC154	0.41
BC157*	0.13
BC158*	0.12
BC159*	0.14
BC160	0.52
BC161	0.58
BC167B	0.15
BC168B	0.14
BC169C	0.15
BC170*	0.15
BC171*	0.15
BC172*	0.14
BC173*	0.22
BC174A & B	0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	0.15
BC182L*	0.15
BC183*	0.14
BC183L*	0.14
BC184*	0.15
BC184L*	0.15
BC185	0.36
BC186	0.25
BC187	0.27

Type	Price (£)
BC192	0.56
BC204*	0.39
BC205*	0.39
BC206*	0.37
BC207*	0.39
BC208*	0.37
BC209*	0.39
BC211*	0.36
BC212*	0.17
BC212L*	0.17
BC213*	0.16
BC213L*	0.16
BC214*	0.18
BC214L*	0.18
BC225	0.42
BC237*	0.16
BC238*	0.15
BC239*	0.22
BC251*	0.25
BC252*	0.26
BC253*	0.38
BC261A*	0.28
BC262A*	0.28
BC263*	0.26
BC267*	0.20
BC268*	0.28
BC286	0.40
BC287	0.49
BC291	0.27
BC294	0.37
BC297	0.36
BC300	0.62
BC301	0.38
BC302	0.86
BC303	0.64
BC304	0.44
BC307*	0.17
BC308*	0.14
BC309*	0.18
BC317*	0.15
BC318*	0.15
BC319*	0.19
BC320	0.17
BC321A&B	0.18
BC322	0.28
BC323	1.15
BC327	0.16
BC328	0.18
BC337	0.17
BC338	0.17
BC340	0.19
BC347*	0.17
BC348A & B	0.17
BC349B	0.17
BC350*	0.24
BC351*	0.22
BC352A*	0.24
BC360	0.59

Type	Price (£)
BC377	0.29
BC394	0.39
BC440	0.52
BC441	0.59
BC461	0.78
BC477	0.30
BC478	0.25
BC479	0.33
BC547*	0.13
BC548*	0.13
BC549*	0.15
BC550	0.24
BC556	0.23
BC557*	0.16
BC558*	0.16
BC559*	0.17
BCY10	0.30
BCY30A	1.06
BCY32A	1.19
BCY34A	1.02
BCY72	0.27
BD115	1.35
BD123	1.50
BD124	1.85
BD130Y	1.56
BD131	0.58
BD132	0.68
BD133	0.70
BD135	0.37
BD136	0.38
BD137	0.40
BD138	0.42
BD139	0.46
BD140	0.50
BD144	2.24
BD145	0.75
BD150A*	0.51
BD155	0.90
BD157	0.51
BD158	0.75
BD159	0.68
BD160	2.69
BD163	0.67
BD165	0.66
BD166	0.88
BD175	0.90
BD177	0.58
BD178	0.92
BD181	1.94
BD182	2.10
BD183	1.34
BD184	2.30
BD187	1.20
BD188	1.25
BD189	0.71
BD222	0.91
BD225	0.91
BD232	0.91
BD233	0.62

Type	Price (£)
BD234	0.66
BD235	0.63
BD236	0.63
BD237	0.66
BD238	0.68
BD253	1.58
BD410	1.65
BD433	0.65
BD435	0.70
BD436	0.71
BD437	0.74
BD438	0.75
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BD663BR	0.66
BDX18	1.55
BDX32	2.95
BDY16A	0.63
BDY18	1.55
BDY20	2.29
BDY38	1.38
BF115	0.48
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.48
BF125	0.68
BF127	0.51
BF137F	0.78
BF152	0.19
BF158	0.25
BF159	0.27
BF160	0.20
BF161	0.64
BF163	0.65
BF164	0.95
BF166	0.50
BF167	0.38
BF173	0.35
BF177	0.36
BF178	0.46
BF179	0.58
BF180	0.53
BF181	0.53
BF182	0.44
BF183	0.52
BF184	0.44
BF185	0.42
BF186	0.42
BF194*	0.14
BF195*	0.13
BF196	0.14
BF197	0.15
BF198	0.29
BF199	0.29
BF200	0.25
BF218	0.42

Type	Price (£)
BF222	0.51
BF224 & J	0.22
BF240	0.32
BF241	0.31
BF244*	0.51
BF245*	0.43
BF254	0.48
BF255	0.58
BF256L*	0.49
BF257	0.44
BF258	0.52
BF259	0.54
BF262	0.73
BF263	0.88
BF270	0.47
BF271	0.42
BF272A	0.80
BF273	0.33
BF274	0.34
BF336	0.63
BF337	0.65
BF338	0.68
BF355	0.72
BF362	0.49
BF363	0.49
BF367	0.29
BF451	0.43
BF457	0.46
BF458	0.49
BF459	0.52
BF594	0.16
BF596	0.17
BF597	0.27
BFR39	0.30
BFR40	0.29
BFR41	0.30
BFR50	0.29
BFR52	0.33
BFR61	0.29
BFR62	0.28
BFR79	0.30
BFR80	0.29
BFR81	0.30
BFR88	0.42
BFT41	0.48
BFT43	0.55
BFW11	1.02
BFW30	2.58
BFW59	0.19
BFW60	0.20
BFW90	0.65
BFX29	0.38
BFX84	0.42
BFY50	0.38
BFY51	0.37
BFY52	0.36
BFY53	0.36
BFY90	1.98
BPX25	1.62

Type	Price (£)
BPX29	1.62
BR101	0.53
BR103	0.64
BR303	1.06
BRC4443	1.76
BRY39	0.80
BRY56	0.44
BSS27	0.92
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	3.35
BU105	1.80
BU105/02	1.95
BU108	2.98
BU126	2.91
BU204	2.50
BU205	2.58
BU206	2.59
BU208	2.75
BU407	1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	0.46
D40N1	0.64
E300	0.42
E1222	0.47
E5024	0.19
GET872	0.46
ME0402	0.18
MF0404/02	0.18
ME6001	0.18
ME6002	0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.95
MJE3055	1.22
MPF102	0.40
MPS3702	0.33
MPS3705	0.30
MPS6521	0.36
MPS6523	0.36
MPS6566	0.44
MPSA05	0.30
MPSA06	0.32
MPSA55	0.43
MPSA56	0.45
MPSA93	0.56
MPSL01	0.33
MPSU01	0.61

Type	Price (£)
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
MPSU60	0.82
MPU131	0.59
OC26	1.90
OC28	1.49
OC29	1.60
OC35	1.25
OC36	1.25
OC42	0.90
OC44	0.66
OC45	0.63
OC70	0.65
OC71	0.73
OC72	0.73
OC81	0.83
OC81D	0.95
OC139	1.30
OC140	1.35
OC170	0.80
OC171	0.82
OC200	3.90
OC201	3.95
OC202	2.40
OC205	3.95
OCP71	1.98
ON236A	0.94
R2008B	2.72
R2010B	2.79
R2322	0.75
R2323	0.85
ST2110	0.49
ST6120	0.48
TIC44	0.25
TIC46	0.35
TIC47	0.45
TIP29A	0.47
TIP30A	0.50
TIP31A	0.51
TIP31C	0.67
TIP32A	0.56
TIP32C	0.72
TIP33A	0.77
TIP34A	0.64
TIP41A	0.72
TIP42A	0.80
TIP2955	0.77
TIP3055	0.58
TIS43	0.44
TIS73	1.36
TIS90	0.23
TIS91	0.28
ZTX108	0.14
ZTX109	0.16
ZTX213	0.23
ZTX300	0.16
ZTX304	0.26

Type	Price (£)
ZTX500	0.18
ZTX502	0.22
ZTX504	0.28
2N404	1.30
2N696	0.46
2N697	0.46
2N706A	0.33
2N708	0.29
2N914	0.32
2N916	0.46
2N918	0.54
2N930	0.29
2N1164	8.29
2N1304	1.40
2N1305	1.29
2N1306	1.49
2N1307	1.32
2N1308	1.53
2N1711	0.47
2N1893	0.52
2N2102	0.71
2N2217	0.55
2N2218	0.38
2N2219	0.42
2N2221A	0.26
2N2222A	0.41
2N2369A	0.40
2N2401	0.80
2N2484	0.35
2N2570	0.74
2N2646	0.82
2N2784	1.15
2N2869	2.08
2N2894	0.45
2N2904*	0.40
2N2905*	0.39
2N2906*	0.36
2N2926G	0.15
2N2926O	0.14
2N2926Y	0.14
2N2955	1.12
2N3053	0.48
2N3054	0.66
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	0.80
2N3703	0.17
2N3704	0.19
2N3705	0.17
2N3706	0.16
2N3707	0.18
2N3708	0.17
2N3715	1.70
2N3771	2.09
2N3772	2.08
2N3773	2.90
2N3794	0.40

Type	Price (£)
2N3819	0.47
2N3820	0.72
2N3866	1.08
2N3904	0.20
2N3905	0.20
2N3906	0.20
2N4036	0.94
2N4123	0.17
2N4124	0.17
2N4126	0.17
2N4236	2.20
2N4289	0.32
2N4292	0.32
2N4416	0.85
2N4444	1.90
2N4921	0.60
2N5042	1.65
2N5060	0.28
2N5061	0.30
2N5064	0.63
2N5086	0.49
2N5087	0.50
2N5208	0.59
2N5294	0.66
2N5296	0.68
2N5298	0.71
2N5322	1.16
2N5449	0.18
2N5457	0.46
2N5458	0.40
2N5459	0.58
2N5494	0.85
2N5496	1.05
2N6027	0.55
2N6107	0.71
2N6122	0.60
2N6178	1.07
2N6180	1.39
2N6211	2.74
2SB337BP	4.28
2SC458C	0.78
2SC643A	2.25
2SC930D	1.50
2SC1061	1.45
2SC1172Y	3.55
2SD234	1.48
3N128	1.60
40250	0.98
40251	1.14
40327	0.67
40361	0.48
40362	0.50
40410	0.94
40429	0.88
40530	0.79
40595	1.39
40603	1.13
40636	1.26
40654	0.89

Alternative gain versions available on items marked*. For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)
BRC1330	0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA3068	1.90
CA3130S	1.57
FCH161	2.40
FCJ101	3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	1.03
MC1307P	1.82
MC1310P*	1.84
MC1312P	2.34
MC1327P*	1.86
MC1330P	0.83
MC1350P	1.22
MC1351P	1.42
MC1352P	1.42
MC1357P	2.92
MC1358P*	2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC4008	0.85
MFC4060A	0.98
MFC6040	1.11
MFC8020A	1.10
ML231	3.57
ML232	3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	5.70
SAA1025	10.35
SAS560A	2.01
SAS570	2.01
SC9503P	1.40
SC9504P	1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	4.20
SL917B	5.60
SL918A	5.95
SN72440N	2.21
SN76001N	1.67
SN76003N	2.20

Type	Price (£)
SN76008KE	2.66
SN76013N	1.66
SN76013ND	1.40
SN76018KE	2.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.20
SN76110N	1.20
SN76115N	1.62
SN76116N	1.78
SN76131N	2.10
SN76226N	2.60
SN70227N	1.61
SN76228N	1.80
SN76502N	1.92
SN76530P	0.97
SN76533N	1.38
SN76544N	1.85
SN76546N	1.85
SN76570N	1.81
SN76620AN	0.99
SN76650N	1.48
SN76660N	0.64
SN76666N	0.96
TA7073P	3.51
TAA263	2.20
TAA300	3.85
TAA320	1.10
TAA350A	2.48
TAA370A	3.18
TAA435	1.70
TAA450	3.39
TAA521	1.10
TAA522	2.09
TAA550	0.35
TAA560	1.93
TAA570	2.20
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
TAA661B	1.75
TAA700*	2.80
TAA840	3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	3.20
TAA970	2.81
TAD100	2.66
(Filter)	0.98
TBA120A	0.90
TBA120S*	0.99
TBA120SA	1.02
TBA231	1.1:

Type	Price (£)
TBA240A	3.98
TBA281	2.07
TBA395*	2.58
TBA396	2.40
TBA400	2.20
TBA480Q	1.64
TBA500*	2.21
TBA510*	2.21
TBA520*	2.98
TBA530P	2.24
TBA540*	2.88
TBA550*	3.13
TBA560C*	3.18
TBA570*	1.29
TBA611B	2.68
TBA641	2.55
TBA641A12	2.35
TBA641B11	2.61
TBA651	2.12
TBA673	2.31
TBA700*	2.50
TBA720AQ	2.38
TBA720Q	2.38
TBA750*	2.18
TBA800	1.65
TBA810AS	1.69
TBA920*	2.80
TBA940	3.52
TBA950	2.08
TBA990*	2.90
TCA270A*	3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	2.10
TCA440	1.67
TCA640	4.26
TCA650	4.26
TCA660	4.26
TCA730	4.10
TCA740	4.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	4.16
TDA1003	1.68
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	2.98
TDA2610	2.86
TDA2640	2.66
ZN414	1.45

* Indicates Q version is also available.

DIODES

Type	Price (£)
AA113	0.17
AA119	0.21
AA129	0.28
AA143	0.18
AAY30	0.28
AAZ13	0.42
AAZ15	0.35
AAZ17	0.28
AY102	3.85
BA100	0.24
BA102	0.36
BA104	0.19
BA110	0.80
BA111	0.70
BA115	0.17
BA116	0.56
BA121	0.85
BA129	0.45
BA145	0.19
BA148	0.19
BA154	0.06
BA155	0.17
BA156	0.12
BA157	0.25
BA158	0.28
BA159	0.40
BA164	0.14
BA182	0.27
BA201	0.13
BA202	0.14
BA203	0.14
BA216	0.08
BA219	0.11
BA243	0.45
BA317	0.06
BA318	0.07
BAV10	0.10
BAV21	0.18
BAW62	0.06
BAX13	0.07
BAX16	0.10
BAX17	0.19
BAY72	0.16
BB104B	0.52
BB105B	0.33
BB105G	0.30
BR100	0.40
BY100	0.35
BY103	0.35

Type	Price (£)
BY114	0.60
BY118	1.10
BY126	0.20
BY127	0.21
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.83
BY182	1.14
BY184	0.44
BY189	5.30
BY190	4.90
BY206	0.26
BY238	0.25
BYX10	0.30
BYX38/600	0.70
BYX70/500	0.53
ITT44	0.08
ITT210	0.63
ITT827	0.80
MCR101	0.48
MR854	1.10
OA5	0.88
OA10	0.58
OA47	0.20
OA81	0.19
OA90	0.13
OA91	0.15
OA95	0.20
OA200	0.13
OA202	0.13
OA210	0.89
TIL209	0.14
TIL211	0.18
TV20	2.25
IN914	0.06
IN916	0.06
IN4001	0.06
IN4002	0.07
IN4003	0.08
IN4004	0.08
IN4005	0.09
IN4006	0.10
IN4007	0.12
IN5400	0.15
IN5401	0.17
IN5402	0.20
IS920	0.09
IS921	0.11

ZENER DIODES

400mW plastic	3.0-75V	14p each
1/1.3W plastic	3.3-200V	18p each
1.5W flange	4.7-75V	† £1.26 each
2.5W plastic	7.5-75V	67p each
20W stud	7.5-75V	£1.31 each
75W stud	7.5-75V	£7.95 each

VDR's, etc.

Type	Price (£)
E295ZZ	
/01	0.28
/02	0.28
E298CD	
/A258	0.25
E298ED	
/A258	0.22
/A260	0.22
/A262	0.22
/A265	0.22
/P268	0.22
E298ZZ	
/05	0.25
/06	0.22
E299DD/P116-P354	all 0.23
E299DH	
/P230	0.72
R53	1.75
VA1015	0.92
VA1026	0.79
VA1033/34/38/39/40/53	all 0.20
VA1055s/56s/66s/67s	all 0.23
VA1074	0.20
VA1077	0.31
VA1091	0.29
VA1096/97/98	all 0.20
VA1103	0.32
VA1104	0.46
VA1108/09/10/11/12	all 0.24
VA8650	1.20
2322 554 02221	0.59
2322 662 98003	0.88

VALVES

Type	Price (£)
DY86/87	0.75
DY802	0.75
ECC81	0.78
ECC82	0.95
ECC83	0.78
ECH81	0.83
ECL80	0.82
EF80	0.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	3.08
EY51	1.20
EY86/87	0.67
PCC84	0.61
PCC85	0.79
PCC89	0.74
PCC189	0.94
PCF80	1.20
PCF86	0.87
PCF200	2.32
PCF801	0.74
PCF802	1.20
PCF805	3.37
PCF808	2.00
PCL82	0.93
PCL83	1.12
PCL84	0.65
PCL86	1.27
PCL805/85	1.00
PD500	3.75
PFL200	1.40
PL36	1.20
PL81	0.94
PL84	0.79
PL504	1.50
PL508	1.85
PL509	3.10
PL519	3.10
PL802	3.25
PY81/P810	0.60

BRIDGES

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

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) — 10 of one value; Mixes of a minimum of 10pcs of any value:

	Ea	10 of one value	50pc	100pc	500pc
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	£3.90	£5.40	£25.90

Wirewound (5%)

2½W 0.22Ω-270Ω	18p
4W 1.0Ω-10kΩ	22p
7W 0.68Ω-22kΩ	24p
11W 1.0Ω-22kΩ	28p
17W 1.0Ω-22kΩ	33p
Vertical mounting pillars	3p

Presets (†)
0·1W (Vertical and Horizontal)
100, 220, 470Ω, 1, 2·2, 4·7, 10, 22, 47, 100, 220, 470kΩ, 1, 2·5, 5MΩ — **all 14p each**
0·2W (Vertical and Horizontal)
Values as 0·1W — **all 14p 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)
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COLOUR BAR GENERATOR
CM6052/DB. VHF/UHF gives standard B band colour bars + variable tuning + front panel on/off switch + sync trigger output + blank raster + red raster + crosshatch + greyscale stepwedge + colour bar + centre cross + dot pattern + centre dot. **£182.25**

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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

H.V. Disc Ceramic (†)

1kV	1.5nF	18p	8kV	250, 270, 300pF	39p
3kV	1.5nF	20p	10kV	1nF	67p
8kV	10, 22, 47, 82, 100, 120, 150, 180, 200, 220pF	30p			

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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

Time for a Decision

It's interesting to compare the ways in which various decisions on TV systems have been arrived at over the years. In the early thirties, several different TV systems were under development. Baird was the first to get a system of sorts going, with regular (though very limited) transmissions and sets on sale – as early as 1930. He managed to persuade the authorities (the PO, the BBC and the Home Office) to allow his low-definition system to start, on an experimental basis, and of course at that early date there was no competition. The pace of technical development was rapid however, and Baird's low-definition, mechanical system was abandoned in 1935. At the end of the day about 1,000 owners of Televisors, also some mirror-drum models, found themselves in possession of museum pieces, but at least they'd participated in an exciting experiment.

By 1934, high-definition TV had become a feasible proposition, and the government set up the Selsdon Committee to advise it on which of the two UK systems to adopt – the EMI 405-line system or the Baird 240-line system. The outcome was that the Selsdon Committee couldn't make up its mind and both systems were given a trial run, starting in August 1936. The trial period didn't last long, Baird's system being abandoned in early 1937. At least the two systems had received fair treatment, the public was aware that a trial period was in progress, and few people can have found themselves in possession of an obsolete piece of equipment at the end of the day.

The next thing to come along was colour TV. This time we have to cross the Atlantic to the USA, where the Federal Communications Commission (FCC) is responsible for taking the decisions. CBS demonstrated a non-compatible system in 1947, using a spinning disc receiver and with a bandwidth of some 12MHz. It was subsequently put into service on an experimental basis and then abandoned. Presumably there were again a few owners of obsolete machines, though there can have been little doubt about the experimental nature of the system. The important decision came in 1951 however. In 1949 the FCC had given notice that it wanted to come to a decision on colour – since this would affect the development of the US TV network, a matter then becoming urgent. The National Television System Committee (NTSC) was set up by interested parties in the broadcasting and setmaking fields to make recommendations to the FCC. It reported in 1951, and its report was accepted. NTSC colour transmissions started in 1954.

By the time that Europe was ready to consider colour TV, further developments in the technology had taken place – in particular the SECAM and PAL systems. The European Broadcasting Union (EBU) set up a committee to compare the systems and make proposals. In the event it failed to come to a unanimous decision, and individual governments were left to make their own decisions. As we all know, some opted for PAL, others for SECAM.

In this history of TV system decision making, at least official bodies grappled with the problems and came to the sensible conclusions. There wasn't much to choose between the Baird and EMI systems in 1936. The trial period proved that the EMI system had the greater potential. The NTSC system has its shortcomings, but there was no practical alternative in 1951. There is not a great deal to choose between the SECAM and PAL systems. It's a nuisance having two European colour systems, but of little consequence to the domestic viewer.

Which brings us to the present video situation, the worst in the history of TV so far as the consumer is concerned. There are three VCR (Philips, Sony and VHS) and three disc systems (JVC, Philips and RCA) in competition, and the consumer is simply being left to make up his mind. Since the disc systems have yet to appear on the European market, we'll restrict our comments to VCRs. But even here it's not possible to say anything of consequence. The Philips N1500 system has come and gone, the N1700 system is obviously going to be phased out (as will the Grundig SVR system), while there's not enough experience of the V2000 system for anyone yet to be able to judge its pros and cons. There are plently of VHS and Betamax machines around, and the conclusion here must be that there's not a great deal to choose between them.

Since domestic video systems are not the concern of the broadcasting authorities, there has been no one to bring pressure to bear for the adoption of a common standard. It's worth recalling however that the audio industry and its customers have benefitted immeasurably over the years from standardisation first on the 78 r.p.m. shellac disc and later on the 45 and 33 r.p.m. EP and LP discs. A common cassette also helped.

The present situation in the video field is in no one's interest. Sooner or later certain manufacturers are going to discover they've spent a lot of money on developing systems that fall by the wayside, and consumers will then find they've wasted money on obsolete equipment. Meanwhile attempts to sell video to the public are being made increasingly difficult as a result of the multiplicity of models and systems, and those who might be buying or renting are sitting it out. If video is to become a major consumer product, the sooner the present situation is resolved the better.

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LATE PUBLICATION

Our apologies for the late publication of this issue of *Television*. We have been affected by industrial disputes in both the printing and publishing areas. The latter dispute has still not been resolved at the time that this issue is being passed for press, so we are unable to give a publication date for the next issue. Much work on it has already been done however, and it will be published as soon as possible after the normal date. Meanwhile we hope you will keep an eye out for us, and apologise for the inconvenience caused to readers and advertisers. Normal publication will be resumed at the earliest possible opportunity.

CORRECTION

The value of the focus feed resistor R003 in the Indesit Model T24EGB is 1·5MΩ and not 3·3MΩ as shown in the circuit in our January 1976 issue (page 135) and in the letter published in our May 1980 issue. The mistake in the letter was due to our using the incorrect circuit in our earlier issue as a reference, and we apologise to Mr. Edmands and the reader who pointed this out.

Teletopics

CHATTING TO YOUR SET

One can't quite convince oneself that it will catch on, but it seems that one of the next developments on its way is voice communication with your TV set – and other equipment. In Sanyo's case this includes fans, lighting and other items in addition to TV sets. Sanyo's prototype voice-controlled TV set enables all normal control operations – on/off, channel change, etc. – to be initiated by two-word spoken commands from the viewer. Sixteen words, including channel numbers, are sufficient for a complete control system. To enable two people to operate the set in this way however the prototype stores 32 command words. To register command words in the set's memory, you operate a registration switch on the control panel and speak into a built-in microphone. An Intel 8085 microprocessor stores the voice commands and, in operation, analyses the spoken commands it receives and then initiates the appropriate action. Apparently you can either bellow at the set or use a remote control microphone. Toshiba's voice-controlled set, which is due to be released in the USA shortly, talks back at you. It says "o.k." if it can obey the command, and "repeat" if for any reason it can't. This set was on demonstration recently at a Toshiba sales conference in Killarney, Ireland. On the non-TV side, IBM is planning to introduce a talking typewriter in the USA as an aid to the blind. Apparently the vocabulary is unlimited.

The fact that these voice-controlled TV sets will respond to controls from two people only suggests a reasonable immunity from false commands. One might still need to be rather careful about what one said. With a room full of voice-controlled lights, fans and so on one can imagine a state of Hulot type chaos developing.

AND FOUR PICTURES IN ONE

Another Toshiba development is a 25in. colour set that simultaneously displays four different 10in. colour pictures on the screen. Any of the pictures can be frozen by remote command. It's not stated whether you get the four sound channels as well . . . Chips that enable a colour set to superimpose in monochrome in one corner of the screen the picture from a second channel were used in some up-market continental sets a year or two back, but the idea doesn't seem to have caught on.

NEW SETS, EXPORT SUCCESSES AND THE 1979 CTV DELIVERY TOTAL

As the annual trade shows approach, we can expect the announcement of more new chassis using the Philips/Mullard 30AX colour tube. The Thorn TX10 was mentioned last month, and Panasonic's UK plant is now producing their new U2 chassis to drive the 30AX tube. The first model is the 22in. infra-red remote controlled TC2205. Panasonic comment that the chassis will form the basis of their new European colour TV range, and can easily be modified for teletext or viewdata use.

Sony (UK) Ltd. has received a Queen's Award for colour TV exports. Their Bridgend plant is now producing colour receivers at the rate of over 125,000 sets a year, half of which are exported – apart from Western Europe, markets include the United Arab Emirates, Nigeria, Sri Lanka and Kenya. Thorn have announced export successes for their TX CTV chassis – over £3 million of orders have so far been received. The largest contract is for the supply of TX9 and TX10 chassis in kit form to Philco Italiana S.p.A. of Italy. Another order is for the supply of kits for distribution in Scandinavia.

GEC's new range of colour TV sets is the first to employ the current Hitachi chassis, driving a 90° PIL type tube. The models (C1650H, C2055H, C2057H, C2255H, C2257H and C2259H) range from 16 to 22in. in tube size, those with a final 7 or 9 in the model number incorporating remote control. In addition, Model C2659H drives a 30AX tube and there are also teletext and viewdata models.

Deliveries of colour TV sets to the trade in the UK in 1979 were slightly higher than in the previous year – 1·9 million compared to 1·8 million. The greatest increase was in deliveries of small-screen sets.

BBC SATELLITE TV SERVICE PROPOSED

The BBC has put forward proposals for a satellite TV service. The channel would be used to show the latest films and give live coverage of major world sporting events, and is one of the options being considered by the BBC as a means of improving its financial position. Viewers would require a special receiving unit, and would pay £60-£100 a year on top of their normal licence. With one million subscribers, the new service could increase the BBC's revenue by £100 million a year. The BBC is submitting its plans to the Home Office, which is setting up a consultative committee to consider them.

VIDEO COURSE – ANYONE INTERESTED?

Steve Beeching, who contributes regularly to this magazine on video matters, is thinking of starting a video training course. It would be based mainly on VHS VCRs, but would also take in other machines. If you're interested, you can get in touch with Steve at 64, Manners Road, Balderton, Newark, Notts (telephone Newark 76895).

VIDEO NEWS

Thorn-EMI and JVC have agreed "to establish a close relationship on a world-wide basis with a view to achieving a leading position internationally for JVC's VHD/AHD (video high density/audio high density) disc system." The two companies are to cooperate in all aspects of promoting the VHD/AHD disc system. Details of the VHD system were given last month: the compatible AHD discs provide for the storage of the audio signals in digital form. The relationships between Thorn-EMI and JVC will cover the manufacture of discs and players and the production and provision of programme material. The latter is a very significant factor since EMI, which was recently taken over by Thorn, has vast programme resources. In fact one can see in this announcement what was apparently one of Thorn's main aims in taking over EMI. Discussions with other major companies on the provision of both hardware and software for the system are taking place. The launch of the system in the USA and Europe is expected by the end of 1981. Thorn regard the JVC disc system as being the most attractive "when considerations of technical capability, cost and market opportunity are all taken into account." The announcement certainly strengthens the position of JVC in the coming video disc war, which now looks more open than ever. The rotational speed of the VHD/AHD discs will be 750 r.p.m. in Europe (900 r.p.m., as stated last month, in the USA and Japan).

Meanwhile Philips do not appear to be doing too well with their video disc system in the USA. The system has been test marketed in three areas (Atlanta, Dallas and Seattle) for over a year, but only some 5,000 players are estimated to have been sold. It's interesting that Sony's chairman Akio Morita has commented that he does not see a great consumer demand for video discs, at least to start with. Sony, which is operating in conjunction with Philips in the video disc field, will be concentrating mainly on the business, educational and training sectors. Sony's video disc system is expected to be launched later this year.

On the VCR front, the latest launch in the UK is a VHS machine from Mitsubishi – the HS300, which has a suggested price of £660 including VAT. Features include wired remote control, optional infra-red remote control, freeze frame, single frame advance, slow motion, picture search, feather-touch controls, automatic rewind, an air-damped cassette housing and a tuner/timer system giving six recordings on any channel during a one week period.

VIEWDATA/TELETEXT NEWS

The Post Office has demonstrated what could be called the next generation of Prestel – picture Prestel in colour. This provides a still colour picture facility of excellent quality. The system is wholly compatible with the current Prestel standards, operating over ordinary telephone lines, but receivers would need some modification.

The first viewdata/TV set to have been given BEAB approval is the ITT 26in. Model TXV82.

In addition to Labgear, the PO have now approved a Prestel adaptor produced by Oracle Electronics. Adaptors are also available through Granada TV Rentals. Granada comment that the adaptor will plug into the aerial socket of nearly all ordinary TV sets and in addition can be used to drive several sets. It can save the user up to 40% on the normal annual rental of a special Prestel equipped TV set. The VAT inclusive annual rental charge for the adaptor is £248·60 (the charge for a 22in. Prestel set is £423·50).

During the recent National Association of Broadcasters conference in Las Vegas, BBC Ceefax pages were being broadcast by the CBS affiliate KLAS-TV. The Ceefax pages, from the BBC centre in London, were converted to a viewdata code by a BBC programmed minicomputer and sent to Las Vegas over ordinary public telephone lines. They were decoded at the Las Vegas end by a specially programmed Mullard decoder, then transferred to a teletext transmission system provided by North American Philips. Philips, Sony and other sets were used at the conference to display the pages.

VINTAGE MATTERS

What kind readers we do have! A couple of months ago we mentioned our loss, way back, of *Newnes Complete Wireless*, which was published in the mid-30s. Now, thanks to W. Swire of McGrath Electrical Co., we once more have this historical work on our shelves. And yes it does include an article on the Baird Televisor. The circuit is shown in Fig. 1 – and we don't ever expect to see a lower component count than that! The neon lamp is driven from the secondary winding of the associated radio set's audio output transformer, and in series with this is the Baird Automatic Synchroniser. At the end of each line the signal fell to black level, and this was used as the sync signal – the frequency was 375Hz. These "sync pulses" were fed to a couple of electromagnets which were mounted on each side of a cogged wheel. The latter was linked to the motor that drove the Nipkow disc. The idea was that the

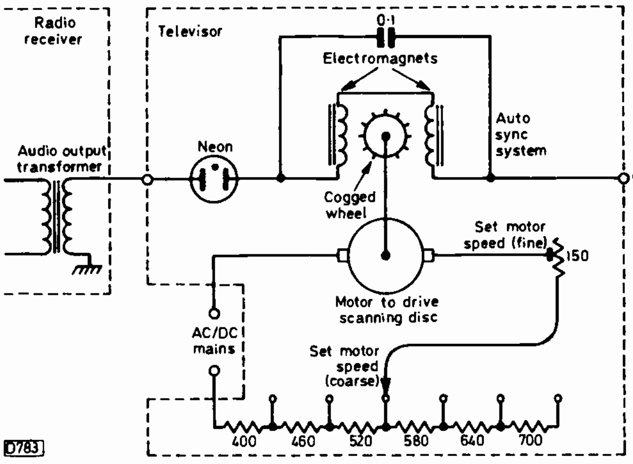

Fig. 1: Circuit diagram of the world's first commercially produced TV receiver – the Baird Televisor.

electromagnets pulled on the teeth of the cogged wheel, thus slowing down the motor.

In case you are wondering what servicing was all about in those days, we quote "it is essential for proper functioning that the air gap between the pole face and the tooth face should be as small as possible, something of the order of 0·006 inch." The cogged wheel was also taken out to a front control knob called the framing knob. Adjusting this rotated the cogged wheel and moved the picture up and down. Each time you switched on you had to adjust the speed of the motor and the framing. We quote once again: "All synchronising operations should be done slowly."

The Vintage Wireless Company (64 Broad Street, Staple Hill, Bristol, BS16 5NL, telephone Bristol 565472) has published its 1980 catalogue of vintage wireless miscellanea. It's available at £1 in the UK, £1·50 overseas, post paid in both cases. They even supply rebuilt waxed paper capacitors . . .

Another exhibition of vintage radio and TV equipment has been opened, this time at the Prittlewell Priory Museum, Southend-on-Sea (telephone Southend 42878). It's open till "at least the end of 1980" and amongst the items on show, dating over the period 1910 to 1960, are a Marconi wireless-TV with 5in. screen.

TELETEXT SETS FROM FORGESTONE

A full remote control teletext colour receiver kit, with either 22 or 26in. tube, has been added to the range of kits available from Forgestone Colour Developments Ltd. (Ketteringham, Wymondham, Norfolk NR18 9RY, telephone Norwich 810453). The Forgestone 500RCT is a carefully engineered design and, from the constructors point of view, is practical and easy to build. To eliminate the need for test gear, critical units such as the i.f.strip (with SAWF), the teletext module and the infra-red remote control unit are preassembled and aligned. The main signal panel is arranged to give maximum flexibility for various uses, including video and audio in/out for VDU and VCR use etc. Standard features include on-screen channel identification and time flash. The teletext module is to the latest specification, with background colour, double-height characters etc. There are now six kits in the Forgestone range – from manual control to full remote control plus teletext. Sections of the kits are available separately.

NEW TV TUNING SYSTEMS

Plessey Semiconductors and General Instrument

Microelectronics have announced a new jointly-developed microprocessor-based TV tuning system. It's claimed to be the first frequency-synthesis system to give exact tuning using a single-chip microcomputer with non-volatile memory. The system is being marketed by GI as the Economega IV system, and forms part of the Plessey Key systems family. It has a 100 channel capability and has initially been programmed for the European PAL network. There will be other versions however – for example a multistandard version could cater for four different standards with 100 channels per standard.

ITT Semiconductors have also introduced a frequency-synthesis TV tuning system, this time arranged in four i.c. packs – the SAA1074 control i.c., SAA1075 MNOS memory i.c., SAA1076 MOS display i.c. and SAA1173 programmable u.h.f. frequency divider and amplifier i.c. The system can be used in conjunction with ITT's SAA1250/SAA1251 infra-red remote control package, and caters for teletext, viewdata etc. The generic name Frescon (Frequency Synthesis Control) has been adopted for the system, which operates on the phase locked loop principle for digital tuning, with a non-volatile programme memory etc. Features include direct selection of any standard or non-standard TV channel, ability to store up to 32 preselected channels, an automatic search facility to run through the u.h.f. and v.h.f. bands, individual fine tuning, and simultaneous display of both the channel and programme number on the screen. ITT say that several major setmakers and rental companies will be incorporating the system in their latest models.

RELAY STATION OPENINGS

The following relay stations are now in operation:

Badachro (Western Highlands) BBC-1 ch. 40, Grampian TV ch. 43, BBC-2 ch. 46, TV4 ch. 50. Receiving aerial group B.

Creetown (Galloway) TV4 ch. 54, BBC-1 ch. 58, Border TV ch. 61, BBC-2 ch. 64. Receiving aerial group C/D.

Portpatrick (Galloway) TV4 ch. 54, BBC-1 ch. 58, Border TV ch. 61, BBC-2 ch. 64. Receiving aerial group C/D.

Ullapool (Inverness) BBC-1 ch. 39, BBC-2 ch. 45, Grampian TV ch. 49, TV4 ch. 52. Receiving aerial group B.

The above transmissions are vertically polarised.

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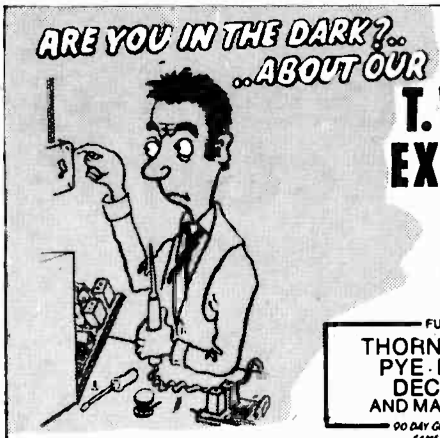

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Components for TV

Part 1

Harold Peters

MANY articles in this magazine explain the reasons for employing the component values used in various parts of TV circuitry. Few articles go into the reasons for using particular types of component however. If you take a look at other magazines, books and service manuals, you'll very often find that no attempt is made to explain how a thing works, let alone why certain values have been chosen. As for the sort of component selected, this could almost be a trade secret – and very likely is!

Quite a lot of people may find that this situation gives rise to problems. The service engineer for example, who's too busy to read all the cross references in setmakers' documentation. The enthusiastic amateur, who's dedicated primarily to the project in hand. The old timer who cut his teeth on valves and still looks upon $4\mu F$ as a lot of Farads. Also the newcomer to the trade, who has got to cram in all the latest technology before he can talk eyeball to eyeball with his bench mate who started out when there was only Ohm's Law.

If you fall into any of these or similar categories (as does the writer), what follows should be useful – if only to reassure you that the spares box components, which aren't a bit like the ones they may be about to replace, will fill the bill either for good or until the right bit is to hand. The obvious thing to start off with is resistors.

At about the time we changed to decimal coinage, and only by coincidence, a profound change came over the type of resistor most commonly used. The carbon composition resistor, which had ruled the roost for almost three decades, gave way to the carbon film type. This was mainly due to the coming of integrated circuits, with their requirement for greater accuracy and stability, along with smaller size and reduced dissipation.

Carbon Composition Resistors

The steady old carbon composition type had a good innings – and still has its uses today. It was made by mixing powdered carbon in a clay-like base and cooking it either in a ceramic tube with wires embedded in the ends or by making it into rods which could be sawn down and terminated with radial wires or eyelets. The more carbon the mixture contained, the lower the ohmic value of the resistor. The body was dipped in paint, and a further spot was applied at one end and in the middle. Thus was born the resistor value code, using colours that still hold good today: black 0; brown 1; red 2; orange 3; yellow 4; green 5; blue 6; mauve 7; grey 8; white 9. The body colour was the first figure, the tip colour the second figure, and the dot indicated the number of noughts. So if the resistor was red all over it was 2,200 Ω. Later the code became a series of bands or dots on a neutral coloured body: it's read in the same way, starting from the outermost end.

Manufacturing processes did not yield consistent results, and the value tolerance was ±20%. This was perfectly adequate for the valved radios for which the range was originally intended. If greater accuracy was required, a selection with a ±10% tolerance was made from the general production and a silver dot or band was added to the colour coding. For really great accuracy, a 5% selection was available, coded with a gold dot or band. Today this tolerance rating is the rule rather than the exception. If you wanted really super-duper accuracy you got a resistor of a value slightly higher than required and filed away at its body whilst measuring its value across a Wheatstone Bridge. To find one of these, open up an old multimeter.

A series of standard values was chosen. These overlapped within a 10% tolerance so that nothing was wasted, and this set of values repeated itself in decades. The writer was given to understand that the somewhat odd values were chosen so that in calculations involving pi or omega the answers would come out easy. A few minutes spent with a calculator have shown this not to be the case. They've gone down in perpetuity however as the "E12 series to BS 2488 1966 and IEC 63." So there.

Wattage ratings were very conservative. A 1W resistor was 1½in. long by ¼in. wide, and if it didn't run cool you got worried. Composition resistors had/have a nasty habit of changing value downwards if overrun, providing the earliest selection of thermal runaway faults. They were also noisy – like carbon granule microphones – in the high-gain, small signal stages.

Their use today is confined to areas where voltage or current surges would normally rupture the more sophisticated types about to be described. You would expect to find clusters of them, 1·5kΩ in value, on the tube base of any self-respecting modern colour set.

Carbon Film Resistors

The current resistor in general use is the carbon film resistor. As its name implies, a film of carbon is deposited on to the surface of a ceramic tube or rod, and wires are attached to the ends by press-on metal caps. A helical groove is then cut in the carbon film, just like turning on a lathe, the cutter being removed electronically when the correct value is reached. If some of you have just thought what a good application for a laser beam you are (a) so right and (b) too late. The whole resistor body is then dipped in a neutral paint and banded with the colour code in exactly the same way as previously described.

This method of construction produces resistors which are very small, very stable and very accurate. They are ideally suited for use in transistorised circuitry. Being made of carbon they still have the disadvantages of their predecessors, namely a negative temperature coefficient. This is around minus 300 parts per million for every degree centigrade rise (written in data books −300ppM/°C). They can also be noisy if of high value. Fortunately the values needed in transistorised circuits fall into the comparatively noise-free end of the range. And being spirally cut there's a limit to the voltage which can be applied before flashover occurs across the helical cut gap. But here again 250V is a value not likely to be encountered too often in modern circuits.

The cut has capacitance across its gap, and being spirally wound can be looked upon as an inductance of sorts. So there's always a danger of resonance effects, especially inside tuners. These effects can generally be ignored below 250MHz, or with values higher than 100Ω. With resistors below this value at frequencies above 250MHz the reactance will be greater than the resistance. Even if nothing else happens, this will cause a phase shift of between 20° and 70° to any applied signal.

The wattage of this type of resistor cannot be directly related to the carbon composition type, which is a pity because it would be nice to show the march of progress by means of a straight comparison. We have instead an elastic situation wherein stability, dissipation and ambient working temperature are related. Thus provided equipment designers work within the resistor maker's limits, liberties that were unheard of in the days of the valve can be taken. For example, a small resistor $\frac{1}{4}$in. long can happily dissipate $\frac{1}{4}$W and run at 100°C if the designer is content with a stability of $1\frac{1}{2}$%.

Metal Film Resistors

Almost as this article is being written the carbon film resistor is itself getting its redundancy pay, being replaced by one popular component manufacturer by metal film types of the same physical size. The only external difference is a change of neutral body colour from beige to pale green. So what, you may ask, is a metal film resistor?

The carbon film types just discussed are not available in the higher wattage ranges. Half a watt is about their limit. To bridge the gap from this point to the wirewound types, and to provide a resistor which overcomes the negative temperature coefficient and noise problems, a range of metal film resistors has for some time been available. Their construction is the same as the carbon film type, with a metallic deposit replacing the carbon film. As before resistance values are determined by cutting a helical groove in the film.

Types are available with dissipations up to 3W, and in general it can be said that size for size the wattage ratings are higher than for carbon film resistors. In the higher wattage ranges the conventional paint and colour coding would discolour or burn off, so it's replaced by a heat resistant body covering, like a cement coating, and a printed value. The body paint is rough finished to assist the dissipation.

Although metal film resistors are less noisy and more stable than their carbon counterpart, they are just as inductive and just as capacitive. Their temperature coefficients are as positive as the carbon types are negative (typically +300ppM/°C). The trend towards their general adoption is brought about more by the economics of having to make only one type rather than for any other reason.

Wirewound Resistors

Where really high dissipation is required the wirewound resistor is out on its own. It has been with us since the beginning of radio, and apart from being cement coated instead of varnished is little different today from the sort that Marconi used.

Although the conventional means of construction – resistance wire wound on a ceramic tube – is predominant, modern vertically mounted pluggable types are increasing in number and these have the resistive element embedded in a rectangular ceramic mount which, being of standard section for all values and wattages, can be spaced off the board by a steel mesh spacer. The taller the block the higher the wattage, with 5W to the inch a rule-of-thumb guide.

Ohmic values between 1Ω and 50kΩ are commonplace. Above the latter value the wire becomes thin enough to make the component fragile. Below 1Ω the resistance of the termination will affect the total value. Naturally wirewound resistors are quite inductive, but fortunately they are not often needed in the high frequency parts of the set. The inductance can be neutralised – at an increase in cost – by reversing the sense of the winding's direction halfway along the body.

Stability is very good, the resistors can be wound to a very high degree of accuracy, and sizes are comparatively small (due to being able to run at high temperatures). What small temperature coefficient a wirewound resistor has is positive and can be ignored – unless it's intended to run the thing glowing red. Thermal agitation then causes the resistance to rise. Examples of this effect are to be seen in firebars, valves, and lamps, which can all be looked upon as wirewound resistors run in a glowing state. They all pass initially high currents, settling down once they've reached their operating temperature. More about this further on under thermistors.

Thick Film Resistors

Of the types of resistor capable of the greatest dissipation for a given size the thick film type is among the leaders. Their use in TV sets has largely come and gone, not because they have inherent problems but because of mounting and termination troubles which show up only after a period of use. The most widely known application came in the Pye 713-725 etc. series, where all three feedback and RGB output transistor collector load resistors were mounted on a single thick film block so that a temperature rise on one colour section would be automatically coupled to the other two, thus keeping the white level constant.

They consist of a resistive material screened on to a ceramic plate and terminated on to a further metalic deposit. In appearance they resemble a printed circuit panel, and can be adjusted to precise values by grinding or burning a slot across the body of the resistive deposit. Because they are relatively stable with heat and are capable of withstanding high voltages, their current TV application seems to be confined to focus and c.r.t. first anode preset potentiometer assemblies – not obvious since these items are usually encapsulated.

Safety Resistors

The next section might be classified as a diversion or digression, since it should truly be "safety components". As most of these components are resistors however we are going to lump them together under the heading "safety resistors".

Since the BEAB scheme of awarding a "Kite mark" to appliances which conform to certain safety standards was introduced, a number of components can be seen in a TV set carrying an ⟨S⟩ mark on the adjacent top code. These, predominantly resistors, are "safety components", the ⟨S⟩ denoting they are of a specific type or construction which conforms to the BEAB requirements. Should they fail or be ruptured by hostile elements further down in the set, they must be replaced by exactly the same type of component or in exactly the same manner in which the original was fitted (e.g. spaced off the board by $\frac{1}{4}$in.).

The writer used to think that this was all a lot of unnecessary fuss – having spent a childhood in the company of sharp tin toys, real lead soldiers, and teddy bears with nailed-in eyes – until he burnt his fingers at half past eight in the morning on a TV set which he rapidly deduced had been left running the whole of the previous night. "We never touch it, it isn't ours, we only rent it" was the explanation proffered in mitigation by its keeper. With idiots like that around we need to have sets as safe as we can get them.

The object of the safety people is to interpose between the supply and any troublesome component or area something which will rupture and prevent any short-circuit or overload causing an avalanche of damage. The rupturing item could be a fuse – perhaps with a time delay – but more often than not it's a resistor. For the heavier duties a wirewound type with a fusible link in one conductor is used. The other type consists of a helically wound film resistor stood up from the board, the value being chosen to be just within its rating when the set is working normally. Any overload causes the resistor to rupture in a matter of seconds.

Naturally the first thing to do before repairing or replacing a fusible item is find the cause of the failure.

With resolderable links, use the solder on the contact – it may well be a low melting point type. Never relax the spring tension to make sure it doesn't rupture again.

Variable Resistors

The way in which variable resistors are constructed depends on how they are going to be used. A preset type need have only a skeletal construction, whilst those intended for continual use by the customer will be designed for durability and the presentation of the cabinet. In this area slider types are at present more common than rotary controls. The method of construction is basically standard however – a carbon film is deposited on a plastic base and secured into the body by the two end electrodes, a wiping contact travelling from one end to the other. If high dissipation is required thick film construction (see earlier) is used. If this is inadequate, a wirewound type is employed. In these, the carbon film is replaced by a flat coil of resistance wire.

Performance is similar to fixed types of comparable construction, with the same degree of stability. Dissipation is given from end to end, ignoring any current taken through the contact. Contact current should be kept to a minimum, and if the potentiometer is being used as a two terminal device the contact and the free end should be joined together to reduce current spikes during adjustment.

The smallest presets, which are about the size of a half penny, are rated at approximately $\frac{1}{10}$ W; the next size up (penny size) is rated at $\frac{1}{4}$W. The multiturn potentiometers used for tuning varicap tuners are rated at between 0·3W and 0·4W. User controls of the rotary type (volume, colour, etc.,) are usually 1W if linear or $\frac{1}{2}$W if logarithmic. This brings up another parameter.

If the carbon on a potentiometer's track is evenly deposited, a linear tracking law will result. In other words, for every degree of knob rotation the resistance from contact to end will change by the same amount. For use as a volume control this could result in an abrupt change of output for a small adjustment at one end of the control – and precious little change anywhere else. For such purposes potentiometers with a logarithmic law are used. Also available for other special applications are controls with a reverse logarithmic law (see Fig. 1).

To check a potentiometer's tracking law, set its wiper halfway and measure the resistance from the wiper contact to the lower terminal. If the reading is half the total value, e.g. 500 Ω for a 1kΩ potentiometer, the law is linear. If the reading is about 10% of the total value, e.g. 100Ω for a 1kΩ potentiometer, the control is a logarithmic one. If the reading is about 90% of the total value the control is a reverse logarithmic one.

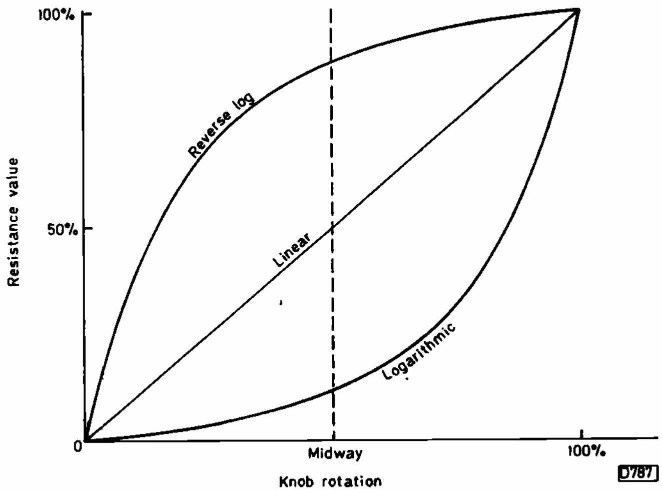


Fig. 1: Variable resistor tracking laws.

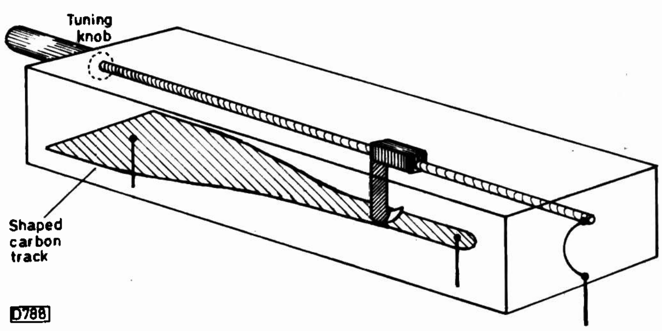


Fig. 2: A special tracking law, neither logarithmic nor linear but in between, is required for the multiturn potentiometers used to tune varicap tuners.

Most of the potentiometers used in a TV set are linear types. One notable exception is the bank of multiturn potentiometers used for varicap tuning. These have a law which is something between linear and logarithmic, and is used to compensate for the non-linearity of the tuning – it needs only 0·1V to move the tuning up a channel at the bottom of Band IV, but it can take 2V to do the same thing at the top end of Band V. The law for these multiturn potentiometers is created not by spraying on a variable deposit of carbon but by shaping the support to look like a stretched out half-an-hour glass (there's probably a word for this, but I can't find it). See Fig. 2.

Potentiometers are available in standard values and all laws, but the halfpenny size is usually only linear.

Non-linear Resistors

The types of resistor so far discussed all obey Ohm's Law, i.e. their ohmic value remains constant regardless of the applied voltage, and varies with heat in a linear manner. Also, flashing lights on and off doesn't change their value. There are also resistors that don't obey Ohm's Law.

Voltage Dependent Resistors

Taking voltage dependent resistors (VDRs) first, with these we have a resistor whose value varies almost logarithmically with the applied voltage. The higher the applied voltage, the lower the resistance value – rather like a zener diode that can be wired up either way round. We

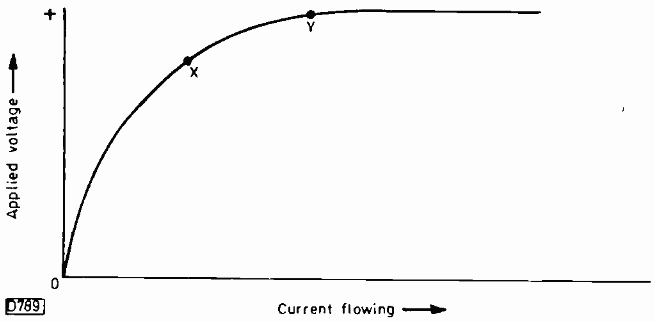


Fig. 3: Voltage-dependent resistor characteristic. At point X (the turnover point) the current begins to increase significantly. At point Y the voltage is virtually clamped to a fixed value – given in data books as the point at which the resistance falls to about a fifth of the cold value.

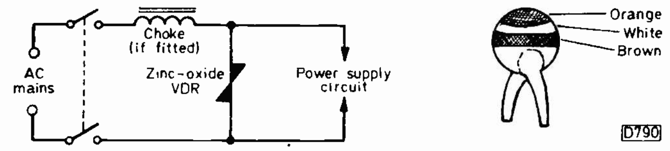


Fig. 4: Using a zinc oxide VDR to provide protection against mains surges. The device conducts only on mains spikes over 300V, protecting the set against fuse blowing etc. If the set incorporates an anti-radiation choke, this should be on the mains side of the VDR.

needn't concern ourselves with just how they work: suffice it to say that they are usually made of silicon carbide or zinc oxide in a ceramic base. As far as electricity is concerned, they look to a current like a complex mass of mixed diodes all joined up. Because they are non-linear, their specification cannot be stated as simply as the components we have considered so far. The current/voltage relationship is shown in Fig 3, and looks just like a zener with its turnover point at X.

Data books give performance families for various currents and dissipations, but for the likes of you and me, interested only in finding out whether the thing we have is dud or not, there's usually a column which gives you the reading you can expect if you apply a continuity tester at room temperature.

Another important parameter is the voltage needed to pass a certain current when in use. This is usually for the point Y in Fig. 3. The ohmic value at this point can be readily calculated, and as a rule of thumb guide the "cold" resistance should be at least five times this amount. Naturally if you are designing something rough guides are out and the full data must be used.

There are two main groups of uses for VDRs in TV sets. The first and most obvious is for the suppression of surges and the regulation of voltages.

This latter feature has been with us for many years in the form of a pencil-like rod from the e.h.t. to chassis – the rod conducts heavily if the e.h.t. tries to rise above its nominal value. Usually a tapping lower down this pencil provides the focus voltage for the tube.

A more recent application, using the zinc oxide type, is as a transient suppressor at the mains input. The VDR is normally fitted to the set side of the on-off switch – farther along if a radiation choke is present. Where thyristor or other solid-state power supplies are used, fitting such a VDR saves a fortune in blown fuses, dud devices and service calls. If you want to use the idea yourself, check the circuit shown in Fig. 4.

The second type of VDR application is in rectifying asymmetric a.c. waveforms, such as line flyback pulses, in order to produce a d.c. voltage for say the c.r.t.'s first anode. How this works may not be obvious until you look at a line timebase waveform with respect to a d.c. baseline (see Fig. 5). If the flyback pulse is positive-going, as shown, then the scan part of the waveform is negative-going with respect to the zero voltage d.c. baseline. If you choose a VDR which "turns on" when some positive voltage point is reached, then only positive pulses will appear at the other end of the VDR. Add a smoothing capacitor and the result is a stable d.c. voltage. It's not a new idea exactly – in fact its use in the Bush TV22 series, dating from 1951, was shown in these pages last December.

It should never be forgotten that unlike a zener diode a VDR works both ways. So if a large sinewave is applied, the current waveform will be distorted in a manner similar to an incorrectly biased output pair – see Fig. 6.

Other applications of the second kind are for suppressing overshoots (those VDRs connected across the field output transformer's primary winding in hybrid sets for example) and in stabilising circuits (remember valve line output stages). Non-TV applications include brush contact protection in cassette recorders and control circuits in domestic appliances.

Thermistors

Unlike VDRs, which can be made to work in only one way (higher voltage, less ohms), thermistors can be produced with either a positive or a negative temperature coefficient. The way they are made in either case differs, so the two types cannot be regarded as truly complementary.

NTC thermistors are prepared from oxides of iron or nickel, and come in all shapes and sizes with widely varied applications all over the field of electronics. Confining ourselves to TV, we find them used as surge limiters in the heater chains of hybrid sets, in power supplies, and as drift correctors in timebases and d.c. amplifiers.

The specifications are couched in the very wide terms necessary for the designer. For "the enthusiast with own Avo" they invariably give the resistance at 25°C (warm room) together with a percentage change per degree Centigrade. For example, the Mullard VA1104 reads about 15Ω at 25°C, dropping to about 1Ω at 100°C. This one is especially made for insertion into the supply leads of colour TV sets to protect the rectifier diodes from overload at switch-on. Other NTC thermistors will be found embedded in the field scan coil winding assembly to compensate for the positive temperature coefficient of the scan coil wires, thus keeping the height constant as the set warms up.

PTC thermistors ("posistors") work in exactly the opposite way. They present little impedance to the flow of current when cold, but change to a high impedance condition when hot. Again the electronics trade abounds in applications, but for TV there are two main uses. One is as a protective "off" switch in a transistor output stage, to prevent thermal runaway with overheating (by restricting the current); the other and better known is as the control device in degaussing circuits. You may also find one in the bedroom – in the wife's hair curling tongs – but it's a special type, like the degaussing one is a special type for us (see Fig. 7).

Every time the set is switched on, a decaying field of 50Hz a.c. is applied from the mains via a large coil of wire to the shadowmask in the c.r.t. This is done to remove residual magnetisation and the ensuing impurity, induced by the presence of radiators, vacuum cleaners, knocks, terrestrial magnetism and the like.

To be effective, the on-rush (or switch-on) current

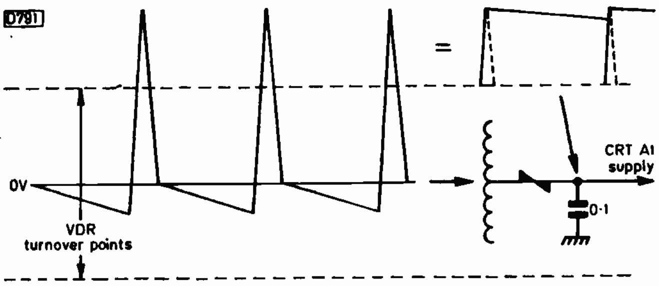


Fig. 5: Using a VDR to rectify an asymmetrical waveform – the line scan/flyback waveform. The VDR hardly conducts in the area between the dotted lines, but passes the positive-going spikes above its turnover point.

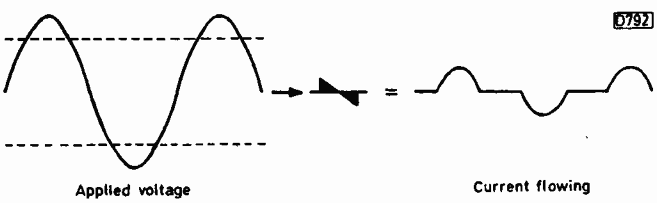


Fig. 6: A VDR will distort a current waveform by conducting on only the voltage peaks.

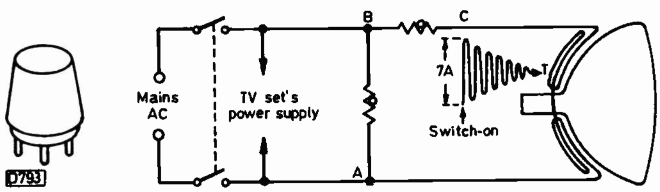


Fig. 7: The action of the dual-posistor degaussing circuit.

through the coils needs to be about 7A, decaying to a few milliamps after about 10Hz and to about 2mA for the rest of the evening's run. Section BC of the posistor does this – being 10Ω when cold, in series with a pair of degaussing coils of 25Ω impedance. 10Hz later the temperature of section BC is high enough to have reduced the magnetisation to zero, and within 2-3 minutes the BC section's resistance is up around the 100kΩ mark, causing the current in the coil to drop to 2mA so as not to bother anybody viewing. It did this by its own heat, because at the on-rush it dropped 70V which across 10Ω is just under 500W.

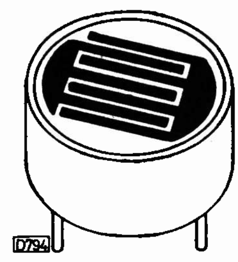
During the first minute or two section BC still draws enough current to maintain the temperature required to keep its value up, but once it's reached the 2mA mark the current is insufficient to maintain this temperature. The thing would then cool down, reduce in value and start "hunting". This is where section BA comes in. The resistance of this section is around 2kΩ when cold and rises on a much shallower curve than its companion BC. Because the two are strapped together, the heat it generates is transferred to section BC, maintaining it at the correct temperature for it to pass 2mA. In other words it keeps its back warm.

Light Dependent Resistors

We are including photoresistors or light dependent resistors for the sake of completeness. The writer can recall only one instance of such a thing being used in a TV set – to automatically regulate the contrast to adjust to the ambient room lighting. It failed miserably when you tried to view beside the romantic flickering of a coal fire!

Photoresistors rely on the property of cadmium sulphate to liberate electrons when exposed to light. Their resistance can be many megohms in total darkness, dropping to a few ohms when exposed to light (data books quote 1000lux as the level).

Fig. 8: The comb layout used in photoresistors derives from the property of calcium sulphate to change resistance across closely spaced boundaries as the light level varies. Such devices have been used to provide "automatic contrast control", e.g. by being connected in series with a contrast control acting on the receiver's a.g.c. circuit.



The most effective arrangement is when two boundaries of cadmium sulphate are separated by a thin gap. Hence most of these items consist of a pair of interleaved combs (see Fig. 8).

The frequency response is not good: the action is rapid when going from dark to light, but much slower when responding to change from light to dark. If it wasn't for that all you would need to check the shutter speed of your camera would be one of these and an oscilloscope, but unfortunately this particular combination tells lies.

Some continental sets use these devices as opto-isolators to transfer an a.g.c. or a.f.c. voltage from its generating source on a d.c. pedestal to a tuner. The control voltage modulates a LED, which alters the resistance of the LDR. There are now better ways of doing this.

Four Black Rings

Some time ago a group of us came across a perfectly normal looking carbon composition resistor with a colour code (if you can call it such) consisting of four black rings. Our speculations lasted for a number of years as checks revealed it to be an unspecified high resistance. We argued whether the code was correct for infinity, or a dead short.

In the end a manufacturer enlightened us. Some setmakers use high value ceramic resistors to wind chokes on. The value, if over 100kΩ, doesn't matter at all. What can affect the issue is if the resistor maker reduces the value by spraying a copper band around the composition. This then acts as a shorted turn, reducing the *Q* of the choke.

So special "non-resistors" were made for the chokemakers, guaranteed not to have any copper bands round them, and these were coded with four black rings.

Letter

RANK Z718 CHASSIS

I was interested to read your reply in *Service Bureau* to the problem of the overload circuit in the Rank Z718 coming into operation just after switching the set on. As you say, this is likely to be due to a line output stage fault. Recently however the trouble on one of our sets was found to be due to a field timebase fault – the lower output transistor 4VT8 (16942) was short-circuit between its collector-emitter. The source of the trouble was discovered by unhooking 4R32, the resistor which supplies the field driver/output stages – with 4R32 disconnected, the set remained on. The 30V supply to the field timebase comes from the line output stage, the point being that the overload protection circuit protects the line output stage in the event of faults affecting the 30V supply as well as faults in the stage itself.

John Stevens,
Preston, Lancs.

Servicing the Kuba Florence

Mike Phelan

THE Kuba Florence is a 110° 26in. colour set made in Italy. It's another of the foreign sets that were imported during the colour boom period in the early 1970s. Apart from the two valves used in the line output stage, the rest of the circuitry is all solid-state. There are six i.c.s, plus the usual TAA550 tuning voltage stabiliser. Colour-difference tube drive is used, with BF337 colour-difference output transistors and a BD115 luminance output transistor. The colour-difference drives are a.c. coupled to the c.r.t. grids, with double-diode clamps. A beam limiter diode is incorporated in the luminance drive to the c.r.t. cathodes.

There are four tuner pushbuttons. In addition, an on–off switch and an a.f.c. switch adorn the small control panel. The plastic back cover can be removed after slackening the two small screws at the bottom. It seems to be a fact that Italian sets have backs that are extremely difficult to replace – though this one is not quite as bad as the Indesit T24EGB!

The chassis consists of one large printed board assembly which can be swung down to either the horizontal or a 45° position when the two plastic nuts are taken off. The decoder unplugs after unscrewing the retainer, and the raster correction panel also unplugs when the two screws that attach it to the line timebase panel have been taken out. The convergence panel is accessible either from the back, after removing the nuts, or from the front when the small screw in the speaker grille is taken out. The grille is held in be Velcro and must be pushed out from inside: any attempt to prise it off from the outside will certainly cause damage.

Power Supply Circuits

A discrete diode bridge rectifier fed from a tap on the mains transformer provides the h.t. supply. Any of the diodes going short-circuit will blow the associated 2A anti-surge fuse F602. Frequent h.t. fuse blowing is often due to C415 (0·01μF, 2%) going open-circuit intermittently. This is the line oscillator timing capacitor, connected to pin 14 of the TBA920 sync/line generator i.c.

Positive and negative l.t. supplies are provided by the two encapsulated bridges which are fed from separate secondary windings on the mains transformer. Either bridge going short-circuit blows the appropriate fuse. A word of warning: the connections on the bridges are in a different order to those of most replacement types such as the BY164.

One bridge provides a –27V line. The series regulator transistor TR602 is in the earthy side of this supply. If the supply is missing, there'll be severe lack of height, most evident at the bottom. TR602 can be faulty to cause this trouble. If you're unlucky D607 may also have failed.

The other bridge supplies a two-transistor (TR603/4) series regulator circuit giving a 25V output. The regulator transistor TR603 rarely fails. A second regulator transistor TR601, which is driven by TR603, frequently goes short-circuit however, causing repeated failure of the pair of sound output transistors (TR54/5). The driver transistor

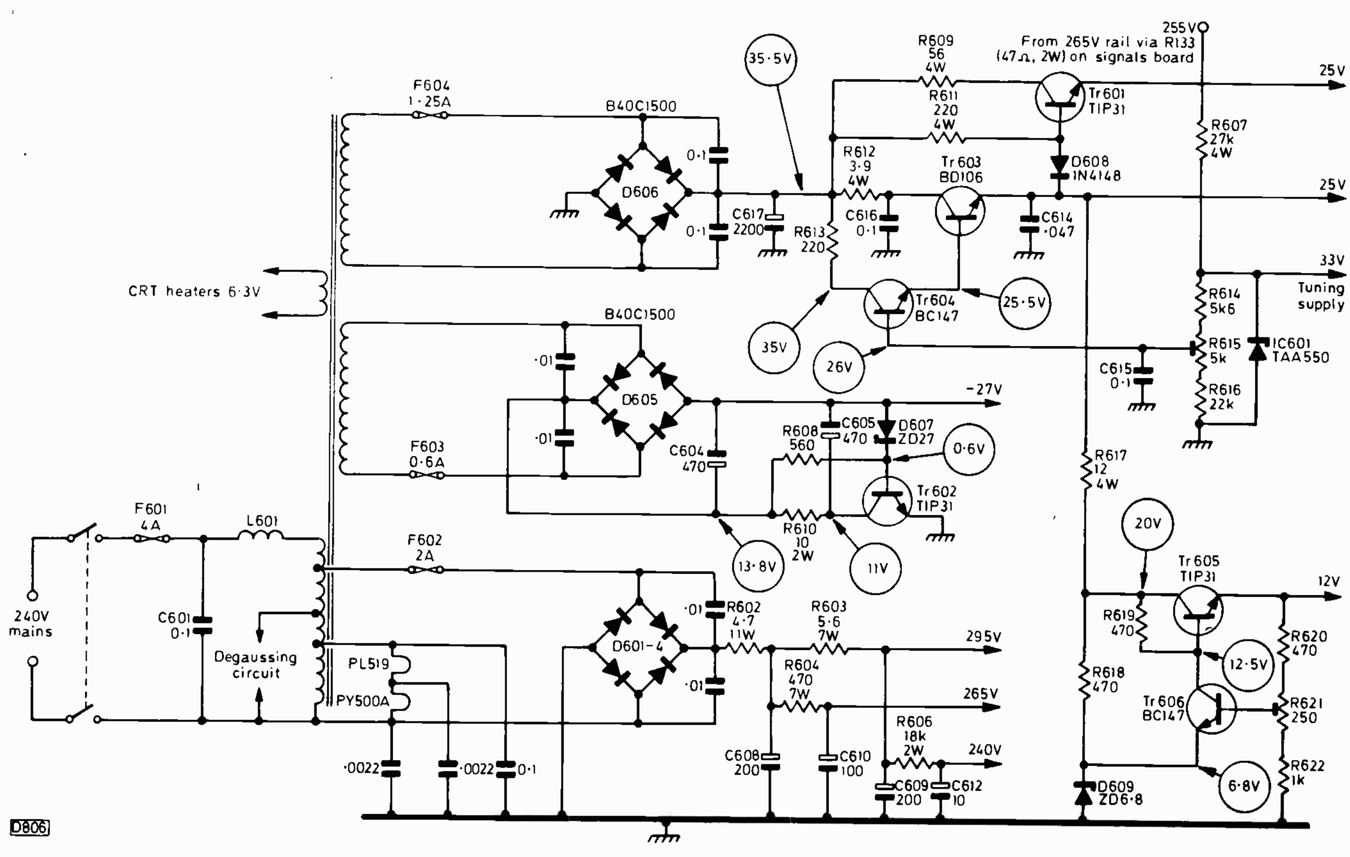


Fig. 1: The power supply circuits in the Kuba Florence.

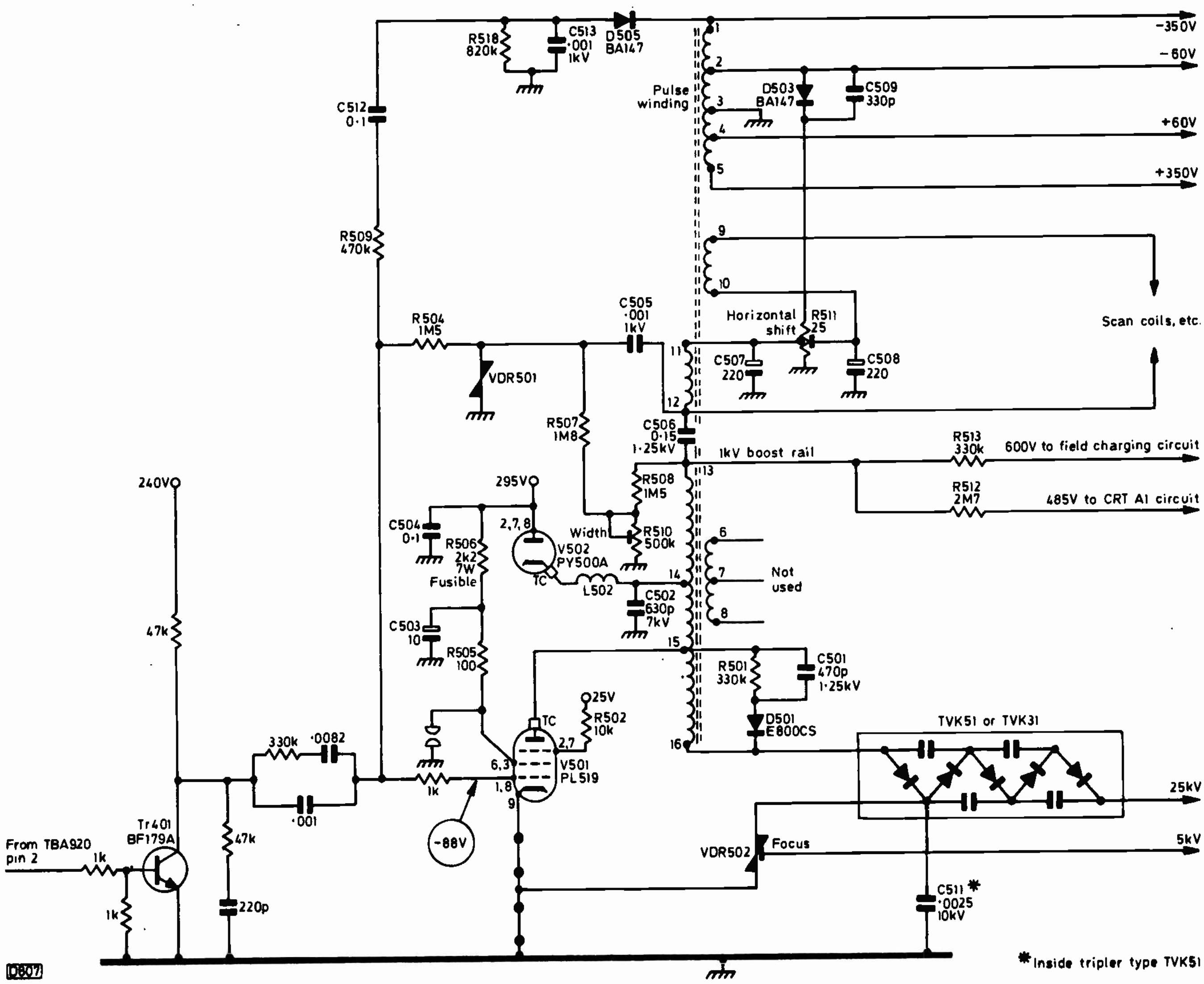


Fig. 2: The line driver and output circuits used in the Kuba Florence. Most common types of line output stage fault will result in the fusible resistor R506 going open-circuit. In addition to the usual width/e.h.t. stabilising circuit (C505, VDR501 and associated resistors) there's also a quick-acting stabilising circuit to cater for rapid beam current variations due for example to captions. This consists of rectifier D505, its reservoir capacitor C513, the coupling capacitor C512 and the associated resistors. D505 operates on the flyback pulses present at tag 1 of the line output transformer, producing a negative-going output which is porportional to the beam current.

TR604 gives hum on sound when faulty. The same thing happens when the rectifier's reservoir capacitor C617 (2,200μF) goes open-circuit. The reference voltage for this regulator comes from the TAA550 tuning voltage stabiliser i.c. As a result, absence of the h.t. supply will remove the positive l.t. rails. When the TAA550 goes open-circuit there's a severe hum bar. Those familiar with the ITT CVC5 etc. chassis will recognise this l.t. regulator arrangement!

A further regulator (TR605/6) is fed from the 25V rail. This provides a 12V line, and is situated above the i.f. circuits. If this line rises to 25V, TR605 is faulty. If it's at about 19V, the reference zener diode D609 (6·8V) is open-circuit. With TR605 short-circuit the sound can't be turned off.

Note that it's most important on this chassis to set both the 25V and 12V rails to the correct voltages (R615 and R621).

The Line Timebase

The line timebase employs a TBA920 i.c., a driver transistor (TR401, BF179A), a PL519 line output valve and a PY500A boost diode. The first two items give few problems, but if the line driver transistor fails persistently replace the oscillator timing capacitor C415 (previously mentioned in connection with fuse blowing). With C415 open-circuit the oscillator tries to run at several MHz, much to the annoyance of TR401!

The two line output stage valves fail as often as they do in any set. Don't use a PL509, as in this valve the cathode and the suppressor grid are internally connected. In this Kuba set, the PL519's suppressor grid is fed from the 25V line via R502 (10kΩ) – so fitting a PL509 will result in R502 going up in smoke. Apart from R502 burning up, the symptoms will be lack of width and no chroma. Use a PL519 of reputable make if you expect the valve to last for any length of time.

Apart from these few things the line output stage is reliable – neither the transformer nor the tripler are prone to failure. Dry-joints seem to occur on the valve bases from time to time, and if not attended to the result is that large holes will be burnt in the panel. It's essential to replace the glassfibre strip that holds the valves in position horizontally. Here's a very unusual fault: the conventional type of VDR width stabilisation circuit is used, and intermittent loss of raster was eventually traced to the VDR (VDR501).

No raster due to no c.r.t. first anode supply means that

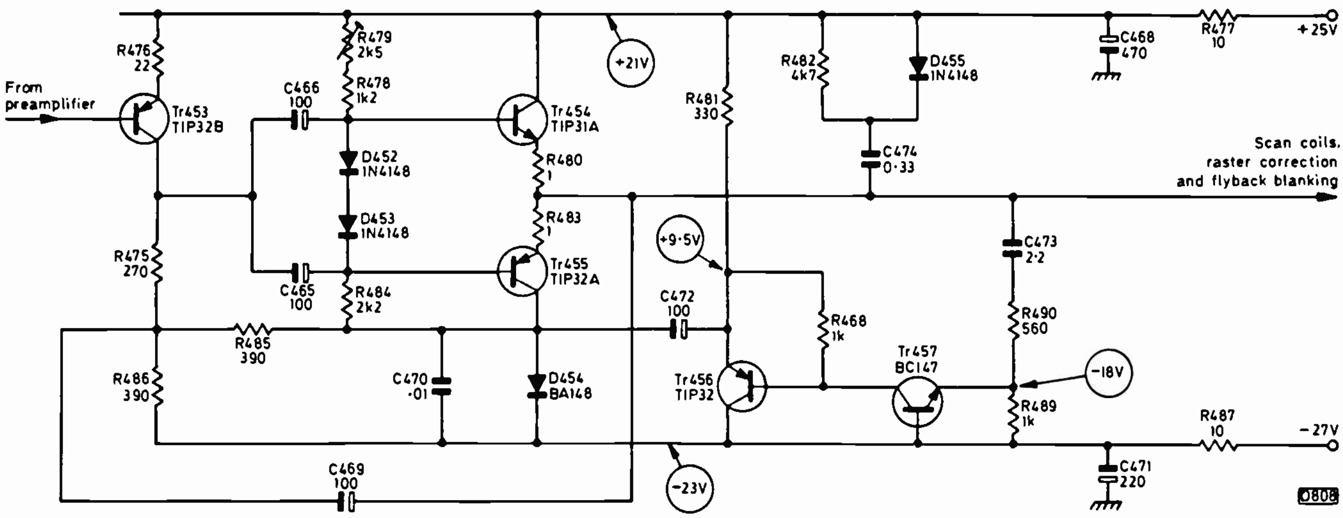


Fig. 3: The field driver and output stages. Tr456/7 and diodes D454/5 enable the flyback action to take place.

C583 (0·01μF) has gone short-circuit: it's located under the edge of the line can, and is the smoothing capacitor for the 720V supply to the first anode control network. This whole circuit is a bit unusual, though it won't be to anyone familiar with the Philips G6 chassis. The point is that a rectifier (D580) rectifies positive and negative line flyback pulses, producing a "floating" 720V supply that sits on top of the 485V supply obtained from the boost rail. Faults in the pulse feeds can be responsible for lack of brightness therefore – for example C585 and C584 going short-circuit.

The first anode controls themselves often fall apart – they can be replaced with ordinary presets. Another problem here is random grey-scale variations – due to leaky paxolin in the first anode potentiometer assembly.

Note the unusual arrangement of the first anode supply switches – one switch for the blue raster and one for blue and green. The switch on the other side of the chassis is for switching off the video.

The focus control (VDR502) can easily be broken by carelessness – a Bush or GEC type is a suitable replacement. If either C507 or C508 (both 220μF) in the line shift circuit go short-circuit, the line shift control R511 disappears in a puff of smoke.

Raster Correction

The raster correction and convergence circuits give very little trouble, though the centre transductor on the small raster correction panel can develop shorted turns, producing a grossly misshapen and misconverged raster. The transductor concerned is L555. If the corners of the raster fold in or misconverge at low brightness levels, replace all the electrolytics on this panel.

The Field Timebase

Severe lack of field scan has already been mentioned (TR602). This trouble can place a strain on C468. The timebase circuit itself gives little trouble apart from an occasional leaky driver transistor (TR453, type TIP32B) causing top foldover. The field output stage is a bit unusual however, so it's worth taking a look at the operation of the circuit.

A.C. coupling (C465/6) is used between the driver transistor TR453 and the class B complementary–symmetry output stage (TR454/5) so that the vertical shift control R479 can act on the biasing.

During the first half of the scan, TR455 and D454 are both conductive. TR454/6/7 and D455 are all off. Just before the drive waveform cuts TR455 off, TR454 starts to conduct to give the second half of the scan. When the flyback occurs – negative pulse at the collector of TR453 – TR454 is cut off and TR455 is driven hard on. The negative-going pulse at the output forward biases D455, and the scan coils "ring" with C474. The only snag at this point is that without a little extra circuitry the mid-point voltage would be clamped at about –22V via TR455 and D454. This is where TR456/7 – and D454 – come into action. The negative-going flyback pulse at the output is differentiated by C473 and R490 and applied to the emitter of TR457, thus driving TR456/7 on. A –40V pulse appears at the emitter of TR456, cutting D454 off. At the end of the pulse D454 switches on again and D455 switches off. The forward scan cycle then recommences.

TR456 is a large transistor, since the pulse applied to D454 has to cancel the saturation current of TR455. TR453/4/5 are mounted on a massive heatsink at the bottom of the chassis, and failure is very rare – this is in fact one of the most reliable solid-state field timebases I've encountered. Any fault in TR456/7 will result in top foldover since the flyback will be slowed down.

Signal Circuits

Turning now to the signal side of things, let's start at the front. Tuner drift is a common fault on this set, the

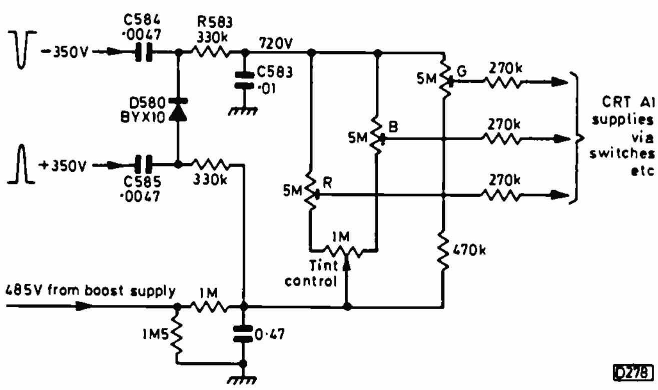


Fig. 4: The unusual c.r.t. first anode supply circuit used in the Kuba Florence. Diode D580 rectifies line frequency pulses, producing across C583 a voltage which "sits" on the 485V supply obtained from the boost rail in the line output stage.

pushbutton unit or the tuner itself being favourite causes. Unfortunately no British tuner is a direct replacement. We've found however that if the covers are removed from the tuner and the innards are washed with methylated spirit, then dried, in most cases all will be well. The reason is that most of the tuners that drift have a film of dust and goo on the ceramic capacitors inside, and washing removes this film. The pushbutton unit can be replaced with the type used in RRI monochrome sets. Leave the band-switching disconnected as it's not required.

The i.f. strip and the decoder are so reliable they can virtually be forgotten about. Luminance signal processing is carried out by a TBA500P i.c. (IC101). This drives the BD115 luminance output transistor TR101, which in turn drives the tube cathodes via a simple diode beam limiter (D104, type BA145). There are no drive controls, but the grey scale can be set up all right provided the tube is in good shape – it enjoys a fairly long life in this set. The beam limiter diode very occasionally gives trouble – causing brightness variations.

The intercarrier sound chip is usually a TBA120. It feeds a discrete component audio circuit with a complementary–symmetry output stage (AC141K and AC142K). In the event of failure of the audio output transistors, check the l.t. rails – at the emitter of TR601, not TR603. With an SN76666 intercarrier sound i.c. you can get crackles at minimum volume – replace the i.c. with a TBA120A.

The Decoder

The decoder is a good one. The edge connector can become intermittent, but can be repaired with a sharp point and the pins cleaned. There are three i.c.s – a TBA510 for chroma signal processing, a TBA540 reference oscillator/burst channel combination and a TAA630 demodulator/PAL switch/matrixing i.c. The colour-difference output transistors are on the decoder panel, but the load resistors and clamps are on the main chassis. Failure of one of the transistors or loads will result in loss of that colour-difference signal. The tint control on this set operates on the earthy side of the red and blue first anode presets.

Decoder Adjustments

There are two removable shorting links on the decoder. Removing P2 disables the colour-killer and removing P3 removes the burst. Putting a link in position P1 shorts out the input to the chroma delay line to give simple PAL operation so that L211 can be adjusted for no blinds on R – Y and then C231 for the same on B – Y. Severe blinds on R – Y means that the PAL switch in the TAA630 has failed. Less severe blinds which disappear when P1 is fitted can be due to the TBA510 i.c. being defective or alternatively the delay line. If the colour goes on changing channel, check with the killer disabled: the symptom will then be seen to be no ident, usually because the relevant detector in the TBA540 has become inoperative.

Conclusion

In conclusion, it's a great pity that many of these sets are being scrapped. They have a modern looking cabinet and the chassis is extremely reliable. It's probably the simplest 110° delta gun tube set that was ever produced. The picture quality is undoubtedly well above average (all the Meg bars on the test card are resolved!).■

next month in TELEVISION

● VCR SPEED CONVERSION

There are many Philips N1500 series VCRs around, and they are capable of giving excellent pictures. The drawback of course is the one hour playing time. It's possible to convert these machines to the later 2½ hour N1700 standard however. We decided to obtain the necessary bits and pieces and try it out. As a result, we've produced a fully illustrated feature on how to go about it.

● THE B & O 3400 SERIES

A large number of the B and O hybrid, 110° delta-gun tube sets were imported into the UK. They are very up-market, giving a superb picture. Well worth restoring then, though all those watts mean that there are quite a number of things that might require attention. Eugene Trundle explains. (Part 1).

● AUTO FIELD SYNC CIRCUIT

The only sets distributed in the UK to incorporate auto field sync were those fitted with the Philips K70 and K80 chassis. How the auto field sync circuit used in these imported sets works has been one of the best kept secrets in the domestic TV world however. We finally found someone who knew.

● SERVICING HINTS

The next instalment in our beginners series deals with a two-thyristor power supply (the one used in the Philips/Pye G11 chassis). Plus fault reports this time from Mike Dutton.

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Monochrome Portable

Part 2

Luke Theodossiou

THE TIMEBASE BOARD

This month we are dealing with the timebase board which also contains the power supply regulator. The complete circuit diagram is given in Fig. 1.

Starting with the power supply, the output from the mains transformer (details will be given next month) comes in via connector D. The bridge rectifier in conjunction with the reservoir capacitor C26 produce a d.c. voltage of around 17V. Connections are provided through connector D to the reservoir capacitor for battery operation.

The regulator circuit we adopted uses a 5V monolithic regulator, IC3, whose output voltage is increased by the combined resistance of R21 and VR4. This effectively increases the closed loop gain of the device, which sets the output voltage by comparing it to an internal reference. This method can be used in other applications when a non-standard voltage is required. Its performance is very good indeed and the output current may be increased, as we've done here, by the use of a series pass transistor. Purists may criticise this approach since the feedback loop excludes the pass transistor. Therefore, as the transistor warms up, its base-emitter voltage will change and the stabilizer doesn't compensate for this. The effect, however, is so small that it can be ignored for all but the most stringent of applications. Its main advantage is its simplicity. With C25 and C30 providing compensation to ensure stability, the circuit provides better performance than most discrete designs and uses a fraction of the components normally encountered.

The field timebase uses the well known SGS-Ates i.c. type TDA1170. We have described the i.c. in quite some detail in past issues of *Television* and all that is required is to point out the departures from the usual method of application. First of all we have designed out the field hold control. If ±5% components are used for C5 and R6 (as specified), the free running frequency of the internal oscillator is sufficiently accurate to enable synchronisation. The height control is connected between pin 12 and the positive rail instead of between pin 7 and ground. This makes the height track with beam current variations, enabling a correctly sized picture to be displayed which is virtually independent of beam current. Field blanking is taken from the flyback

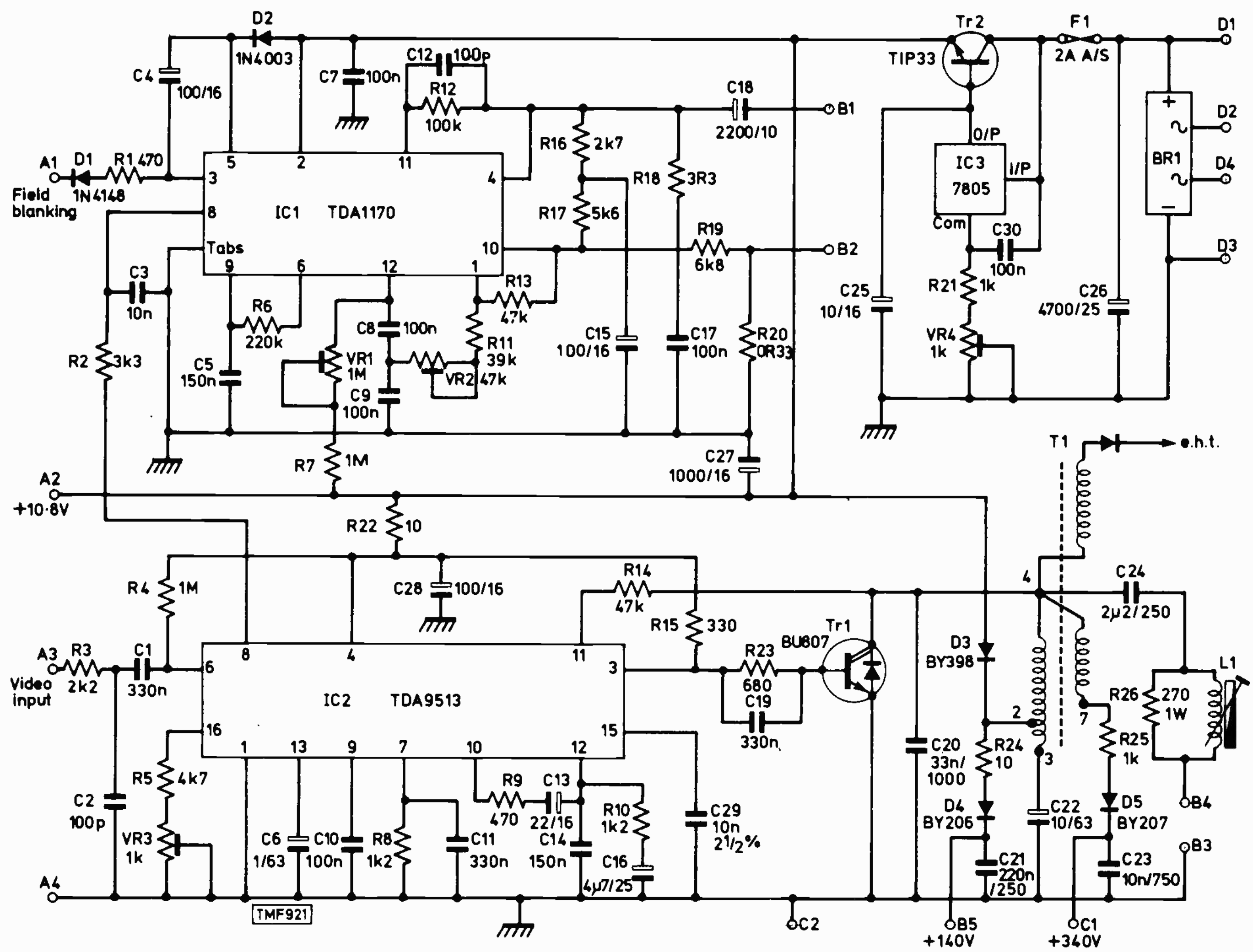


Fig. 1: Circuit diagram of the timebase/power supply board.

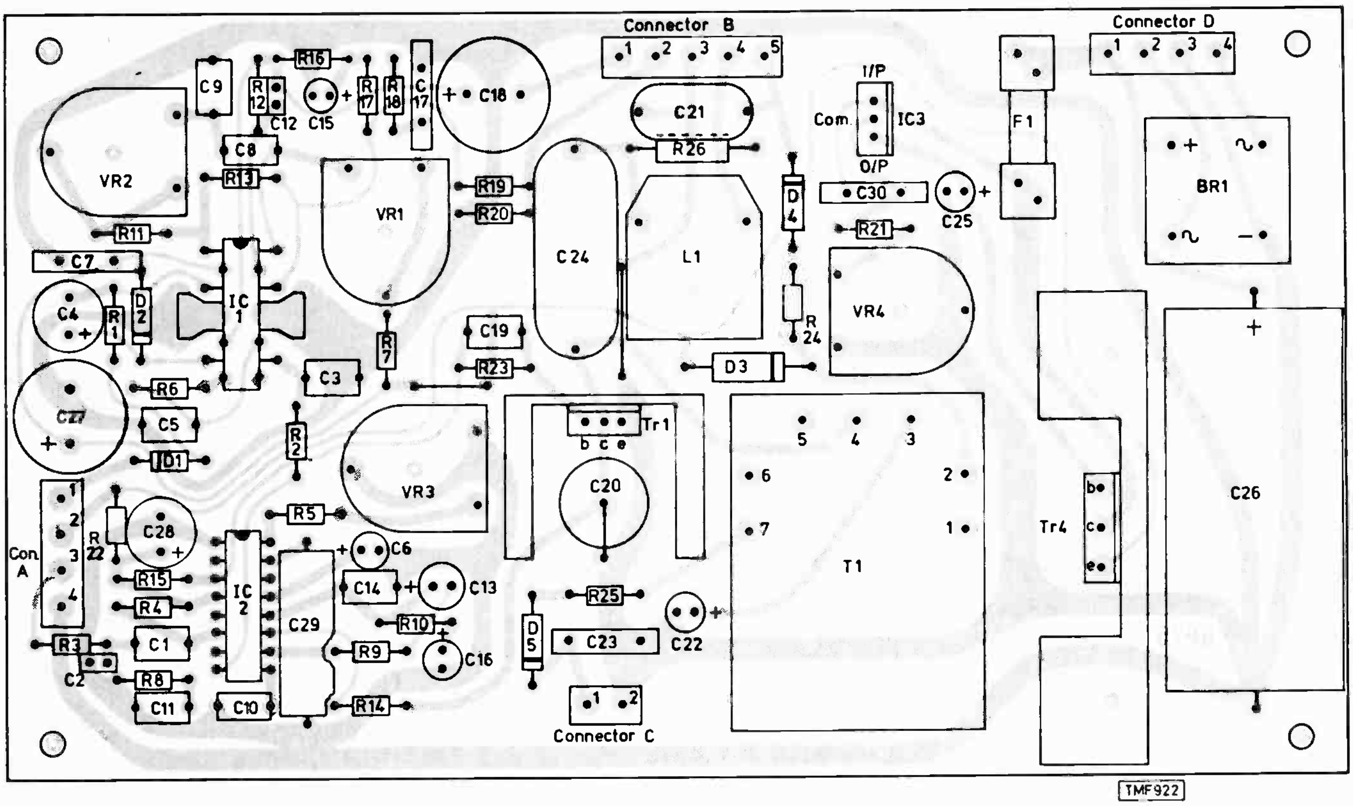


Fig. 2: Component layout, timebase/power supply board. The board is slightly larger than shown here.

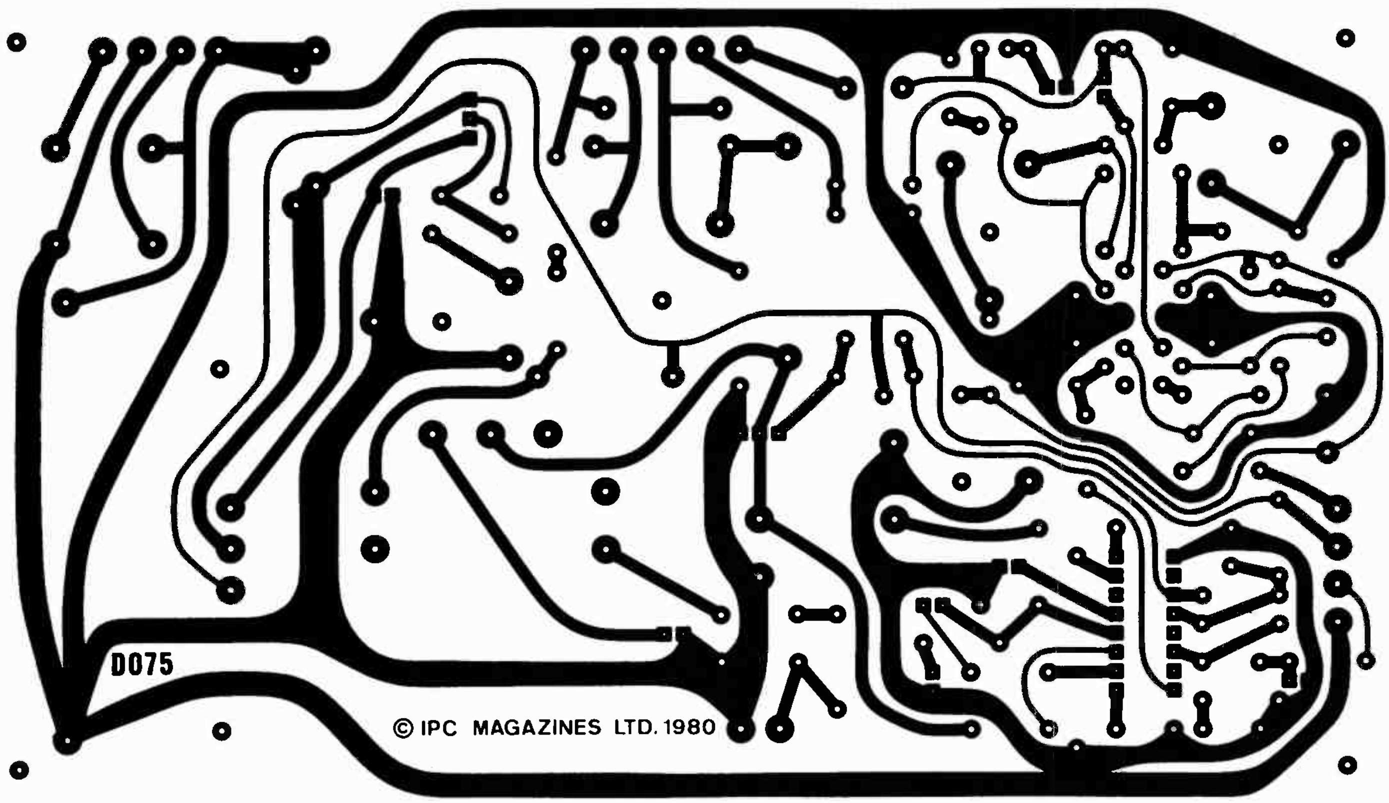


Fig. 3: Track pattern, timebase/power supply board. The overall board size is $7\frac{3}{8} \times 4\frac{1}{4}$in.

generator via pin 3, current limited by R1 and applied to the signals board via D1. Field sync is applied to pin 8 via R2 and C3 which prevent line pulses giving false triggering.

The TDA9513 is a development of the TDA9500 which we have described in past issues. The main difference is that it incorporates a high current output stage which is suitable for driving a Darlington line output transistor. This of course eliminates the usual line driver transistor and transformer with a consequent saving in board space. The *RC* network R23 and C19 is responsible for developing the negative voltage for switching off the Darlington Tr1. The line output transistor has speed up diodes which help reduce switching times and it also features a built-in efficiency diode. Capacitor C20 is responsible for flyback

COMPONENTS LIST

Resistors: Carbon film ±5%, 0·25w unless otherwise specified.

R1	470Ω
R2	3k3
R3	2k2
R4	1M
R5	4k7
R6	220k
R7	1M
R8	1k2
R9	470Ω
R10	1k2
R11	39k
R12	100k
R13	47k
R14	47k
R15	330Ω
R16	2k7
R17	5k6
R18	3R3
R19	6k8
R20	0R33
R21	1k
R22	10Ω
R23	680Ω
R24	10Ω
R25	1k
R26	270Ω 1w
VR1	1M
VR2	47k

VR3 1k	All presets standard
VR4 1k	horizontal mounting skeletons.

Semiconductors:

D1	1N4148
D2	1N4003
D3	BY398
D4	BY206
D5	BY207
BR1	RS Components 262–078
Tr1	BU807
Tr2	TIP33
IC1	TDA1170
IC2	TDA9513
IC3	7805

Miscellaneous:

P.c.b. ref. no. D075
Molex 0·2" pitch connectors
Heatsinks: For Tr1: RS Components 401–964
For Tr2: 75mm length of RS Components 401–497
For IC1: Staver V8–800

T1	Orega 3186
L1	Orega 55346
F1	20mm 2A anti-surge with p.c.b. mounting fuse clips.

Capacitors:

C1	330n Siemens polyester
C2	100p ceramic plate
C3	10n ceramic plate
C4	100μF 16V plug-in electrolytic
C5	150n Siemens polyester
C6	1μF 63V plug-in electrolytic
C7	100n ceramic disc
C8	100n Siemens polyester
C9	100n Siemens polyester
C10	100n Siemens polyester
C11	330n Siemens polyester
C12	100p ceramic plate
C13	22μF 16V plug-in electrolytic
C14	150n Siemens polyester
C15	100μF 16V plug-in electrolytic
C16	4μ7 25V plug-in electrolytic
C17	100n ceramic disc
C18	2200μF 10V plug-in electrolytic
C19	330n Siemens polyester
C20	33n 1000V mixed dielectric or polypropylene
C21	220n 250V polyester
C22	10μF 63V plug-in electrolytic
C23	10n 750V ceramic disc
C24	2μ2 250V polyester
C25	10μF 16V plug-in electrolytic
C26	4700μF 25V electrolytic
C27	1000μF 16V plug-in electrolytic
C28	100μF 16V plug-in electrolytic
C29	10n ±2·5% polystyrene
C30	100n ceramic plate.

tuning. Diode D3 is the boost diode with C22 as the boost rail reservoir which is charged up to around 30V. Flyback rectification from pin 2 of the line output transformer provides the +140V rail for the video output stage. The same method is used to generate the +340V accelerating potential from pin 7 of the l.o.p.t. The line scan current flows via the S-correction capacitor C24 and the line linearity control unit L1 (which is damped by R26) to the scan coils. The line output transformer features a built-in e.h.t. rectifier.

CONSTRUCTION

Construction is straightforward using the p.c.b. ref. D075. Fig. 2 shows the component layout on the board and Fig. 3 the copper track pattern. We strongly recommend using the components specified since substitutes are unlikely to fit the board even if they are electrically compatible. The testing and setting up procedure will be given in the next issue.

CONTINUED NEXT MONTH

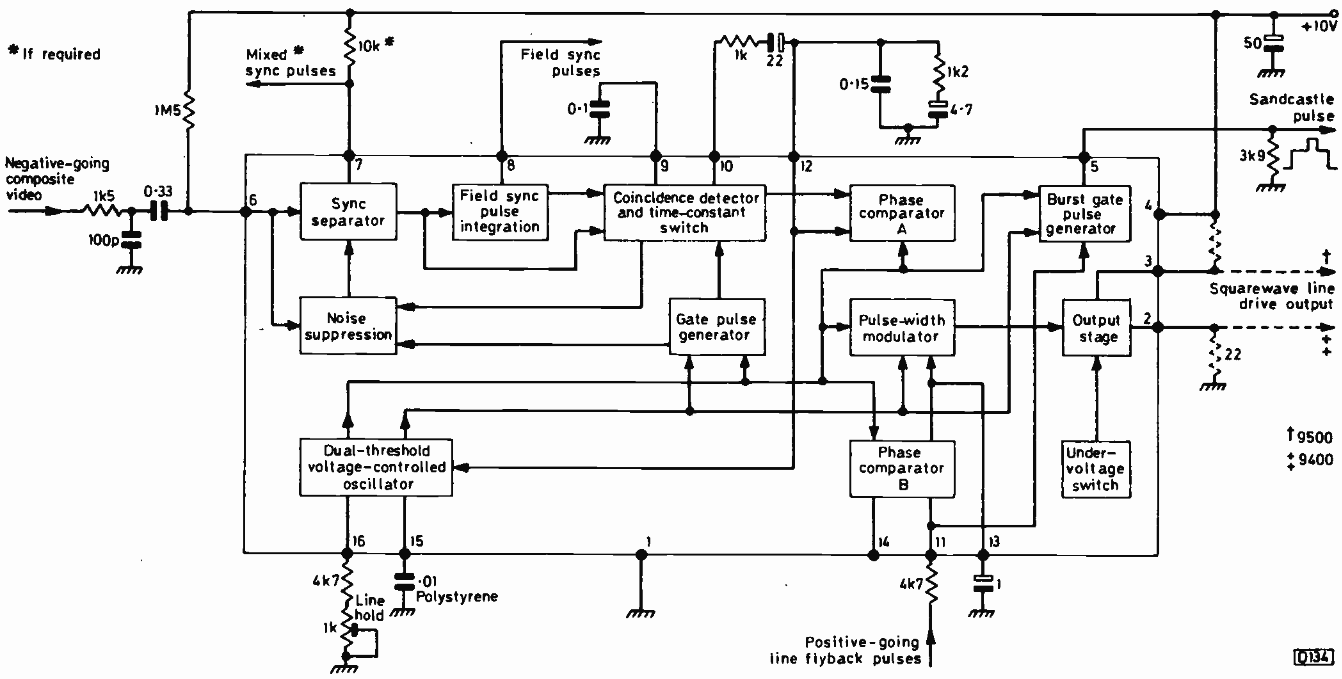


Fig. 4: Block diagram of the TDA9400/9500 series line processor i.c.

VCR Muting Systems

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

AN interesting feature incorporated in some VCRs is a muting circuit which cuts off the sound and vision outputs when a stable picture is not present. The idea is that when the VCR goes from stop to play the viewer won't be presented with a wobbly picture and Donald Duck sound while the tape is running up to speed. This can take between three and seven seconds, depending on the type of machine.

JVC's HR3300 VHS VCR is reasonably typical in this respect, and as a large number of these machines are around under a variety of brand names we'll take it as our first example. Fig. 1 shows the video muting system in block diagram form. IC5 combines the luminance and chrominance signals on playback. After mixing, the signal is clamped, squelched and buffered, then fed to both the video output connector and the r.f. modulator. The squelch section of the i.c. acts as a simple switch, disconnecting the video output when the VCR is running up to speed and also on pause.

The circuit of the squelch detector i.c. (IC6) is shown in Fig. 2. Its operation is simple enough. In the record mode, 12V is supplied to pin 6. This turns Tr2 on, as a result of which the voltage at pin 8 falls to the low condition. This closes the squelch switch in IC5, the VCR then providing a video output signal.

When the VCR is switched from stop to play, pin 3 rises towards 12V at a rate determined by the time-constant

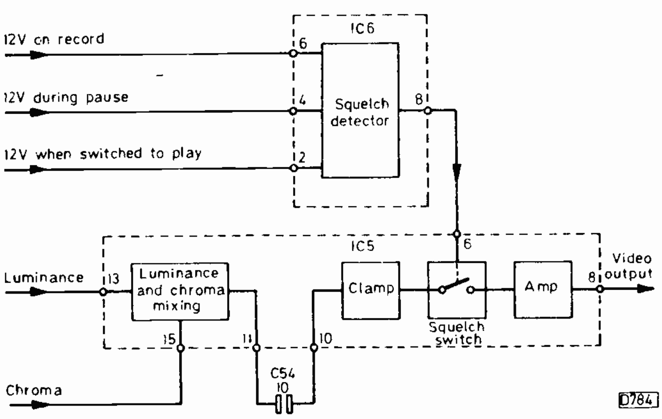


Fig. 1: Block diagram of the video muting system used in the JVC HR3300 videocassette recorder.

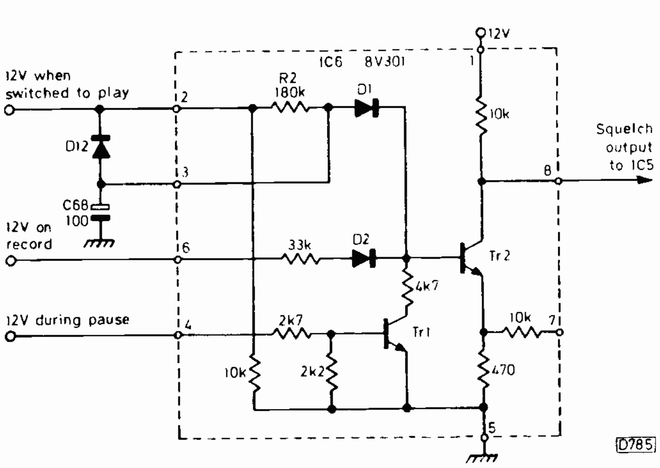


Fig. 2: The squelch detector circuit.

formed by R2 and C68. This allows the tape to reach its operating speed before Tr2 comes on and the video signal appears on the screen of the TV set.

When pause is selected, Tr1 switches on holding Tr2 in the off condition. Thus no still picture is seen when pause is applied. If you want, you can alter this by disconnecting the input to pin 4. The easiest way to do this is to cut through the PCB print with a Swiss file. You need remove only the machine's base to get at board 04, the luminance and chroma board on which IC5 and IC6 are mounted. This modification will give you a still picture on pause, but due to the use of the slant-azimuth head system the picture is usually rather noisy.

A similar technique is used to mute the audio signal, but this time using discrete transistors.

Betamax machines employ a similar though slightly more complex arrangement. The example we'll look at is the Sanyo VTC9300P, whose basic muting circuit is shown in Fig. 3. The sound and vision signal outputs are fed to simple transistor switches which blank the outputs when switched on by high level outputs at pins 18 and 24 of i.c. Q813.

The basic muting circuit arrangement is similar to that used in VHS machines of the JVC HR3300 etc. type, being designed to blank the sound and vision signals on play until the tape has run up to speed and stabilised. When play is selected, 12V is applied to pins 2 and 17 of the i.c. Pin 24 of the i.c. rises towards 12V at a rate determined by the time-constant network R826/C812. This takes around four seconds, after which the delay switch in the i.c. opens and pin 18 goes low. This however can occur only if the AND gate behind pin 18 detects the presence of control track pulses at pin 9. If there are no control track pulses, the hold and the AND outputs go high and the voltage at pin 18 stays high. Thus no sound or vision emerge from the VCR.

If you try to play back a tape with no signal on it, i.e. there are no control pulses, the TV set's screen will remain blank rather than producing the more familiar snow. This can be confusing to say the least from the servicing point of view.

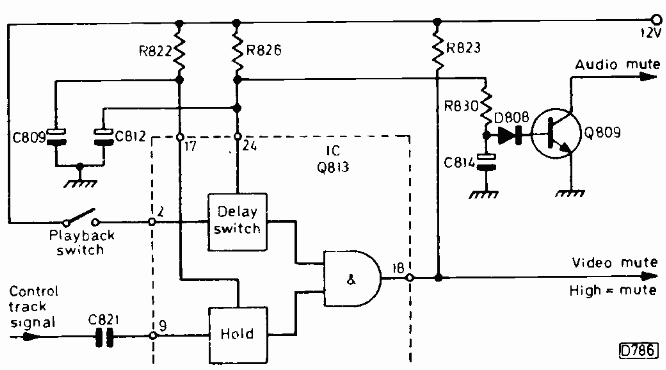


Fig. 3: The signal muting circuit used in the Sanyo VTC9300P, a Betamax format VCR.

For audio muting Q809 is held off until C814 has charged via R830. This again takes about four seconds after the play button has been pressed.

So the next time a VHS or Betamax machine won't give any video or sound output, remember that the muting system could be responsible.■

Satellite TV

lying between 11·78502-12·09190GHz. Left-hand circular polarisation would be used, with a peak video deviation of 13·3MHz.

Chances of Satellite Reception

With no u.h.f. satellite TV transmissions available to UK enthusiasts, what chances are there of satellite reception? The Intelsat series of communications satellites operate in the 3·8-4·2GHz spectrum and from time to time carry TV transmissions – mainly on a closed-circuit international link basis. During the time of the World Cup in Argentina, football coverage could be resolved at most times of the day (or night). The field strengths however are very low, necessitating the use of very low-noise amplification and high-gain aerials. One should also bear in mind that the terms of the receiving licence don't cover such viewing – always assuming that you could demodulate the signals successfully.

Part 2 **Roger Bunney**

LAST month we described a couple of Japanese designs for units to receive the proposed 12GHz satellite TV services. For the present, only the OTS satellite is providing test transmissions – intermittently – in the 12GHz band in Europe, and another two-three years could well elapse before full-scale tests start. Other bands are in use for satellite TV distribution however, and a few enthusiasts have managed to build receiving equipment for some of these bands.

Development of Satellite Services

Of particular note historically was the SITE experiment for the Indian sub-continent, conducted by NASA using the ATS-6 satellite, since the programmes were beamed down to India at 860MHz (channel 70). The orbital position of ATS-6 was 35°E. Fortunately due to the characteristics of the transmitting beam it was possible to receive these transmissions in the UK and Europe at fair quality, using relatively simple equipment. Some enthusiasts constructed f.m. video demodulators to demodulate the f.m. video transmissions, while others simply used their normal DX receivers, relying on slope detection of the video signals. This nevertheless produced quite good quality video – see for example our first photo (from Clive Athowe) which shows the AIR caption received at Norwich using an 8ft dish aerial.

The USSR's Statsionar satellites use u.h.f. (714MHz) for TV programme distribution, and there are rumours that they are to be superseded by a new craft already in orbit and 12° above our horizon – making it accessible to enthusiasts in the UK. Signals from the present craft at 99°E have been received over quite a wide area – as far as South Africa in fact, where the signal path is just above the horizon. Unfortunately there's no evidence so far that the new craft will use 714MHz for transmissions. We can only hope!

As the leader pointed out last month, five channels have already been allocated to the UK for a satellite TV service in the 12GHz band. These are channels 4, 8, 12, 16 and 20,

Receiving the Russian Satellites

Operating at a slightly lower frequency than the Intelsat craft is a series of Russian TV communications/distribution satellites. These craft, in the Statsionar and Gorizont series, operate in the 3·6-4GHz band. Steve Birkill has successfully constructed a receiving terminal in his back garden for these craft. It uses an 8ft. surplus radar dish aerial, and the remarkable quality that can be achieved is shown in the two accompanying photos. It goes without saying, or should do, that above average skill and knowledge are necessary in constructing equipment to operate at microwave frequencies. We hope to be able to provide details of a head and down-conversion system in the future however. For the time being, Steve has very kindly supplied circuit details for the intermediate electronics (see Fig. 1). This circuit can be used for i.f. amplification and demodulation of the signal, providing a video output that can either be fed to a monitor or remodulated in a.m. form on to a u.h.f. carrier for feeding to a conventional set.

SHF Reception

The i.f. strip shown accepts the i.f. signal from a standard low-noise u.h.f. tuner. For s.h.f. reception (e.g. at 4GHz), wideband down-conversion to u.h.f. is first required, the u.h.f. tuner then covering the required passband using standard tuning practice. The circuit shown is a tried and proved one – though neither Steve nor the magazine can

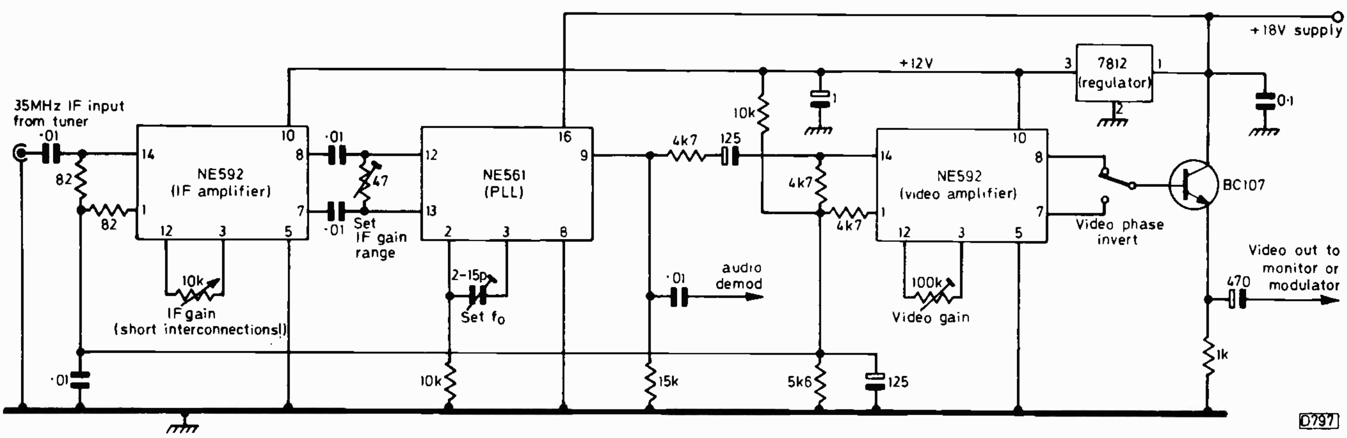
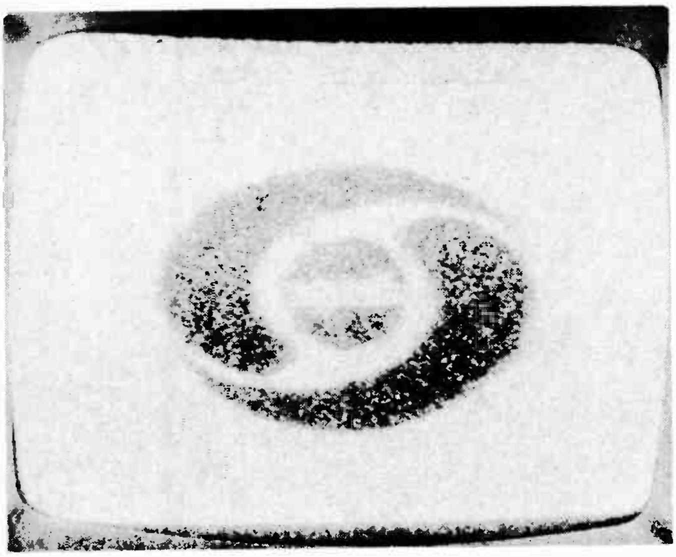
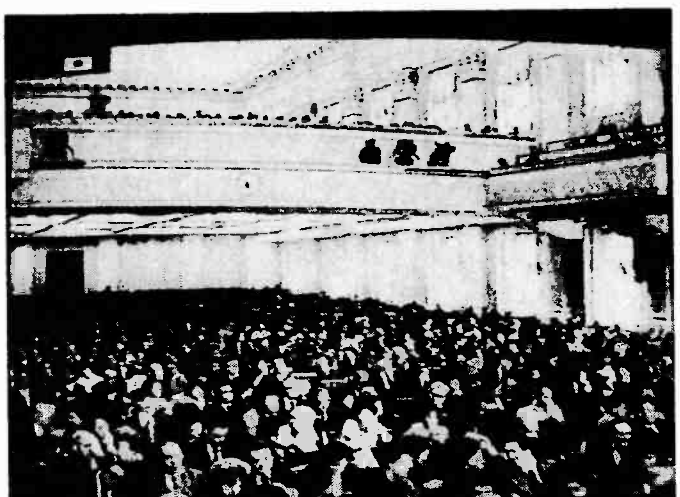


Fig. 1: Steve Birkill's i.f. strip for satellite TV reception. A phase-locked loop is used to demodulate the f.m. video.



Reception of the 860MHz signal from the ATS-6 satellite by Clive Athowe (Norwich) in 1976.

Children's programme interval caption received by Steve Birkill (Sheffield) from the USSR's Statsionar 4 communications/distribution satellite. Reception on ch. 1 (3·695GHz), in September 1979.



A political meeting being televised and distributed via the USSR's Gorizont 2 satellite. Reception at 3·695GHz by Steve Birkill in October 1979.

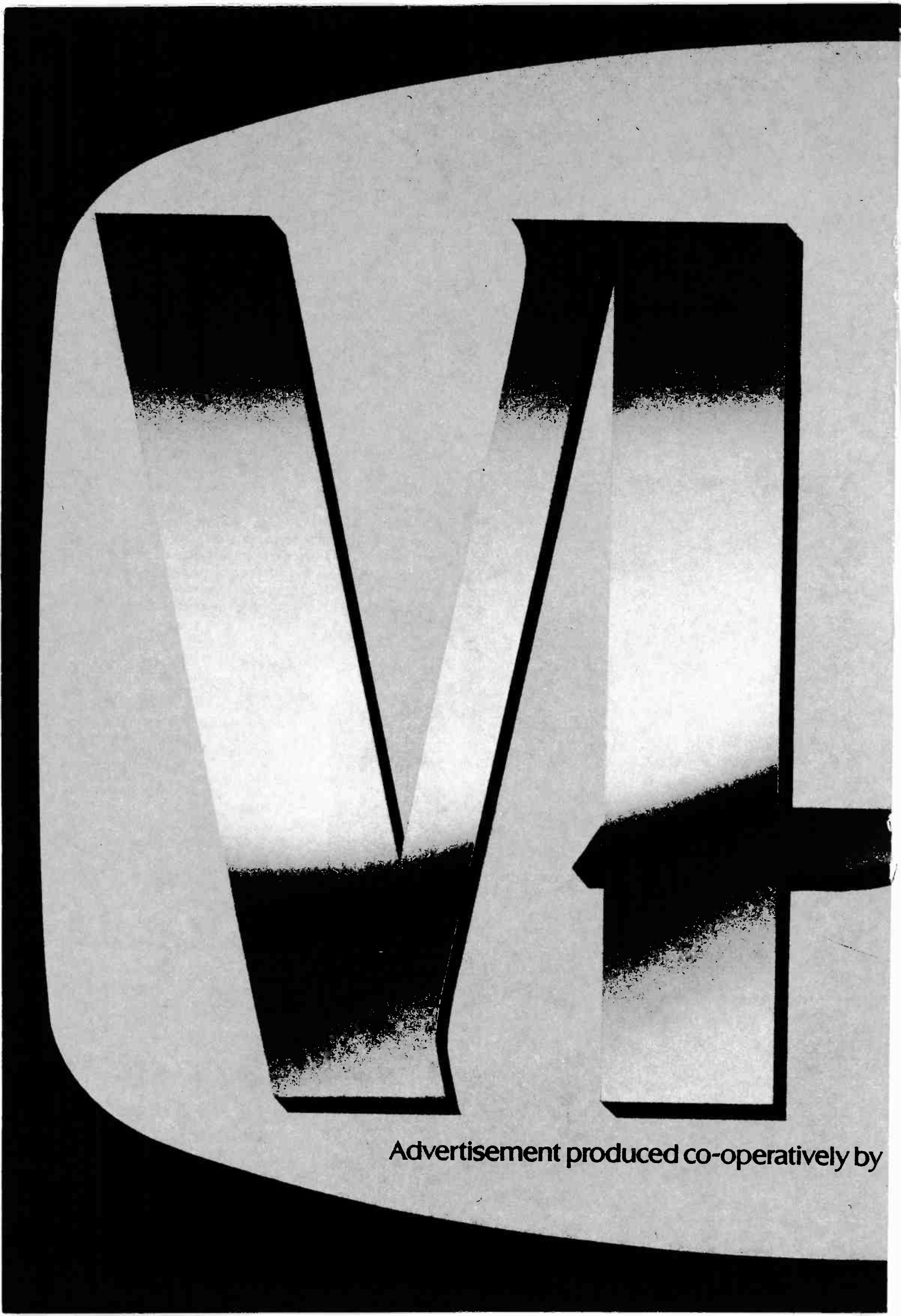
enter into correspondence on modifications and the application of this circuit, since by its very nature such reception is at present experimental.

Sources of Information

Steve has written a series of detailed articles on the theory and practice of satellite reception. These originally appeared in a US magazine, since such reception is now possible there. You can get the series of articles (twelve) in photostat form from Real World Technology, 128 Cross House Road, Grenoside, Sheffield S30 3RX for £6·50 post paid. Real World Technology hope in due course to be able to supply PCBs and other items so that constructors can build s.h.f. receiving equipment. We'll be passing on further details when available.

Information on s.h.f. equipment is often given in the RSGB's excellent magazine *Radio Communication*. The RSGB's publication *VHF-UHF Manual* is also worth consulting.

The Russian Statsionar 4 satellite operates at about 14°W, with Moscow ch. 1 (3·695GHz) and ch. 2 (3·895GHz) at relatively high powers. With the growth of satellite TV, the pickings will become more attractive. Considerable use is now being made of satellites for TV distribution in the USA, and with suitable receiving equipment covering the 3·7-4·2GHz band viewers can receive movies, sporting events and so on from several satellites. The US satellites are unfortunately beyond our horizon in the UK, but we hope to provide more details in future issues of equipment covering the Russian frequencies. I'd be interested to hear from anyone who's done any work in this field.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Vintage TV: Projection Systems

Part 1

Vivian Capel

DEMAND for larger screen sizes in the mid 1950s led to the appearance of projection receivers. There were two basic types, the front projection type which gave a 3ft by 4ft picture on a silver screen, and the more common back projection type which produced a 12in. by 16in. image on an etched translucent plastic sheet.

Picture size wasn't everything though – the first 21in. direct-view models were making their appearance at about the same time. Owners tended to be devotees who swore that no direct-view set could match the performance of a projection receiver. Indeed the pictures did possess a sparkle and needle sharp focus right to the edges that were rarely seen on conventional sets.

A number of firms ventured into this field, including Decca, Etronic, Ferranti, Philips and Nera, and some of the popular models we'll cover from time to time in future articles in this series.

The Optical Unit

One thing that all models had in common was the optical unit, which we'll describe here. It was made by Mullard and consisted of a $2\frac{1}{2}$in. c.r.t. and a Schmidt optical system (see Fig 1). A concave mirror is required to collect the light from the tube face and focus it on to the screen. Using a simple spherical mirror however would give uneven focus, as the light rays collected by different parts of the mirror have different lengths.

One way of overcoming this – used with Newtonian reflecting telescopes – is to make the mirror surface a parabola. The snag is that this is a difficult shape to produce accurately, so parabolic mirrors are expensive. In the Schmidt system a spherical mirror is used with a correcting lens in the optical path. Even this could be an expensive item, so the Mullard unit employed a composite lens consisting of a glass concave base on which was moulded a convex centre of gelatine (see Fig. 2).

The optical unit was in two main parts: the casing, which included the mirrors and correcting lens; and the c.r.t. with its scan and focus coils. To part them, three screws holding the flange of the focus assembly to the casing are loosened after which the c.r.t. assembly can be rotated clockwise and withdrawn.

Opposite the face of the c.r.t. inside the unit is the spherical mirror, whose centre was blacked out to prevent light being reflected back on to the tube face. The rest of the mirror's surface reflected light back on to the flat mirror which surrounded the tube and was set at an angle. From there it was reflected upwards through the corrector lens, after which it left the unit. Above the unit in the receiver's cabinet was another much larger flat mirror which directed the light to the back of the plastic screen.

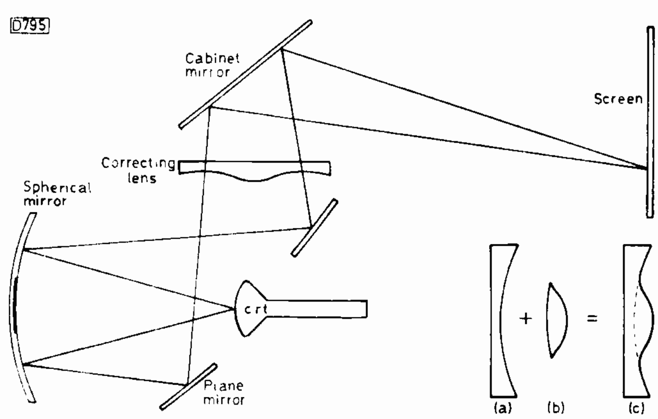


Fig. 1: Arrangement of the Schmidt "folded" optical system used in projection TV systems. The c.r.t. was a $2\frac{1}{2}$in. one produced by Mullard (type MW6-2).

Fig. 2 (lower right): Way in which a composite assembly was used to obtain the correction lens.

Centring

Centring is done by moving the large cabinet mirror, slots being provided in the fixing struts so that the position can be altered when the supporting screws are loosened.

First however the picture must be centred on the tube face. To do this the tube assembly has to be removed from the unit and operated outside, at low brilliance level. When the linearity, width and height are all correctly adjusted the picture is centred so that the corners just touch the round edge of the tube's face.

There's a flange on the rear of the deflection coil housing and another facing it at the front of the focus assembly. Two studs join the flanges, one fixed and the other spring-loaded. At 90° from these are two screws. The screws are adjusted to tilt the focus assembly in order to centre the picture. A locking screw at the back must first be loosened and retightened when the centring is completed.

Cleaning

Cleaning the optical system was always a tricky job with projection sets. The problem is that the mirrors are all front silvered and thus easily scratched, or even de-silvered if drastic cleaning methods are used. Mild detergent and cotton wool was the maker's recommended method. Even this called for firm rubbing if the mirror was badly tarnished and could result in disaster.

Although this was frowned upon, I found that the best thing to use was a window cleaner such as Mirroglo. Wiping the fluid gently on, allowing it to dry, then wiping off with a clean cloth removed the dirt without any hard rubbing at all. The risk of damaging the mirror was actually less than with the recommended method. The mirrors would come up sparklingly clean, and not one was damaged.

The cabinet mirror could be taken out and laid flat on the bench for cleaning. When handling this it was important not to touch the silver, gripping the mirror by the edges. If mirrors in existing sets are beyond normal cleaning they can always be resilvered by any good mirror silvering firm.

As the optical unit was sealed, the internal mirrors needed less frequent cleaning. When they did however the problems really started. The spherical mirror was quite easy to get at with the c.r.t. assembly removed – it was the plane mirror that was the difficult one. The lower part was reasonably accessible, but the upper part was not.

One solution was to remove the corrector lens. This is carefully positioned during manufacture however and has to be replaced exactly as originally fitted. L-shaped jigs were used to mark the position of the rim accurately – fixed in place one at a time when the securing clamps were removed. This was tricky, and if the lens was not exactly positioned even focus could not be achieved.

With practice and a little dexterity, the upper portions of the mirror could in fact be reached with a cloth wrapped around two fingers, though you couldn't reach right to the edge. The uncleaned edge seemed to have little effect on the final result however.

Focusing

The optical path had to be correctly focused by means of three black knobs on the optical unit. These tilted the tube in different directions. Most engineers found this quite a headache, and many lengthy sessions were spent trying to get it right. One of the difficulties lay in the relative positions of the optical unit and the screen. This differed in different models. There were four possible positions, and the behaviour of the controls was different in each case. If you had the manual it wasn't too bad, but if not you could find yourself making matters worse rather than better.

I devised a little chart at the time (see Fig. 3), giving the correct adjustments for all four positions. With the aid of this I managed to focus sets I'd not even seen before.

The first step is to get a blank raster and to focus it electrically. Next loosen the locking nuts on the black knob-shafts. On fully unscrewing the top knob a narrow strip of the raster will be in focus. The angle of the strip will as shown vary between models according to the relative

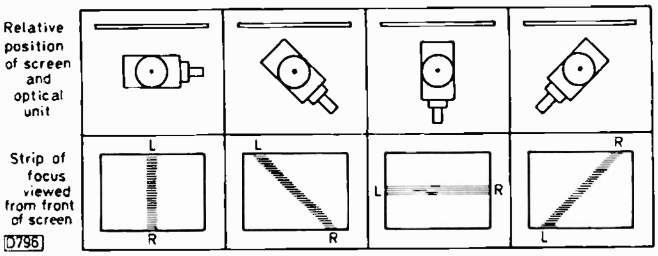


Fig. 3: Focusing chart for projection TV sets.

positions of the screen and optical unit. The strip must cross the geometric centre of the screen, and this is accomplished by adjusting the two side knobs. Each of the two knobs moves one end of the strip, thus turning them in opposite directions rotates the strip while adjusting them in the same direction moves the strip across the screen without changing the angle.

When the strip is at the correct angle and crosses the centre of the screen the top knob is screwed down. This widens the strip until the whole screen is in focus. There's an optimum position – if taken too far, parts of the raster will go out of focus again. Lastly tighten the locking nuts.

A New Projection System

Mullard recently announced that they will be bringing out a new colour projection system, called the "Empress", using a Schmidt optical system. Whether this bears any physical resemblance to the old projection unit remains to be seen. Funny how things seem to go round in circles. We may once again find ourselves tweaking optical units for optimum focus as part of our daily chores.

Product Review: Electronic Mailorder High Gain Preamplifier

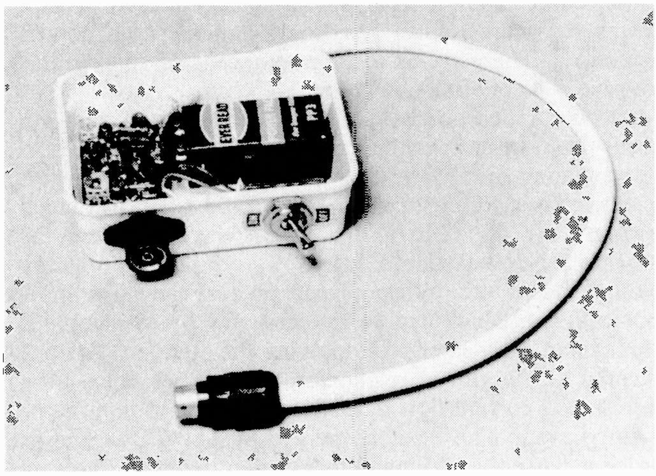
Roger Bunney

A REGULAR advertiser in this and other technical magazines for many years has been Electronic Mailorder Ltd. of Bury, Lancashire. Amongst other things they offer a range of budget "set-side" signal preamplifiers for the v.h.f. and u.h.f. bands. A recent addition to the range is the B45/High Gain. It looked very good value at the price quoted, so I purchased a sample to try it out.

It's a two-stage preamplifier for set-side use but instead of being a wideband device (as the standard B45 is) it's aligned to a single u.h.f. channel. The idea is to provide high gain for such purposes as getting reception of an extra ITV channel. It employs a couple of pnp (BF183) transistors operated in the common-base mode, with tuned lines in the collector circuits. There's a small preset capacitor in each collector circuit so that the user can peak the circuits to the required channel. Any channel in the u.h.f. band can be tuned in. Some increase in bandwidth could be obtained by stagger tuning, but since the amplifier is not intended for use in this way it was tested only when peaked to a single channel.

The unit is powered by a self-contained 9V PP3 battery, the sample amplifier drawing some 3·8mA. The gain is quoted as 18-20dB, but on test the sample provided a voltage gain of 23·5dB at 500MHz. This was confirmed with off-air tests from Crystal Palace ch. 23. It's quite easy to peak the amplifier by observing the screen, adjusting the preset capacitors carefully, though a.g.c. action in the receiver may produce a degree of "masking". Using a field strength meter, we found that optimum gain was obtained by initially peaking the second stage, then the first, finally making a further check on the second stage.

The amplifier is built on a PCB and housed in a flexible



View of the Electronic Mailorder B45/High Gain preamplifier with the snap-on top cover removed.

white polythene box. The aerial input connection is via a standard, good quality 75Ω coaxial socket while the output is via a flying coaxial lead approximately 15in. long terminated with a reasonable quality coaxial plug. There's a substantial SPST toggle on/off switch. The PP3 "floats" within the box, the snap-on lid holding things stable.

At £7·70 plus 30p postage I call it very good value, and I'd certainly recommend it to anyone wanting a high-gain, single-channel u.h.f. preamplifier.

The BF183 is a comparatively old device. The use of a BF362 or BF479 in the first stage would give even better performance. With a BF362 you could probably increase the voltage gain by 3dB and, more importantly, reduce the noise from around 7dB to 5dB. With a BF479 an even better noise performance – perhaps 3·5-4dB – could probably be achieved. These figures apply at 800MHz. An experienced constructor might also consider adding an input tuned circuit to achieve greater selectivity. A BF362 or BF479 would require little or no alteration to the biasing when trying the change out to see what improvement in system performance could be achieved. Personally I prefer to use a diecast box, in the interests of screening and rigidity.

The points made in the previous paragraph are suggestions for getting even better performance from the unit. The amplifier in the form supplied does however give excellent results and is wholly adequate for normal domestic use.■

Tubes

Les Lawry-Johns

TUBES are the subject exercising our little minds this month. They are of all sorts. Most are alive, like trees, snakes and people. Take people for example. Long tubes with a hole at the top equipped with a mincing machine to break down bits of other tubes. And with two sticks at the same end to grasp the food and two at the other end to enable the food to be sought and collected. Trees are much more efficient, staying in the same place while sending down their lower sticks in search of sustenance. Also they don't need all the bits and pieces people, and other animals, require around their tube – pipes, pumps and filters, with a central control system at the top. Trees don't need such paraphernalia and therefore live a lot longer. Snakes are also more advanced than people: no sticks, just a basic tube, having taken a leaf out of their lowly cousin, the earthworm's, book. We seem to have a long evolutionary path ahead of us before we can stand still like trees. I've probably got it all wrong however, which leads me to the next bit which I've also probably got wrong but has been causing some concern lately.

Rebuilt colour tubes

It's our custom to keep in stock a few rebuilt colour tubes of the more common sizes, so that customers aren't kept waiting for more than a few hours and the cash flow is maintained. There seems to be an unexpected snag in this desirable state of affairs however.

It would appear, and we stand to be corrected, that if a tube is taken fresh from the ageing process (the final part of the rebuilding procedure) and installed, tested, converged, etc. there's very little trouble. If the tube is held in stock however, say for only a few days, when it's fitted the emission is below standard and shows symptoms of muddy colours, flaring etc. When placed on test the guns show poor emission which can be restored only by reageing, i.e. overrunning the heater and applying the standard positive potential to the grid in relation to the cathode, measuring the resulting current flow in milliamps. Some 15 minutes or so may have to elapse before the accepted 60–70 milliamps can be achieved – and maintained when the heater voltage is returned to 6·3V.

If this is done and the tube is put into use, no further trouble is experienced. If it's not done and the tube is left working the resulting picture will be inferior and will remain so, i.e. it will not "bed itself in" or "age" itself.

You may say that this is because we have employed rebuilt tubes from one source and that this source has not used hot pumping or has not aged the cathodes for a long enough period. This, as far as the first two points are concerned, is not so. We have used tubes from several sources. Hot pumping is definitely used at least at one of these sources, which we've visited.

It's the ageing process about which we're in doubt. How long should this be if the cathode material is not to revert towards its inert state when not put into immediate use? These notes are not the result of a few isolated instances. They are based on experience over several years, and we now always check the emission of rebuilt tubes which have been held in stock for any period before using them.

There now. I've already been given ten thousand reasons why all this can't be, and if you want to add to this by all means do so. But just check that tube before you fit it if it's been laying around for a while.

It keeps going dark

When Mr. Bristol brought his set into the shop we didn't expect to have the trouble we ended up having. It was a Bush colour set fitted with the A823 chassis. He said the picture kept going dark and off tune. So we checked the tuner and found the nylon collars on the threaded rods in various stages of decomposition. To save time, we stuck on our spare assembly and refitted the tuner. It stayed in tune and the picture remained bright.

Back he came the next day to say that it still went dark. So we put it on a soak test. It remained bright until it was moved, after which the picture could be seen only with the brilliance control fully advanced – and even then only the highlights were in evidence. When the set was moved to gain access normal brightness returned and of course remained despite persistent prodding etc.

When at last the screen did darken, the cathode voltages were found to be correct and we were just in time to record a first anode voltage of about 250V on the blue gun before it shot up to about 500V and the brightness returned. "Ah ha" we said, but it didn't do us much good. Over a period the first anode voltages varied, and we leapt from the convergence panel where the presets are mounted across to the scan control panel where the supply comes from several times, each time becoming more frustrated.

There was no leakage on the convergence panel, and indeed the voltage was coaxed to vary with the supply removed from this panel. So we were back with the 2·7kΩ resistor 6R7, the rectifier 6D2 and the reservoir capacitor

6C13 (see Fig. 1). We prepared to replace the latter, only to find a dry-joint at one end. Not leakage after all, simply the intermittent lack of a reservoir.

As soon as the joint was remade the first anode voltages returned to normal and stayed there. It's one thing to know you've definitely cleared a fault, another thing to convince the customer. Two days later however Mr. Bristol popped in to say that everything in the garden was bright and cheerful.

A naughty 3000

In the meantime we'd encountered another mystery. A bulky brute with folding doors, an HMV label and a Thorn 3000 chassis. It seemed to have just about everything wrong that this type of set can have. The main trouble however was that an initially indifferent picture would slowly go out of focus, become a bright blur, then disappear.

More in hope than conviction we changed the tripler. No difference. The old tripler felt quite warm however so the tube must have been drawing a fair amount of current. We next noticed that when the picture became a blur the tube neck became blue. So we immediately accused the tube of becoming soft – a severe cold was playing havoc with our reasoning (which is not very evident at the best of times). After an all round general panic, during which measures were taken that I'm ashamed to relate, we started to behave more rationally. We unhooked the tripler and took voltage readings at the tube base. Previously these hadn't made a great deal of sense. We now found that the cathode and grid voltages remained reasonable, but the first anode voltages (yes again) on all three guns increased to over 1kV – in fact were probably higher than this, allowing for the effect of the meter. My nose blowing assumed force nine proportions.

We eventually discovered that the first anode supply earth return resistor R727 (see Fig. 2) read right when cold but became open-circuit when heated. After replacing this the picture remained in focus and we were able to clear the hundred and one other faults which could now be seen.

Caught again

Having made a complete mess of a simple repair on an HMV set we next proceeded to butcher an innocent Dynatron set fitted with the Pye 691 chassis. The complaint was that it went out of focus after ten minutes or so, becoming a complete blur with the width coming in to denote overload conditions.

Our ice cool reasoning was impeccable and, of course, wrong: either the cathode voltages are dropping due to a fault in the PL802 luminance output stage (not so – the cathode voltages were fairly steady at about 200V), or the tripler is faulty – in which case it will be hot. The tripler was indeed hot, so we proceeded to replace it – which is easier said than done in the 691. Manfully we tackled the job, and finally had the lot back together.

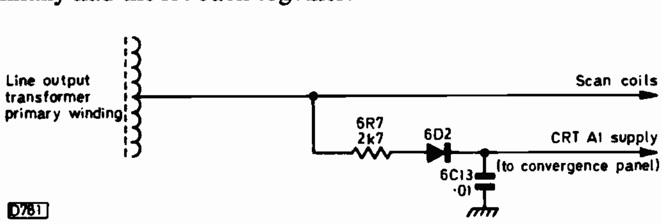


Fig. 1: A dry-joint on the c.r.t first anode supply reservoir capacitor 6C13 caused intermittent loss of brightness in Mr. Bristol's Bush colour set (A823 chassis).

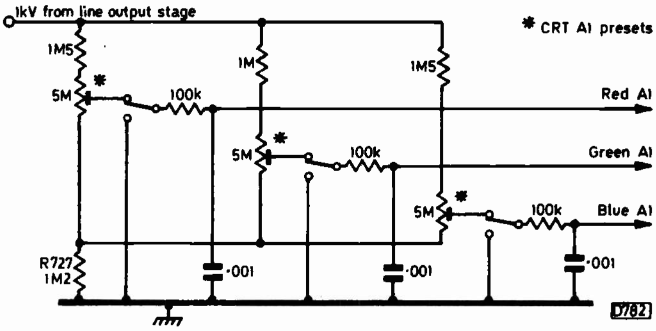


Fig. 2: A particularly nasty one this, on the Thorn 3000 chassis. When warm, R727 would go open-circuit, with the result that the c.r.t.'s first anode voltages became excessive. The symptoms were loss of focus, the picture becoming a bright blur then disappearing.

We switched on and started to write out the bill. As we did so we became aware that something was wrong. We heard the e.h.t. rustle up but no picture appeared. Hurriedly we checked the tube base voltages again. Cathodes o.k. First anodes o.k. But whilst there should have been about 100V on the grids there was a heavy negative voltage instead.

I was well aware that we'd had this trouble more than once before, but what with a thick head and old age I couldn't remember what had caused it. "Clamp pulses, clamp pulses" I thought blearily and checked them and the clamp triode grids and cathodes. Not at fault. Faulty PCL84? Not so. Oscillation due to lack of decoupling? Then the penny dropped. Sure enough, an electrolytic on the h.t. supply line to the CDA panel restored normal conditions, and of course the main smoothing capacitor was open-circuit.

A replacement was fitted and the picture appeared quite good for about five minutes. It then started to go out of focus. . . . Back to square one. Why wasn't I born a cat or a dog? All they have to do is watch me making a fool of myself. I'm not very good at being a human.

I rested my hand on top of the cabinet and hung my head in despair. The cabinet was warm over the top of the long focus unit. Touch the focus unit. Hot and getting hotter. The plastic was melting before my very eyes! Off off, switch the thing off. The focus unit continued to bubble and no wonder, since the VDR was acting more like a fire bar element than a focus rod.

Once again I remembered. Pity I couldn't have managed to do so before fitting the tripler. I'd even written about it a couple of years ago. A new focus unit restored reliable operation, but I didn't feel so good.

The K80

Oh yes, I nearly forgot. There are three chroma amplifier stages in the Philips K80 chassis. I had replaced two of them and finally reached the third which is way down on the panel where the print side is obscured by the power unit. The latter had to be removed to gain access. All three transistors had apparently been blown, presumably by an accidental short on the tube base holder where a solenoid is activated when the colour-killer circuit supplies 25V to it and the chroma amplifiers. I suppose the sudden application of 200V from an adjacent cathode connection would upset things a bit.

Have you ever tried to converge a 110° delta-gun tube when there's an unsuspected dry-joint on one of the controls?

Class AB Video Circuits

George Wilding

A LOGICALLY drawn circuit tends to bring out the d.c. rather than the a.c. conditions. Take Fig. 1(a), a simple enough example. Tr1 develops its output across R1, and this is coupled to the base of Tr2 by C1. R3 and R2 provide Tr2 with forward base bias and are in series across the d.c. supply. If C1 went short-circuit, R1 and R2 would be connected in series across the supply. C2 decouples the positive d.c. rail to chassis. From an a.c. point of view however, R1, R2, R3 and the second transistor's input impedance are all in parallel. This is because C2 earths the positive side of the supply from the signal point of view – a factor which becomes clearer if we redraw the circuit as shown in Fig. 1(b), this time placing the emphasis on the a.c. conditions.

Shunt Capacitance

There is appreciable capacitance across a video output transistor's collector load resistor, and while the resistor is connected to an h.t. rail the capacitance can be considered as being, from an a.c. point of view, between the collector and chassis, along with all the other capacitive effects that add up to give a total, and unwanted, shunt path (see Fig. 2). The other capacitive effects are mainly the transistor's feedback capacitance, which is multiplied by the Miller effect, the c.r.t.'s input capacitance, and the capacitances between heatsinks, components, wiring etc. and chassis.

The reactance of this total shunt capacitance at the highest video frequencies is only a few kilohms, which means that there's no point in using a load resistor of much higher value. A high value load resistor will increase the gain at the lower and middle frequencies, but the result will be that the h.f. roll-off is accentuated, i.e. the video response becomes increasingly non-linear at the higher frequency end.

Video output circuits have received increasing attention in recent times. With the advent of teletext and other alphanumeric display applications, it's been increasingly desirable to improve the h.f. performance of video output circuits. The aim is to greatly reduce the effect of the output stage's shunt load capacitance.

When the waveform at the collector of a class A video output transistor, and thus across the shunt capacitance, is

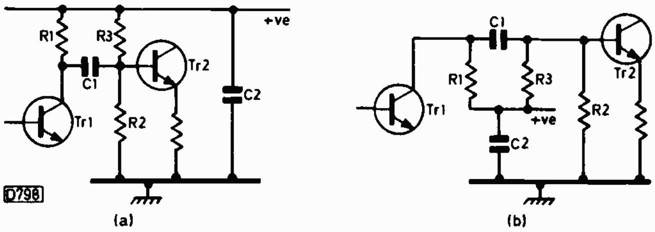


Fig. 1: (a) A.C. coupling between stages by means of an RC network. Note that from a d.c. point of view R2 and R3 are connected in series. (b) Circuit redrawn to bring out the a.c. conditions. From the a.c. point of view, R1, R2, R3 and the input impedance of Tr2 are all in parallel (with C2 in series with R1 and R3).

negative-going, the shunt capacitance is very rapidly discharged via the transistor's conductive collector-emitter path. The value of the load resistor is hardly significant therefore. When the transistor is fed with an input which causes its collector voltage to rise however, the shunt capacitance charges via the load resistor, whose value now becomes important. As a result of this the circuit has an asymmetric response, i.e. it can follow negative-going output changes more rapidly than positive-going changes.

The problem can be largely avoided by using two transistors in a class AB video output stage, so that the shunt capacitance is both charged and discharged rapidly. The result is improved response to all step, transient and other h.f. signals since the response is symmetrical, sharpened, and the value of the load resistor can be increased.

Basic Class AB Circuits

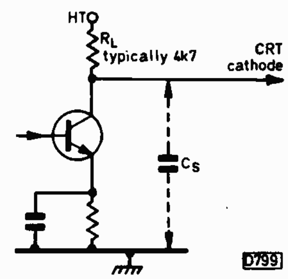
Two types of circuit are now in quite wide use. They are shown in simplified form in Fig. 3. One circuit employs a pair of npn transistors, the other a complementary pair of pnp/npn output transistors. The circuits have another important advantage compared to a simple class A video output stage, substantially reduced power consumption.

Such stages require a greater number of components than a simple class A stage, but this is more than compensated for by the improved gain/bandwidth and step response performance and the reduced dissipation.

NPN Transistor Circuit

The type of circuit shown in Fig. 3(a) has been much more widely used to date, possibly because of its lower component count. Let's briefly consider the circuit action. Since both transistors are npn types, they require opposite phase inputs. At low and medium frequencies, Tr2 acts as a class A amplifier. Because of the circuit's improved h.f. performance, its load resistor R_L can have a much higher value than would be possible with a single-transistor class A circuit. A typical value is 22kΩ, as in the recently introduced Thorn TX10 chassis. When a positive-going step waveform is applied to the base of Tr2, the shunt capacitance Cs is rapidly discharged since Tr2 is driven hard on. Tr2 provides signal inversion, so Tr1 can be driven from its collector. When a negative-going step waveform is fed to the base of Tr2, it will be driven towards cut-off. Its collector voltage will rise sharply to the h.t. rail voltage

Fig. 2: Simple class A video output stage. Cs represents the total shunt capacitance at the output. From the signal point of view, this is in parallel with the load resistor R_L. By using a small value emitter decoupling capacitor, negative feedback can be used at l.f. to optimise the stage's frequency response.



therefore, and this time Tr1 will be switched hard on. Notice that it's an emitter-follower. Cs is now rapidly charged via the low-impedance path presented by Tr1. R1, which is of relatively low value, is included to limit the current flowing through Tr1. A simple and effective circuit, which can be further improved by applying the drive to the emitter of Tr2 instead of its base, i.e. by using Tr2 as the upper transistor of a cascode pair. The lower transistor in this case can be a low-voltage type with high gain.

Complementary-symmetry Circuit

Since the two transistors used in the type of circuit shown in Fig. 3(b) are of opposite types, they require inputs that are in phase with one another. This is achieved by linking Tr1's base to the base of Tr2 by the coupling capacitor C1. The value of this is kept small, 0·0047μF being the usual value, so clearly Tr1 is going to be driven only by h.f. video signals. At low and medium frequencies, Tr2 acts as a class A amplifier, with Tr1 as its load. Tr1 is forward biased by the potential divider network R1/R2, while R3 provides Tr2 with forward base bias. A positive-going step waveform at the base of Tr2 will rapidly discharge Cs. A negative-going step waveform at the input will be coupled to the base of Tr1 via C1,driving it hard on with the result that Cs is now rapidly charged via Tr1 and the comparatively low-value resistor in series with it.

Practical Complementary-symmetry Circuit

Practical versions of the type of circuit shown in Fig. 3(b) tend to be a little more complex than one might suppose. To end with, let's look at an example. Fig. 4 shows one of the RGB output stages used in the GEC 20AX chassis (C2217H series). The input to the emitter-follower driver stage Tr208 comes from pin 3 of a TCA800

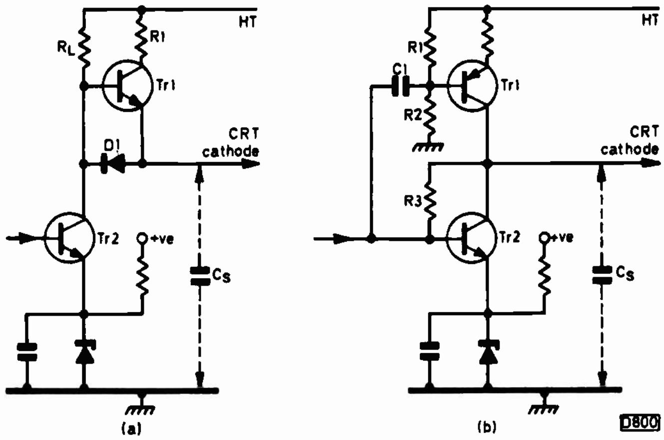


Fig. 3: The two basic class AB video output circuits, (a) using two npn transistors and (b) using a complementary-symmetry npn/pnp pair. In the widely used circuit shown in (a) the lower transistor acts as a class A amplifier at the lower and medium frequencies, driving Tr1 to rapidly charge the shunt capacitance Cs on the positive-going h.f. excursions of the output waveform. In practical circuits d.c. feedback from the output is used to set the black level at the output. In the complementary-symmetry circuit shown at (b), Tr1 forms an active load for Tr2 at the lower and medium frequencies, being forward biased by R1 and R2 so as to provide a constant-current source. At h.f. Tr1 is driven via the small-value coupling capacitor C1. This circuit provides a slightly better performance than that shown in (a), since the latter introduces a form of crossover distortion. This distortion is not normally visible on the screen however, and in practice the type of circuit shown at (a) is generally favoured due to its lower component count.

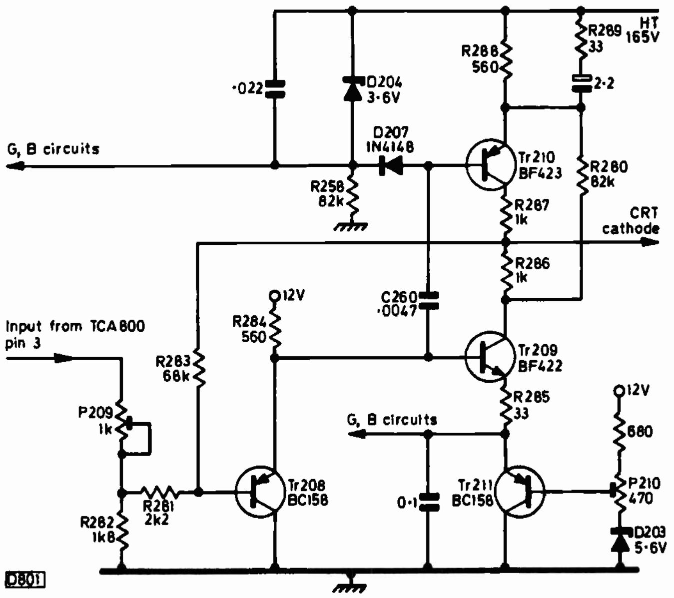


Fig. 4: A practical example of the complementary-symmetry class AB video output stage, as used in the GEC C2201H, C2217H and similar models (decoder panel PC719). P210 forms an output bias control, and is set for a reading of 150V d.c. at the output. A simplified circuit using BF469 and BF470 transistors is employed in the later GEC chassis with PIL tube (panel PC786/7).

demodulator/matrixing i.c., via the drive control P209. Tr208 in turn drives the output transistors Tr209/Tr210. The emitter of Tr209, in common with those of the other two (G and B) npn output transistors, is returned to chassis via Tr211, which acts as a video bias source. The pnp output transistors receive their bias from the junction of D204/R258.

At low and medium frequencies Tr209 acts as a class A amplifier whose load consists of the parallel combination R280/Tr210. Since R280 is connected to the emitter of Tr210, the negative-going voltage developed across R288 as Tr209 is driven into greater conduction reduces Tr210's collector current. As a result of this the current flowing through the combination R280/Tr210 remains fairly constant.

H.F. video signals are applied to the base of Tr210 via C260, with D207 providing a degree of d.c. restoration. At h.f., the two 33Ω emitter resistors R289 and R285 act to equalise the current swings in the two transistors. The 1kΩ collector resistors R286/7 fulfill three main functions. They limit the peak h.f. voltage swings and thus the peak transistor power dissipation, they reduce the risk of harmonics outside the video spectrum being radiated from the drive leads to the c.r.t., and they provide some protection to the transistors in the event of inadvertent short-circuiting.

D.C. feedback is applied from the centre point of the output stage to the base of Tr208 via R283. The values of R283/1/2 are chosen so that no current flows through the drive control P209 at black level.

Acknowledgement

The pulse rise time is less than 100nsec for a 100V squarewave input, with symmetrical response to positive- and negative-going input signal excursions. This type of circuit was originally described by D. J. Beakhirst and M. C. Gander in the October 1975 issue of *Mullard Technical Communications.*■

TV Servicing: Beginners Start Here . . .

Part 33

S. Simon

THE first Bush colour sets to use a solid-state chassis (the A823) appeared in late 1969, replacing the dual-standard hybrid chassis that Rank had started off with at the start of colour in the UK in 1967. Many Bush and Murphy models were fitted with the A823 chassis, which was also used by the Co-op for their Defiant colour sets and by some rental companies. There were several versions of the chassis. The later A823A for example had some important differences from the initial A823, while the final A823B was a BEAB approved version. Early models such as the CTV182S are a somewhat different kettle of fish to say the later CTV1122 therefore. The fault pattern tended to remain much the same however. And in any case we're continuing with our basic theme of how to tackle dead solid-state sets. The object this time is to point you in the right direction rather than to deal with all possible fault conditions – much information has been given in these pages in the past on common, and some not so common, A823 chassis faults. We'll assume then that you have an early set in this series, and that it's fitted with the A801 power suppy unit (see Fig. 1).

As with the Philips G8 and Thorn 3000 chassis we've been considering over the past three months, the power supply used in the Rank A823 chassis includes a mains transformer. One of its duties is to supply the tube's heaters with the required 6·3V supply. So here again we have a simple clue once the back cover has been removed. Are the tube heaters glowing? If so, we know immediately that the supply is reaching the transformer (8T1) and that the mains input fuse 8F2 is intact.

The power panel is mounted on the left-hand side and carries two other fuses (see Fig. 2), the h.t. fuse 8F3 (600mA) at the top and the l.t. supply fuse 8F1 (2A) halfway down the rear edge. The mains input fuse 8F2 (5A) is in a less accessible position – at the bottom centre of the board. It was later changed to a 3·15A anti-surge type.

Tube Heaters Out

If the tube heaters are not glowing, we must conclude that the transformer is not energised and therefore the supply is not reaching the fuse or the fuse has failed. If there is no supply to the fuse holder it's highly likely that the live side of the on/off switch is defective, whilst if all sections of the on-off switch are live, including the metal work, the neutral side could be open-circuit. The type of switch originally fitted was suspect, and should be one of the first things to check.

If the switch is functioning properly, has been switched to on, and is receiving the mains supply, there should be a live indication at one end of 8F2. (All power pack components have circuit reference numbers preceded by the figure 8: once we know this we can drop it and just say F2 etc.) There is no doubt that F2 can fail purely from fatigue, but this must not be assumed (unless you have lots of fuses).

By now we know what a BT106 thyristor looks like. It will be found about halfway up the panel, with the threaded end toward you (hopefully covered). This end carries the full a.c. mains supply, which is why we hope it's covered –

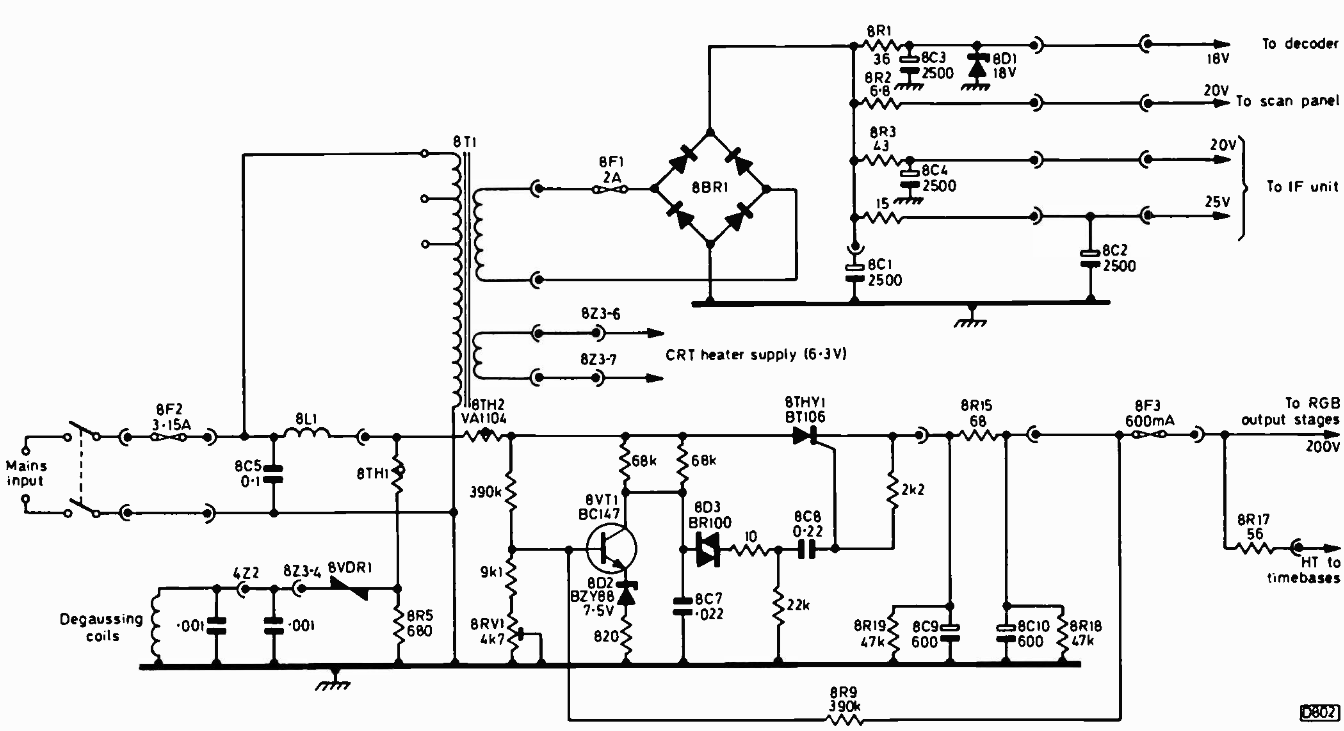


Fig. 1: Power supply circuitry, Rank A823 chassis. Note that there were several minor modifications to this circuit.

so that you don't touch it if adjustment of the preset RV1 is necessary. RV1 adjusts the h.t. output from the BT106 (or whatever thyristor is used). It sets the line scan amplitude and therefore the e.h.t., which is why it's labelled "set e.h.t."

Having located the thyristor, we next need to know whether it's short-circuit. A quick but not conclusive check is to switch the meter to the low ohms range and apply the prods to the anode (body, with the thread) and the cathode (the longer of the two legs). It's common to find a short here, and a new thyristor and fuse could well be the full extent of the repair. It could be.

Faulty Thermistor

In fact there's a thermistor in series with the supply to the thyristor to limit the switch-on surge. It's of the disc type (a VA1104). This resides at the lower centre of the board, in company with the degaussing thermistor TH1 which presents a more rounded appearance. TH2 (the VA1104) leads a hard life, and will often be found disintegrating, the disc parting company with its connecting leads. This of course shuts down the h.t. supply, and is a very common cause of non-operation. If it has seen many summers of service, the failure of the thyristor and the consequent rush of current may well be the last straw and TH2 may decide to die then and there – or perhaps may be found laying in the bottom of the cabinet, truly a drop out, only the stark leads remaining to mark the place where the disc had been.

Common Troubles

So there we have two very common causes of non-operation. If the tube heaters are glowing, the thyristor is probably not short-circuit (but check it) and the disc thermistor may well be found decomposed.

There's a possibly nasty consequence to all this. The leads of the thermistor connect through the panel to adjacent parts of the print. If the thermistor fails, the current is reluctant to stop and will take any alternative path it can. This may well be across the panel between the adjacent tracks, leading to several possibilities. The panel may of course be damaged by a minor conflagration, or there may be a nasty flash-over. The unfortunate point about the latter occurrence is that the power panel backs on to the print side of the decoder panel, which may be dealt a troublesome blow somewhere in the region of the SL901 i.c. The demise of this i.c. is hardly surprising, but the damage may be more serious than this and may vary from case to case. We mention this to illustrate the lighter side of TV servicing . . .

Check at the HT Fuse

We mustn't cheer you up too much however, and we must quickly return to the more mundane faults on the power panel. If the tube heaters are glowing, the next check to make is at the h.t. fuse. We are interested in three things here.

First, is any voltage present at all? Note that the thyristor's output does not go direct to the fuse, going instead via the smoothing resistor R15. This is mounted at the lower centre of the receiver, behind the convergence panel which swings up. Once this has been done you'll find two large electrolytics, a slightly smaller double electrolytic (the centre one), and behind them two power resistors, R15 (68Ω) and R17 (56Ω). R15 is the left-hand one, the thyristor feeding one end of it. The other end of R15 goes to F3 which should be 600mA or 630mA. If there's no voltage at the fuseholder it could well mean that R15 is open-circuit. This will leave the body of the thyristor at a high h.t. voltage which, unless as in later versions there's a 47kΩ discharge resistor (R19) connected across the h.t. reservoir capacitor C9, will remain there after the set has been switched off. If C9 remains charged, a hazard is presented to the unwary. A meter check, first for voltage then for resistance, should determine whether or not R15 is intact.

The next thing to interest us is whether the fuse is intact – it may well not be. The third thing is what voltage is present if it's there? It should be about 200V. If the voltage is high, due to the thyristor leaking, RV1 being misadjusted, or a fault in the control circuit, the over voltage protection circuit on the scan panel may have come into operation. This shuts down the line oscillator, resulting in the no raster symptom. The sound circuits are left on however. So here's an important clue: is the fault "sound section working, no raster", or "no results". We say "sound section working" since models fitted with a varicap tuner require the h.t. to be present for signals to emerge from the tuner, so there may in this case be audio noise but no sound signals. "No results" are in fact more likely to be due to a fault in the l.t. supply rather than the h.t. supply. Once we've satisfied ourselves that the main h.t. line is intact and at about the right voltage therefore we should turn, in our pursuit of the cause of "no results", to the l.t. supply.

The LT Supply

We have mentioned that the l.t. fuse F1 (2A) is mounted on the rear edge of the power panel. It's in the a.c. feed from the transformer to the bridge rectifier BR1. The rectifier itself was originally a BY164, but this was later discarded in favour of four separate BY126 diodes. It's quite common to find the fuse blown due to a fault in the bridge, and an ohmmeter should soon find which diode or which side of the BY164 is shorted.

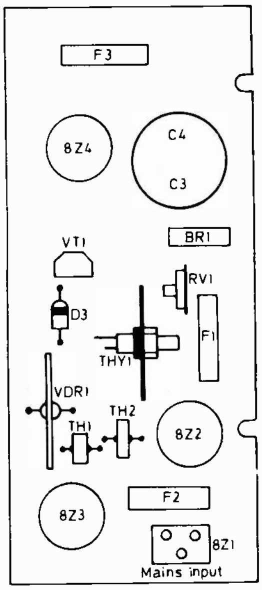
It may be thought that the nearby large electrolytic C3 (2,500μF) is the reservoir for the l.t. supply. In fact it's the smoothing capacitor for the decoder board, with the filter resistor R1 (36Ω) between it and the bridge. C4 is in the same can as C3 and has the job of smoothing the supply to the i.f. stages in conjunction with the smoothing resistor R3 (43Ω). The l.t. supply reservoir capacitor is C1, which with C2 (audio output supply smoothing) is over with the h.t. smoothers in the centre section of the chassis. If a shorted reservoir is suspected therefore, this is where to find it – not on the power panel.

The point we are leading up to is that the l.t. supply is required not only by the audio, the i.f. strip, the decoder etc. but also by the scan drive panel, to power the line oscillator and line driver stages, without which the line output stage and all the services it provides will be inoperative. Hence "no results" can be due to an absent l.t. line rather than the h.t. supply.

Practical Hints

It's often necessary to remove the power panel to gain access to the print side. The panel is secured by two PK screws at the rear edge. When the panel is refitted it's essential that these screws, particularly the top one, are screwed in tightly. Hum bars on the picture are often due to poor earthing at this point.

Whilst one is unlikely to leave any plug out when the power panel is refitted, it's quite easy to do so if the decoder panel is taken out and then refitted, since it's easier to remove the black plug from the bottom of the power panel



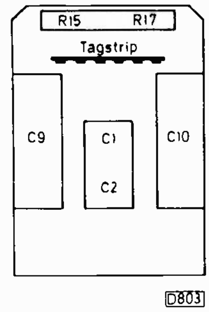


Fig. 2 (left): Simplified layout of the power supply panel.
Fig. 3 (above): Layout of the power resistor/main electrolytic plate, which is at the bottom centre of the chassis.

when removing the decoder (the cable from the plug runs across to the tube base). The result of not refitting this plug (8Z3) is not only that the tube heaters do not light up but also that R5 (680Ω) disappears in a cloud of smoke – since the degaussing coils are no longer shunted across it. This is why R5 will often be found charred for no apparent reason.

Apart from this, the other resistors on the power panel rarely give trouble – unless they are subjected to an overload. For example, R2 (6·8Ω) may often be found open-circuit thus shutting off the power supply to the scan panel. Whilst this can be nothing more than the resistor failing, it's worthwhile checking the BD131 line driver transistor on the lower front of the right side scan drive panel. If this transistor is found short-circuit, check the 0·22μF capacitor and the 22Ω resistor in the BD131's collector circuit since if one of these items becomes open-circuit, thus removing the damping from the line driver transformer, the transistor will short and probably damage R2 on the power panel. Having said that, we must point out that the BD131 fails far more often on its own account. Later models use a heatsink on the transistor, but this appears to have done little to prolong its active life.

"No Go" Summary

To return to our "no go" fault symptom however, we can summarise the important facts as follows.

No results. Tube heaters not glowing. Check supply to bottom centre fuse. If blown check for shorts, particularly the BT106. Also check the condition of the 47kΩ resistor(s) R18/19 across the main smoothing capacitors. These can deteriorate, presenting a dead short.

No results, tube heaters glowing. Check F1 (l.t. fuse) and if blown check the bridge rectifier.

No raster, noise from loudspeaker. Whether the sound is normal will depend upon the type of tuner employed, i.e. a varicap tuner requires an h.t. supply, mechanical ones don't. Check top fuse F3 to ensure that the h.t. is not too high (if it is, reset control RV1 to obtain 200V, switch the set off, then switch it on again – i.e. revert the protection circuit to its dormant condition, then try again).

If F3 is intact, check the h.t. at the far right end of R17, and the l.t. at both ends of R2 to ensure that the line driver etc. are receiving their supplies.

If F3 has failed, check for direct shorts (unlikely) and repeat this check at the right side of R17. If there's a low reading here, remove the relevant plugs to the scan drive panel (5Z2) and follow up to 6Z2 (scan control panel), initially checking the scan-correction capacitor 6C3 (0·47μF) and the line output transistors for shorts. If 6R7 is discoloured, the c.r.t. first anode supply reservoir capacitor 6C13 (0·01μF) is probably short-circuit.

If there's no particularly low reading, remove the cover from the line output stage and disconnect the lower near push-in clip from the tripler unit (from the line output transformer). Then connect a meter switched to 1A or so in place of the fuse and see what current is being drawn. If it's low (under 500mA), refit the tripler and repeat. If it's now over 500mA the tripler is suspect.

If there's no supply at all to F3, check at the left side of R15 (smoothing resistor), and if the supply is present there check at the other end as R15 may be open-circuit.

If there's no voltage to R15 at all, the thermistor TH2 at the lower part of the power panel is almost certainly decomposed and this is where we would in fact have looked in the first place!

It's possible however that this is intact and that a.c. is present at the body (anode) of the thyristor, but there's no d.c. on the cathode or gate leg. It then becomes necessary to check the BR100, the associated 0·22μF capacitors C7 and C8, the zener diode D2 and the resistors. The diac D3 (BR100) can be checked only by replacement.

The thyristor could be open-circuit, but this is less likely and is easily checked by connecting an ohmmeter as for a diode and then connecting the anode to the gate to turn the device on. If it can't be turned on in this way, the thyristor is defective. If it can be turned on this doesn't mean that it's beyond suspicion, merely that it's capable of functioning. The BC147 control transistor VT1 can be checked in the normal way.

All in all then, check that the resistors are what they say they are, that the capacitors have capacitance, and that the BZY88 zener diode D2 is in order – for test purposes it can be treated as an ordinary diode. Faults in the thyristor's control circuit are very unusual though. The most common causes of trouble are the BR100 trigger diac D3 and the BT106 thyristor TH1. Hold these in stock – even if only for "proof of innocence" checks.

Fault Patterns

Readers will by now have noticed that although the detail and the layout vary considerably the fault tracing procedure, and in indeed the fault patterns, on the Philips G8 chassis (see last month) and the Rank A823 chassis are similar. The probability of the h.t. surge limiter in the input to the thyristor going open-circuit for example. In the G8 it's the lower section of the large vertical power resistor. In the Rank chassis it's the VA1104 thermistor. Then in the Philips chassis the top section of the power resistor goes open-circuit. This is the h.t. smoothing resistor, and when it goes open-circuit the h.t. reservoir capacitor is left fully charged! In the Rank chassis the same thing happens with R15, but the reservoir capacitor C9 may or may not be left charged depending on whether it's shunted with a 47kΩ resistor.

The basic fault pattern is not confined to these two chassis. The GEC C2110 series for example uses a very similar circuit, though with a totally different layout of course. Once you've sorted out the layout however you should find little difficulty in servicing power packs using a thyristor.

TV Faults

Robin D. Smith

GEC C2110 Series

As I've mentioned before, the GEC C2110 series solid-state colour chassis is one of my favourites. One of the more common faults is flyback lines on the picture, often due simply to the c.r.t. first anode controls being set too high. Recently however we've had R507 (300kΩ, see Fig.1) go open-circuit to give the poor picture plus flyback lines symptom. We've also had problems with R701 (180kΩ, Fig. 1 again) which provides forward bias for the beam limiter diode D604. As it goes higher in value, the picture gets darker: if it goes open-circuit D604 switches off and there's no raster. The clue is the voltage at PL17-6: this should be 25V if R701 is in order.

We had an interesting fault recently on one of the later versions of this chassis – the one with the single-panel decoder. The symptom was a poor, smeary picture with flyback lines, most noticeable at low brightness levels. R507 was checked and quickly eliminated, and as the flyback blanking pulses were present we turned our attention to the RGB output stages. These are a little unusual, being of the complementary-symmetry type. The obvious thing to do first was to check voltages. These turned out to be slightly out, so we took a look at the circuit to see whether anything could be responsible for a voltage shift in all three stages. This revealed that the bases of the three pnp transistors are all returned to a bias network consisting of a 3·6V zener diode and an 82kΩ resistor (R258) – which turned out to be open-circuit (see Fig. 4, page 439). A 1W replacement completely cured the fault.

This decoder uses a TCA800 demodulator/matrixing i.c. which also provides clamping. The three 2·2μF capacitors C244/5/6 connected to pins 2, 4 and 6 comprise the clamp reservoirs. If one goes open-circuit you loose a colour: if the print linking the three to chassis goes open-circuit, all colours are lost.

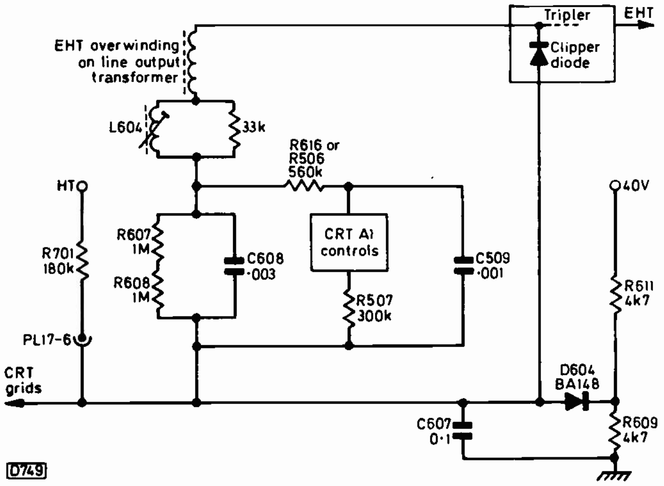


Fig. 1: CRT first anode supply and beam limiting circuits, GEC C2110 series. The factory preset L604 provides fifth harmonic tuning. Several resistors in this area can cause problems. R506/616 (depending on which board it's mounted on) going high in value reduces the brightness, as does R701 since the beam limiter then operates at a lower beam current level. R607/8 can fall in value quite dramatically, producing smoke and fuse blowing.

One of these sets came to grief when my family doctor decided to let his teenage daughter hold a party. During the course of this a pint of beer flooded the set – whilst it was on. The result was that it went off with a bang. For your interest, the outcome was as follows: 3·15A mains fuse shattered; BT106 thyristor short-circuit; clipper diode D703 short-circuit; control transistor TR701 (BC147) decomposed. After replacing these items the set was restored to life.

Another of these sets suffered a mishap, this time a result of the time honoured (?) habit of standing vases on TV sets. On this occasion the fusible resistor R411 (2·2kΩ) which supplies the line driver stage had gone open-circuit. Drying out and resoldering put this right.

Pye Hybrid Colour Receivers

We've had several Pye hybrid colour receivers in recently. The problem with the first was reported as "line hold drifting after five minutes". On removing the back I noticed that the valves were glowing rather too brightly, and on checking the heater rectifier diode D48 (BY126) this was found to be leaky. Replacement cured both the valve heater and line hold fault.

The complaint on the second one was field collapse for the first three minutes. A quick check showed that the −20V supply to PL10C on the field timebase panel was missing. So over to the line timebase/power supply panel, where a print break near the h.t. supply thermistor R305 was discovered. The heat from the thermistor had warped the panel, causing the break in the print.

The third set had rather more wrong with it. To start with, the line output valve had literally melted. We made the usual checks before fitting a replacement, and as everything seemed to be in order a new PL509 went in. The set worked satisfactorily, so we left it at that. A day later however the new PL509 heater had gone open-circuit, and this time we found that the line oscillator had stopped. Replacing the PCF802 line oscillator valve cured that, and we now knew why the original PL509 had melted – the oscillator had stopped and the customer hadn't switched the set off quickly enough. A day later the heater rectifier diode went open-circuit. Last, but not least, the CDA panel started arcing and smoking. Carving away charred print put things right, and hopefully the set will give a little longer service . . .

Intermittent White Raster

The customer's complaint about his Thorn colour set (3500 chassis) was an intermittent white raster. Checks revealed that the 400V clamp/brightness pulses were not present at plug 14/7 under the fault condition, though they were present at plug 20/3 on the line timebase board. A resistance check on the lead then proved that it was open-circuit, renewing the lead completely curing the fault.

ITT CVC20/CVC30 Series

Like many ITT dealers apparently, we've been experiencing sound problems (distortion and excessive sibilants) with the CVC20/CVC30 series chassis. The distortion can usually be removed by setting up the audio output stage quiescent current correctly. The procedure is as follows. Unsolder one end of service link W11 on the mother board, soldering an

0·1μF, low-voltage non-polarised capacitor in place of the link on the copper side of the board. Connect the Avo on the 10mA d.c. range (see note below) across the capacitor, taking care to get the polarity correct. Then adjust R407 on the audio output module for a reading of 7·5mA, ignoring any downward drift after making the adjustment. Remove the capacitor and resolder the link. Note that at switch on the surge will be greater than 10mA: I connect the meter switched to its 100mA range, quickly turning down to 10mA.

The sibilant problem is more involved, and depends on the particular version of the chassis.

On the CVC20, with the CMK10/2 i.f. module and CMA10 audio module, ensure that L312 (quadrature coil) in the i.f. strip is correctly adjusted, then check the audio output stage quiescent current. Change C332 in the i.f. module from 0·033μF to 0·068μF, and add an 0·068μF capacitor and 3·3kΩ resistor in series across R109 on the mother board.

On the CVC30 (CMK10/2 and CMA30 modules), check the quadrature coil and output stage quiescent current adjustments as above, check that C33 is 0·068μF and add an 0·1μF capacitor and 1·5kΩ resistor in series between pins J2 and J3 of the audio module.

On the CVC30 with SWAF i.f. module CMK30/1, check the quadrature coil and quiescent current setting as above and if possible replace the CMA30 module with the CMA30/1.

We've had some some success with these modifications, but still don't feel that the problem has been cured to our complete satisfaction.

We've had several cases lately where the tripler in the CVC25/30 chassis has failed, destroying the line output transformer and EW modulator driver transistor T13 at the same time. ITT have extended the guarantee on these items to two years, a move we welcome.

We had an awkward fault recently on a CVC30 – the 1kΩ fusible resistor R92 in the supply to the line driver transistor (T12, BF355) going open-circuit once a week. Being so intermittent, we can't say for sure whether we've cured the fault, but the set's holding up for the moment after fitting a new BF355.

Snowy Picture

The customer's complaint about her Rank set (T22 chassis) was a snowy picture – but only in the centre of the screen. We didn't believe this, but on visiting the customer saw what she was on about. A dozen or so dots or lines had dropped out. This was quite a common fault on early colour tubes – but this one was only three weeks old. Replacement was necessary of course, clearing the trouble.

Saga of a Sony

Malcolm Burrell

MY wife and I sat down one Sunday evening recently to view the first episode of a new TV series. As usual I'd depressed the set's on–off switch and the characteristic degaussing hum then rang through the cabinet, followed by the onslaught of sound and the surge of e.h.t. This had been the way things would go for some three years – since the little Sony KV1810U Mk II was new – and we'd no reason to loose faith in it now. The red gun had been showing signs of decay lately, but there was still plenty of life in the tube.

Just before the end of the episode I was awakened from my stupor by the sudden absence of line whistle (which I tend to sense rather than hear). Three coloured dots were fading away in the middle of the screen. These were followed within milliseconds by an internal hum denoting heavy loading. Then with a click the set went dead. A quick check revealed that one of the mains fuses (F601, 2·5A) had blown. Although the bridge rectifier diodes weren't likely to be responsible for the heavy current flow, I gave them a quick check. Alas, they were o.k.!

These are excellent little sets (despite mutterings from certain quarters about Japanese tubes having incorrect phosphors) so we've had few encounters with them. Perhaps then I can be forgiven for plunging in head first without making sure there was any water there.

False Steps

Anyway I decided to replace the 2·5A fuse with a 1·6A one, switch on and see what happened. Bang! I switched off quickly and when the smoke had cleared I noticed a spiral of foil where one of the h.t. smoothing capacitors (C623, 10μF) used to be. The fuse was still intact however. Hmmm. Maybe the capacitor had been the cause of the trouble in the first place. A suitable replacement, rated at 160V, was found and fitted, and again the set was switched on. Sizzling noises like frying eggs caused me to switch off quick.

This time the other smoothing capacitor C621 (see Fig. 1) was hot and the filter resistor R616 between the two capacitors had gone open-circuit. Time to get the meter out and of course the chopper Q603 – a gate-controlled switch, type SG613 – was short-circuit. I was too short-sighted however to consider that there might be a reason for this.

Some days later a replacement GCS arrived, under guarantee (Sony guarantee their semiconductor devices for five years but their tubes for only two – I wonder why?). The GCS was hastily fitted and the set switched on again. More sizzling, and we'd another dead GCS on our hands.

This time common sense prevailed and the line output device was checked. It's another GCS, of the same type, circuit reference Q510, and was short-circuit. We ordered a couple more GCSs and, while waiting for them to arrive, decided to study the power supply a little more carefully. For a full description, see the July 1977 issue of *Television* – "Developments in Switch-Mode Power Supplies" by E. Trundle.

Circuit Action

Briefly, the chopper GCS provides a 130V h.t. rail. A monostable circuit is used to provide a variable mark/space ratio drive waveform – in much the same way as in the Thorn 3000 chassis – the monostable circuit being triggered by pulses from the line oscillator. Should the line oscillator fail or the monostable stop however the h.t. is likely to shoot up. The line output GCS and probably the chopper GCS will then go short-circuit and the fuse will blow. Although there's an excess voltage protection circuit, the fact is that a GCS switch has to be turned both on *and off*. The excess

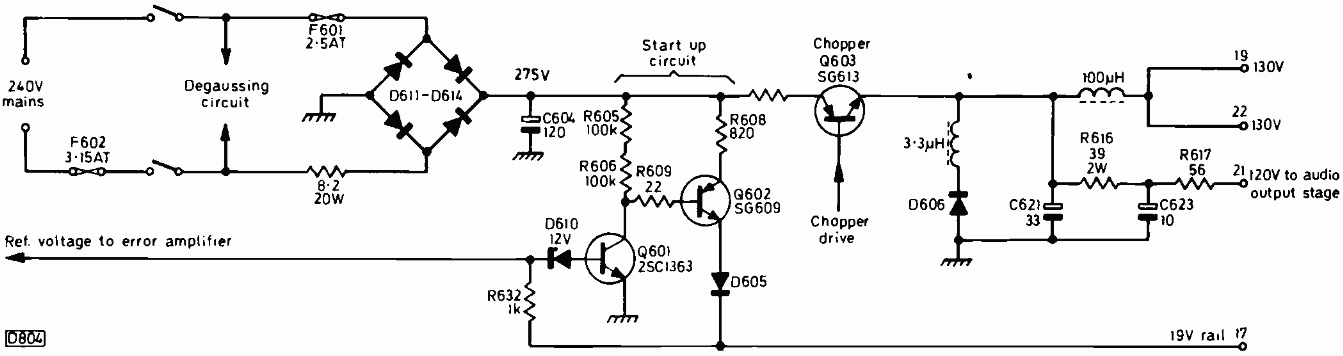


Fig. 1: Simplified circuit showing the mains input, chopper, start-up and h.t. filter circuits in the Sony Model KV1810UB Mk. II. Once the set starts up, the 19V supply is derived from the line output stage.

voltage circuit removes the trigger pulses from the monostable circuit, but may well leave the chopper on. . . .

The line oscillator is powered from a 19V supply derived from the line output stage. So a start-up circuit is required to get this, the monostable and rest of the chopper drive circuit going at switch on. This takes the form of a small GCS (Q602) which conducts for a short time following switch on, linking the 19V rail via an 820Ω resistor (R608) to the 275V output from the mains bridge rectifier.

Simulating a Variac

The safest way of tackling one of these sets when you've got the sort of trouble I had is to use a variac. This enables you to apply an input voltage of about 80V. You may, like me, not have one of these items. A solution could well be found in your junk box however.

I remembered once reading how someone had used part of a transformer primary winding as an autotransformer to replace an open-circuit dropper resistor. Perhaps the autotransformer used in the Thorn 900 and 950 monochrome chassis could be used in place of a variac? These transformers have a 150V tapping to supply the heater chain, but this voltage is still rather high. After experimenting with a couple of these transformers however I found it possible to get an output of 100V, just right for the purpose. The arrangement is shown in Fig. 2. Do note however that an autotransformer is not the same thing as an isolating transformer, so normal safety precautions must still be observed – the chassis is live!

Clearing the Faults

The new GCSs arrived and were fitted. Next the set was connected to our 100V mains supply. At switch on the degaussing circuit was heard to operate. Then nothing! A meter check showed that although the mains bridge rectifier

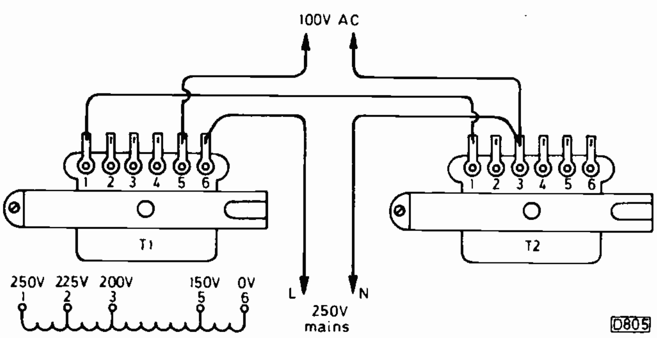


Fig. 2: Method of obtaining a 100V a.c. mains supply using two autotransformers from the Thorn 900/950 chassis. Note that the pinning of some transformers differs.

was providing an output there was no output from the chopper. A couple of PP9 batteries in series were connected to the 19V rail therefore. The current drain meant that there was only some 16·5V present, but this was sufficient for the line oscillator to start up and trigger the monostable. An output of about 80V was now obtained from the chopper, but there was no sound or raster. The temporary l.t. supply was removed and the chopper's output returned to zero. At least the line oscillator and the monostable were working.

Why wasn't the line output stage coming to life? The line output GCS was checked, then the driver and the pre-driver transistor. The driver transistor Q509 (2SC1475) had leakage between its base and emitter, but everything else was o.k. No 2SC1475 was to hand so we fitted a BD131 and switched on. Still no result. Apply the temporary l.t. supply and the set sprang to life. This time removing the batteries left the set working. Obviously the start-up circuit required investigation. Both Q602 and R608 were open-circuit. Send off again to Sony for replacements.

We still had the autotransformers connected, so we reconnected the batteries and switched on to take a look at the screen. Only a green line! Well the red and blue guns were slightly low and the tube heaters were being fed from the under-run line output stage, so the lack of red and blue wasn't surprising. Why no field scan? Both field output transistors Q503/4 short-circuit.

Eventually a new collection of semiconductors arrived – Q503/504/509/602 – and were fitted. On switching on the set immediately sprang to life, though the field scan was reduced and cramped at the centre. This was due to R553 (120Ω, 5W) which feeds the field output stage. It lives on a tagstrip on top of the chassis frame, and had gone high in value. Fitting a replacement restored the field scan to a better approximation of what it should have been.

Finally an aerial was connected to see whether a picture could be obtained with the reduced mains input. Pictures were present on some group A channels, only noise on the higher ones (we can receive signals from two transmitters here). The sound was barely audible, and there was no colour at all. The raster was fairly well resolved, slightly defocused, and of course of reduced size.

The moment of truth arrived when I decided to apply the full mains voltage. The meter was connected to pin 19 (h.t. output) on the power supply panel and as soon as the set began to function the h.t. was adjusted (VR601) to a little under 130V. The height, field linearity and vertical bias were then adjusted, the latter being checked by monitoring the voltage at the emitter of Q503 (should be 70V). At last normal results were obtained.

I hope that the morals of this story will enable others to avoid falling into similar traps, help promote logical fault-finding – and encourage regular reading of the magazine!■

VCR Colour Systems

Part 2

Steve Beeching, T.Eng. (C.E.I.)

LAST month we described the technique used in VHS VCRs to cancel the effects of chroma crosstalk between adjacent tape tracks. A similar approach to the problem is used in Sony Betamax VCRs, though there is quite a bit of difference in the details. Instead of a 90° phase shift at a single carrier frequency, two carrier frequencies are employed. The frequency for head A is $(44 - \frac{1}{8})$fh, or 685·54688kHz, while that for head B is $(44 + \frac{1}{8})$fh or 689·45312kHz. If the following equation is solved

$$\cos(\omega ct + \varphi) = \cos\left[(44 \pm \tfrac{1}{8})fht + \varphi\right]$$

two factors become clear. The first is that 685·5kHz (for short) has a clockwise phase rotation of −45° per line with respect to the line frequency (fh), and the second that 689·4kHz has an anticlockwise phase rotation of +45° with respect to fh.

Let's Have it in Words!

Clue time. This means that on every line the phase of the recorded chroma signal has been shifted by 90° for one head with respect to the other. So instead of holding one head's signal constant while shifting the phase of the other line by line as in the VHS system, Sony phase shift both signals with respect to each other in the opposite directions. This results in the same recording vectors we illustrated last month for the VHS system (Fig. 3). Thus in applying replay correction for either head, the crosstalk picked up from the other head's track will be in opposite phase every two lines, so that it can be cancelled using a two-line delay – as explained last month. You can work out a vector chart if you wish – it'll be the same as in Fig. 3.

In explaining how the Sony system works, we'll be considering two carrier frequencies rather than a single frequency with a stepped phase shift for one head.

Betamax Chroma Record System

The Sony Betamax chroma record system is shown in block diagram form in Fig. 7. The 4·43MHz chroma input signal is first filtered and gain controlled, then fed to the pilot burst adder. This inserts in the horizontal blanking period, just before the normal burst, a pilot burst of 4·43MHz carrier with a 90° phase shift – it's cleaned off the signal during the replay processing. The idea is to provide a replay reference of off-tape phase errors (Δf) that aren't swinging about (the phase errors we're considering here are those due to changes in tape speed and tape fluctuations).

The sync input provides the phase comparator with line sync pulses (fh) to phase lock the variable frequency oscillator (VXO). There are two counters in the phase lock loop, ÷351 (A) and ÷353 (B). The count selected is controlled by a 25Hz pulse from the head servo. As a result, the VXO oscillates at 5·484375MHz when head A is recording and 5·515625MHz when head B is recording. The VXO's output is then divided by 8 to give 685·546kHz and 689·453kHz. These two signals are then added to the 4·433619MHz carrier, which is phase locked to the input chroma signal, in balanced modulator 1. The output from balanced modulator 1 is then mixed with the 4·43MHz chroma signal in balanced modulator 2. After filtering, we get a 685·546kHz output for head A and a 689·453kHz output for head B.

I've not placed too much emphasis on the $44 \pm \frac{1}{8}$ business, but if you consider the period of one line as 360° then divide by 8 you get −45° and +45°.

Betamax Chroma Replay System

The Betamax replay system is shown in Fig. 8. As in the record mode, 685kHz and 689kHz (for short) reference carriers are provided by the divide by 8 counter. This time the sync pulses used to phase lock the VXO come from the replayed luminance signal. Frequency selection is again provided by a 25Hz PG signal from the head servo.

The replay chroma signal, at 685kHz and 689kHz, will contain Δf phase errors introduced by the tape transport system. The replay chroma carrier frequencies are restored to 4·43MHz in balanced modulator 2, but the output may still contain Δf errors. The signal is then passed through a filter, after which the pilot burst is gated out (with Δf) and fed to a phase comparator. This compares the pilot burst with the output from a free-running 4·43MHz oscillator. The resulting error signal, containing Δf, is modulated on to the output from the 4·43MHz VXO. As in the VHS system, the two 5·1MHz intermediate carriers fed to balanced

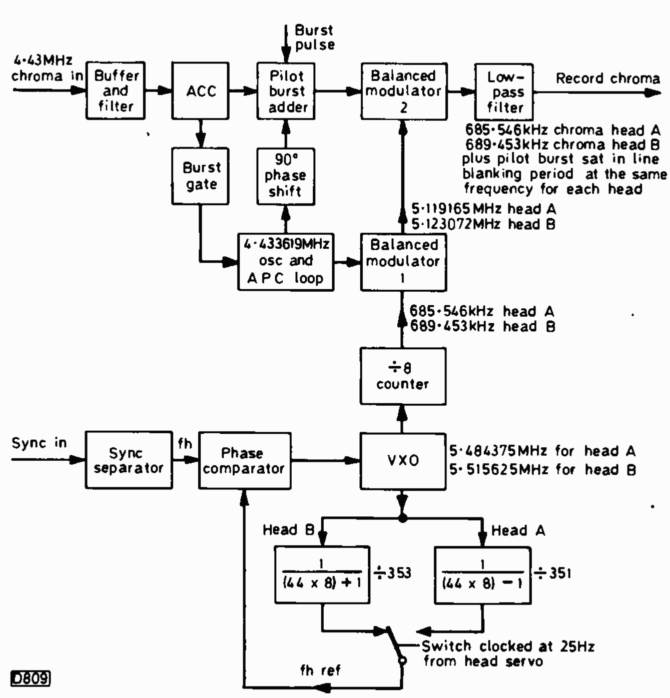


Fig. 7: Betamax chroma record system.

modulator 2 also contain Δf. In the subtraction mixing therefore Δf is cancelled.

The second pilot burst gate feeds the ident detector. This compares the pilot burst with the signal from the free-running 4·43MHz oscillator, phase shifted by 90°. If the pilot burst is correct, no problem. If it's 180° out of phase however the ident circuit inverts the 5·119MHz and 5·123MHz carriers.

These actions are similar to those carried out in the VHS machine.

Action of the Delay Line

The two-line delay system works as follows. Let's consider the case of a 4·433619MHz replay signal from head A. The direct and delayed carriers are in phase and thus add – see Fig. 9(a). If the 689·453kHz crosstalk is subtracted from the 5·119165MHz carrier the result is a 4·429712MHz signal. Delaying this signal by two lines and adding it to the direct signal produces complete cancellation – see Fig. 9(b). Let's consider this in a little more detail.

We mentioned last month in passing that a standard delay line introduces a 180° phase shift. This is because it's delay time is not exactly 64μsec, i.e. one line, but 63·943226μsec. Why? Well, the duration of one 4·433619MHz cycle is 0·2255493μsec. If we divide 64μsec by 0·2255493μsec the result is 283·75 cycles. For the adding and subtracting business to work, the odd quarter cycle must be avoided. So the delay line is given a duration of 63·943226μsec, i.e. 283·5 subcarrier cycles. If we now take a two-line delay, we must double this figure to give 127·88645μsec. 567 cycles of subcarrier are now passing through the delay line, which means that the output and input are in phase. So also are the output and the direct signal.

In the case of a 4·429712MHz crosstalk signal, 566·5 cycles pass through the delay line. The output is in opposite phase to the input therefore and cancellation takes place.

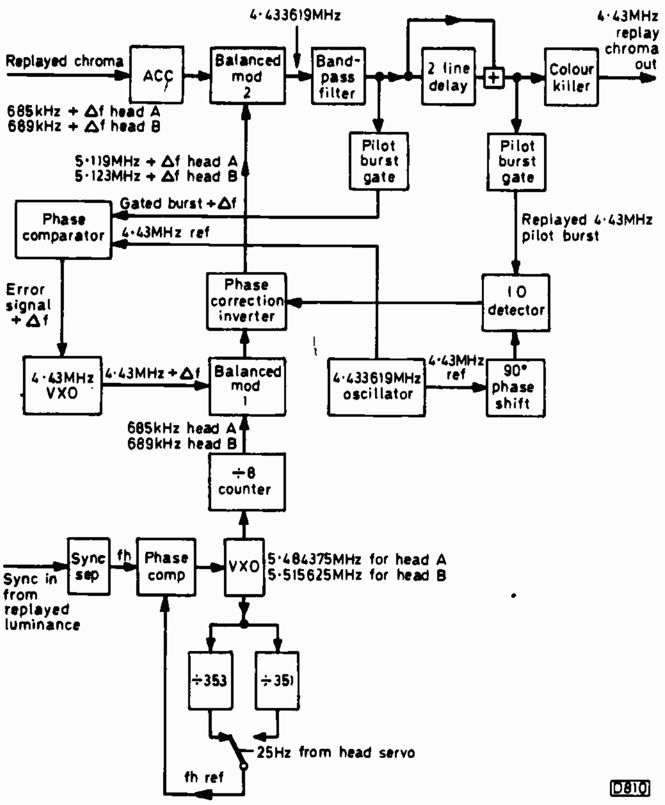


Fig. 8: Betamax chroma replay system.

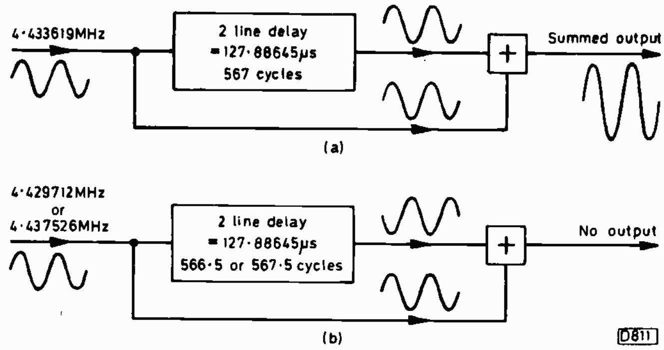


Fig. 9: Delay line system used in Sony Betamax machines. (a) Wanted chroma signals add. (b) Unwanted chroma crosstalk signals cancel. The head A replay intermediate frequency is 5·119165MHz, so the head B crosstalk is 5·119165 – 0·689453 = 4·429712MHz. The head B replay intermediate frequency is 5·123072MHz, the head A crosstalk being 5·123072 – 0·685546 = 4·437526MHz.

With a head B replay signal the intermediate carrier is 5·123072MHz and the head A crosstalk 5·123072 – 0·685546 = 4·437526MHz. Each cycle of this takes 0·2253507μsec, so there will be 567·5 cycles passing through the delay line. Again the output is in opposite phase to the input and cancellation occurs.

A Final Look at the VHS System

Let's finally return to the VHS system. Can this frequency shift way of looking at things be applied here? The answer is yes.

Referring back to Fig. 4 (VHS chroma record system block diagram), the sync locked carrier is 625kHz for head A. Now retarding the signal 90° per line is the same as losing a complete cycle every four lines. The line frequency is 15·625kHz, and dividing this by four gives us 3·906kHz. Consequently the head B frequency is 625 – 3·906 = 621·094kHz. Going through balanced modulator 1 then is 4·435571 + 0·621094 = 5·056664MHz, which is the head B intermediate frequency. From balanced modulator 2 we get 5·056664 – 4·433619 = 0·6230457, i.e. 623·0457kHz, which is the phase retarded head B recording frequency.

So on replay we have two carrier frequencies, the head A one at 626·952kHz and the head B one at 623·045kHz. We'll also have two intermediate frequencies, 5·060571MHz for head A and 5·056664MHz for head B.

For head A the subcarrier on replay is 5·060571 – 0·626952 = 4·433619MHz. The head B crosstalk is 5·060571 – 0·623045 = 4·437526MHz.

For head B the subcarrier on replay is 5·056664 – 0·623045 = 4·433619MHz. The head A crosstalk is 5·056664 – 0·626952 = 4·429712MHz.

This brings out the similarity between the two systems. Both produce the correct 4·433619MHz subcarrier for the two-line delay, and both produce 4·437526MHz and 4·429712MHz crosstalk frequencies.

Personally I think that the VHS system is easier to understand when considered in terms of frequency, as the sums come out right. When it's considered in terms of phase, as we did last month, the question arises as to how a phase advance of +90° per line is achieved on replay – there's no phase select reversal, nor could there be as a phase advance in this area would produce a higher intermediate carrier. In fact, as the sums show, the replay carrier at 5·056664MHz is still –90° per line. It's the balanced modulators that produce the outputs to provide the correction.■

Long-distance Television

Roger Bunney

MARCH has been extremely quiet and, judging by the lack of reception reports, this seems to have been the situation throughout Europe. The main activity reported was the excellent tropospheric opening during February 26/27th – just too late to be mentioned in my last column. This opening produced Band III and u.h.f. signals in the UK from central and eastern Europe. There has also been occasional F2 reception of African Band I signals. I've logged many US and Russian v.h.f. signals here, but unfortunately the frequency seldom rose above 40MHz. On a personal note, my new receiving system is now complete, and the revised preamplifier bay and receiver layout give easier tuning.

During the end-February tropospheric opening Hugh Cocks (East Sussex) received excellent and sustained ch. R12 and R33 signals from CST (Czechoslovakia), the latter signal being sufficiently strong to float over Crystal Palace. On the 27th he found that DFF (East German) signals were present on many channels during the daytime. Cyril Willis (Ely) reported very good West German signals. Farther to the south Ryn Muntjewerff received great numbers of CST signals at both v.h.f. and u.h.f. On the 24th he had good strength Swedish u.h.f. signals, also Polish ch. R12, R25 and R29 signals. Perhaps the most remarkable receptions he logged were SR (Sweden) ch. E25 (Hugelholm – 1·6kW) on the 24th and ORF–2 (Austria) ch. E24 (Klagenfurt) on the 27th. Andrew Tett (Surbiton) recently installed a Vorta DX4 stacked bowtie aerial: despite overloading from Crystal Palace, he logged several French, Belgian and Dutch stations and a large number of West German u.h.f. transmitters on the 27th.

On several days the F2 conditions allowed ch. E2 video to be received – Hugh logged Gwelo (Rhodesia) using the checkerboard pattern on the 8th and the 16th, with a mystery (suspected Ghana) ch. E2 signal on the same days.

Anthony Mann (Perth) reports great things in Australia! March 3rd produced China ch. R1 for the first time in three months, followed on the 7th by West Malaysia ch. E2. On the 8th he received chs. B1 and B2 (both vision and sound) and at Carnarvon (north of Perth) the signals were very strong. On the same afternoon an intense F2 opening produced signals including Magadan (USSR) – almost 1,000 miles north of Japan! Excellent F2 signals were again present on the 15th, with China ch. R1 (C1) and C2 plus an unusual visitor – Korea AFKN (American Forces TV) ch. A2 (525 lines).

NEWS ITEMS

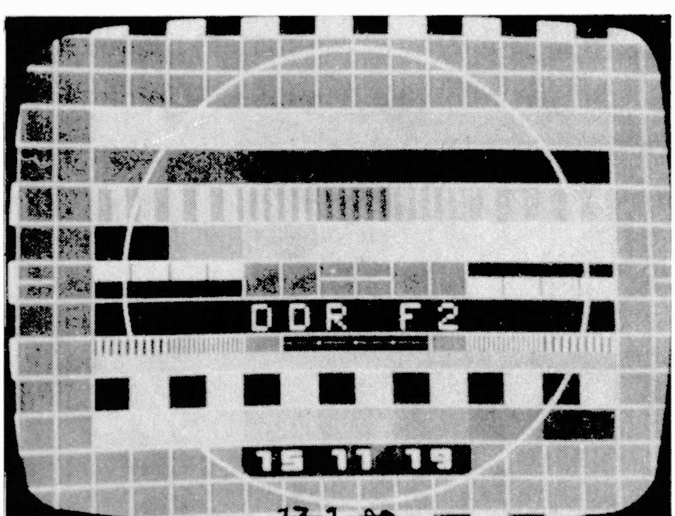
UK: It has now been announced that the 405-line v.h.f. service is to be phased out. Closure of transmitters will begin in 1982, and the network will be closed down over a period of about four years. Meanwhile a further u.h.f. relay station building programme has been approved. The last v.h.f. transmitters to be closed will be some of the high-power ones covering more remote areas.

China: Plans to set up a 12GHz distribution network are at an advanced stage. The system would employ several thousand low-power translators (suggested power 50W, mounted on 150ft. masts), each covering an area of up to 8km.

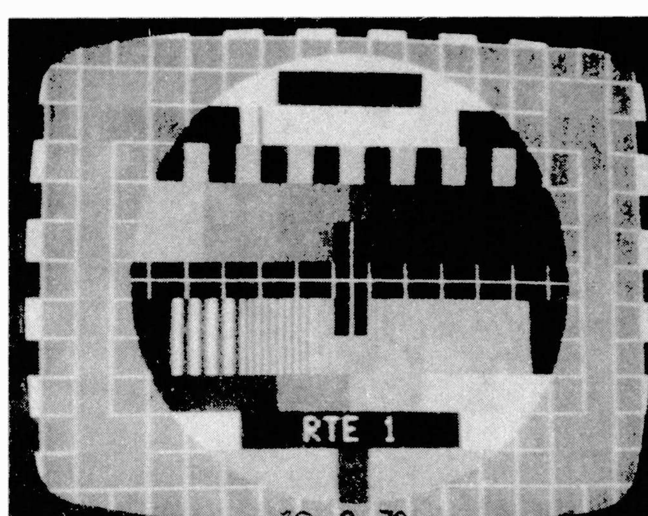
Sweden: Discussions on a nordic satellite service are continuing. The countries likely to participate in the proposed direct-to-home 12GHz service are Denmark, Norway, Sweden, Finland and Iceland. The Scandinavian broadcasting service would provide eleven radio and seven TV channels, and it's hoped to start operations in 1985.

DECIBELS!

A regular reader, Kim Plaskett (Luton), has written in about my comments on gain in the February issue (page 208). He writes "when dBs are being used to express the ratio between two signals, i.e. gain, so long as both signals are at the same impedance it doesn't matter whether voltage



The new DFF (East German) test pattern, photographed off-air (ch. E34) in Holland by Ryn Muntjewerff.



The RTE-1 PM5544 test pattern (Gort ch. B) received via SpE in Holland by Ryn Muntjewerff.

or power gain is being considered – the gain in dBs is the same. Each unit of 6dB corresponds to a voltage gain of two which is a power gain of four, 3dB corresponding to a voltage gain of $\sqrt{2}$ which is a power gain of two. An aerial with a voltage gain of two with respect to a half-wave dipole has a gain of 6dB (not 3dB as stated), corresponding to a power gain of four. Using units of 6dB and 20dB (a voltage gain of ten), it's possible to convert various quantities of dBs to a voltage ratio. For example, an aerial preamplifier with a gain of 26dB (20 + 6) has a voltage gain of $10 \times 2 = 20$. A length of coaxial cable with a loss of two dB – a 'gain' of −2dB (6 + 6 + 6 − 20) – has a voltage gain of $(2 \times 2 \times 2)/10$, or 0·8."

My thanks to Kim for writing to clarify the confusing world of the dB.

FROM OUR CORRESPONDENTS . . .

I've had a couple of letters during the past month on the subject of proposed aerial systems for DX–TV purposes – where problems have arisen with the local council. There seems to be a certain amount of confusion about the subject in planning departments. I'd stress that when applying for permission to erect aerials for DX purposes it's wise to state that the aerials to be used are standard domestic ones for reception in the normal TV bands. Too detailed a technical description may "frighten" planners and lead to the application being refused. I'd be grateful if anyone who's recently been refused permission would write to me.

John Cowan (Ayr) has recently returned from a visit to north west Africa. Unfortunately he suffered from food poisoning, but after loosing two stones in weight he's now restored to full health. Whilst in Morocco he was able to study Band I reception there in the absence of local Band I transmissions. Every evening between 1830–2230 (i.e. at sunset) there was Trans-Equatorial skip (TE) propagation, with ch. E2, 3 and 4 signals from Rhodesia, Nigeria and suspected Ghana. The video was poor but the sound clear. The NTV ch. E3 caption was seen clearly on several occasions however. The signals tended to suffer from the usual TE multiple image effects and smearing. F2 signals were completely lacking – they probably passed over him. He also confirms that the ch. E3 PM5544 pattern he received at the end of 1979 was from Amman, Jordan.

Robert Copeman (Australia) confirms that ATV ch. 0 closed down on February 13th, continuing only with the caption "please retune to ch. 10" which Hugh Cocks received on the 14th (see last month). Further information on the recent changes has come from Wenlock Burton (Melbourne). GLV ch. 10 moved to ch. 8, which has produced interference on Melbourne chs. 7 and 9. As a result, ch. 8 notch filters have had to be supplied. Some areas that received good ATV ch. 0 signals cannot obtain satisfactory reception on ch. 10. The cost of the ATV move to the new channel allocation is in excess of $A1 million – taking into account promotional expenses, new equipment and notch filters – apart from the cost of the new transmitter itself.

It strikes me that receivers for use in Melbourne must have fantastic selectivity to avoid adjacent channel interference, considering that signals are present on chs. 7, 8, 9 and 10. Another Melbourne channel which has been suffering from problems is ch. A2. It seems that there were widespread complaints of "dots" on the picture. This was eventually found to be due to the recent dry conditions (the Australian summer) – a type of dust had settled on power lines, the effect being worse near the coast due to the addition of salt. . . .

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a 75p postal order (made out to IPC Magazines Ltd.), the query coupon from page 451 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.

DECCA CTV19

I've been renovating one of these sets and am a bit puzzled about the setting of the purity magnets. To get a red centre patch the scan coils have to be pushed forwards, then to get a full red screen they have to be pulled backwards again. This is the opposite of what it says in the manual! The purity and convergence are quite good, but I've noticed that the purity magnets are cracked. VR508 on the convergence panel has had to be replaced twice as it burns out.

The idea of sliding the scan coils along the tube neck is to separate the deflection and colour centres so that accurate adjustment of the purity is possible. It doesn't matter therefore whether the coils are fully withdrawn or fully forward when the purity adjustment is carried out. If the purity rings are cracked they'll have to be replaced, but if the cracking is confined to the outer thumbgrips the performance will not be affected. The trouble with VR508 is probably due to tolerances in the convergence circuit. Try adding a 10Ω, 5W wirewound resistor in parallel with it.

PHILIPS 320 CHASSIS

There's a line sync fault on this set. The line scan has started to pull, as if the picture wants to break up. The trouble stopped after turning the line hold control a little, but has now started again.

The two components that cause this sort of thing are C2413 (820pF), which is in parallel with the line hold control, and the line oscillator chip IC2401. Since the capacitor is by far the cheaper item, try changing this first. Note that two slightly different chips (TBA720Q and TBA720AQ) were used, with minor but important associated circuit changes.

SABA CHASSIS H

The line output transformer on this set failed and was replaced. A month later R613 failed, and after another three months R614 failed. These resistors have been replaced and the set seems to be working normally. Have you any idea why they might have failed?

The two resistors mentioned are in series with the 270V h.t. supply to the thyristor line output stage. They do tend to fail intermittently, for a variety of reasons. The basic cause is misfiring of the thyristors. Excessive current is drawn, and the automatic switch-off circuit is not always quick enough to act, with the result that either R613 or R614 burns out rather violently. Check that the line oscillator can is earthed correctly – if there's no earthing strap, fit one from the can to the nearest chassis point. Check the large metal scan-correction capacitor (C686, 0·68μF) which can be intermittent – change it if the case is bulging. Also check the large blue tuning capacitor C681 (0·12μF), making sure that it's not dry-jointed where soldered to the board. This capacitor sometimes gets very hot and discoloured, with consequent intermittent operation. The two diodes and thyristors can also cause trouble. The only sure way of proving them is by replacement – there doesn't seem to be a reliable way of testing them out of circuit.

DECCA CS2203

The problem with this set is streaking across the screen, so that large areas appear misty. For example, if there's a light coloured object in the centre of the screen, with a dark background, a band the same width as the object and slightly darker than the background will be present to the right. There are also some vertical bars on the left-hand side of the screen.

The effect you describe is usually due to frequency response problems in the luminance output stage. Check the PL802 luminance output valve and the 4μF capacitor which decouples its screen grid (pins 6, 8). If this doesn't solve the problem check the value of the 2·7kΩ, 7W anode load resistor. If the striations on the left-hand side persist, check the 1·2kΩ, 2W line linearity coil damping resistor.

PHILIPS 170 CHASSIS

Ten minutes after switching the set on the brightness increases to maximum. The picture can be restored to normal by turning down the brightness control. Switching the set off then on again also restores normal brightness for a few minutes before the maximum brightness returns.

There are several possibilities to explain the sudden increase in brightness. If the voltage at the tube's cathode falls, the PFL200 video output valve could be at fault. If on the other hand the c.r.t.'s grid voltage rises, the VDR in series with the brightness control could be faulty. This can be checked by shorting out the VDR and resetting the brightness control. The other possibility is that the tube develops grid-cathode leakage, with the result that the grid voltage rises and the cathode voltage falls at the same time.

ITT CVC2 CHASSIS

The trouble with this set is pincushion distortion, greatest along the lower edge. Adjusting the linearity controls fails to provide any correction and I suspect the raster correction transductor.

First make sure that the 150Ω resistor Rh20 alongside the transductor is all right, and that the pincushion phase control Lh1 has some effect. If so, it's likely that the transductor is faulty – the part number is 1422/123/06085.

THORN 1500 CHASSIS

The problem is the presence of two bright lines, about two inches apart, superimposed on the raster. These lines have a tendency to drift either upwards or downwards. When moving upwards, the bottom of the picture flutters on each cycle. The picture is otherwise good.

This sounds like a hum problem, and the main suspects are C58 (330μF, 63V) and C56 (400μF, 40V) which smooth the l.t. supply obtained from the earthy end of the heater chain. They have a tendency to dry up. If these electrolytics are in order, the problem is likely to be in the h.t. supply. Try decoupling the various lines with a 100μF, 300V electrolytic.

PYE 67 CHASSIS

There's a brightness fault on this chassis. The controls are set at maximum, but the screen starts only half bright and goes really dark after half an hour.

The most likely cause of the trouble is a faulty component in the tube's first anode supply. Measure the voltage at pin 3 of the tube base, which should be over 600V (depending on the loading effect of the meter). If this voltage is absent or low, check the feed resistor R156A (4·7MΩ) and its decoupling capacitor C116A (0·047μF, 1kV). If the voltage is well up, check at pin 2 which should swing from 48V to 200V as the brightness control is advanced. Finally check the cathode voltage (pin 7) which should be less than 200V if the bias resistors R79 and R79A in the potential divider network are of the correct values (560kΩ and 220kΩ respectively). If however the width is lacking and varies when the brightness control is advanced, the trouble is in the line timebase/e.h.t. section.

THORN 1500 CHASSIS

When the set is switched on from cold there's a full picture. After a few minutes however the height starts to reduce, in jerks, until it's only about 4-5in. It can then flicker from any size to full, but after about two hours remains stable at 4-5 in. high. I've replaced the PCL805.

The prime suspects are the filter components in the feed from the boost rail to the height circuit. Check C89 (1μF, 350V) and R123 (330kΩ).

MURPHY V1400

The trouble with this 14in. portable appears to be in the field timebase. The picture is split into two halves, the top half being superimposed on the bottom half in the middle of the screen, with a gap at the top and bottom. The superimposition doesn't appear to be foldover, as both halves of the picture are the right way up.

The absence of foldover suggests that this is a field speed fault. Concentrate on the field oscillator stage therefore. It's a little unusual, consisting of a single transistor (TR22) with feedback from the field output transformer. Suspects are the two electrolytics in the circuit, C412 (470μF) and C408 (1μF), and the transistor itself (type 2SA539). The best check is by substitution.

THORN 3000 CHASSIS

The trouble with this set is that the cutout operates after about five minutes. Reset it and the same thing happens five minutes later.

This problem is often caused by leakage in the over-voltage crowbar thyristor W621 or its associated zener diode W617. If on the other hand the voltage at the h.t. fuse F603 creeps over 68V as the fault occurs, the suspects are the chopper transistor VT604, the error detector transistor VT608 or possibly C628 (in parallel with VT604).

RANK A823 CHASSIS

Once the set has warmed up the raster rises by about 1½in. at the bottom – there also seems to be some foldover. After a little while there's loss of field scan at the top as well, though with no foldover. We end up with a full width picture but with about 2in. missing at the bottom and top. I've replaced the field charging capacitors, the driver transistor and the scan coupling capacitor 7C5, also the bootstrap capacitor 5C34. The output stage bias stabilising thermistor seems to be in order, all the transistor voltages are normal, the h.t. supply to the timebase is correct and the scan coils don't seem to be dragging the voltage down. Another problem is that very occasionally the picture is reduced in size by about 1½ in. all round.

Apart from the items you mention, we've known the following components cause reduced field scan: the output transistors (despite the voltages being correct); 5C28 (5μF) which smooths the supply to the field oscillator stage; a defective scan balance (6RV2) or pincushion amplitude (6RV4) control; the diode (5D9) in series with the field output stage; and the field timebase supply reservoir capacitor (5C38). Note that the height control is fed from the h.t. line, so it may be necessary to check components in this area (5R45/5C32/5R44). For the intermittent picture shrinkage, we suggest you check the reference zener diode 8D2 in the power supply and the "set e.h.t." control 8RV1 which could be noisy.

PHILIPS G6 CHASSIS

The picture rolls up or down, depending on the position of the field hold control. The only way to stop the field rolling is to turn the brightness down to a level at which the picture is only just visible. The field timebase valves (all three) have been replaced.

Since the roll is affected by the brightness control setting, first check the PFL200 luminance output/sync separator valve and its associated components – the sync section's screen grid feed resistor R2122 (33kΩ) can increase in value while the luminance section's screen grid decoupler C2047 (12·5μF) can leak. Suspects in the field timebase are the multivibrator cross-coupling capacitors C4028/30 and R4092 (33kΩ), which is the anode load resistor of the first section of the multivibrator.

SABA F CHASSIS

There's a full-sized raster on this set, whitish pink with horizontal flyback lines, but no picture. Adjusting the contrast, brightness and colour controls over their full ranges makes no difference. Prior to this there was a tube heater fault which I managed to clear, restoring the heater voltage to normal.

Complete loss of luminance on these sets is often due to absence of the –20V line, since this provides emitter bias for the luminance preamplifier transistor T312 and also supplies the brightness control (via R637). This line, also the –30V rail, is derived from the mains transformer via rectifier GR606, which is the most likely suspect. The tubes used in these sets are not too reliable, tending to develop grid-cathode shorts in any of the three guns. A grid-cathode short in the red gun could possibly produce a brilliant pink raster, with the grey-scale control P343 overheating and maybe burnt out. If this proves to be the case, the tube will have to be replaced.

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TELEVISION JUNE 1980

DECCA 80 CHASSIS

The trouble with this push-button tuned set is tuning drift. Sometimes only the colour is lost, but at other times patterning and noise are present. When this happens, selecting either of the other channels also produces a detuned picture. The TBA550 voltage stabiliser i.c. has been changed and I find that tapping the control panel will bring the picture and sound back, but for only a few seconds. All connections and soldered joints seem to be good.

It seems likely that the tuner is faulty. We've known this to be the case when the trouble can be mechanically provoked and there are no dry-joints.

THORN 1590 CHASSIS

There are two faults on this portable. First, no field hold, with unstable line hold. Secondly, the sound and vision signals occasionally disappear. When this happens, touching the connections around the final i.f. transistor VT5 restores the signals.

The most likely cause of the sync fault is that the sync separator's base bias resistor R41 (3·3MΩ) has increased in value, but either of the sync transistors VT7 and VT8 could be defective. Another possibility is C36 (4·7μF) which smooths the video driver transistor's base bias. For the intermittent signals fault the suspects are VT5 itself and its 0·01μF emitter decoupling capacitor C29.

TEST CASE

210

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.

One of our customers, living in a small country town, had for many years rented from us a dual-standard monochrome set. He'd had a u.h.f. aerial erected soon after the start of the BBC-2 service and, since he was in a low-lying area, we'd had to instal a masthead amplifier and accompanying set-back power unit. This arrangement gave yeoman service for many years, but as the set got older its performance and reliability decreased. Eventually our customer decided to take the plunge and invest in a new colour set. His choice was a 20in. Decca set with push-button tuning – one fitted with the 88 chassis (the 20in. version of the 80 chassis).

The big day arrived and the installation man called to instal the new set. The results were disappointing however – the picture was grainy on ITV, very grainy on BBC-1, but worse than this were a pair of floating horizontal white bars on the ITV channel. These were present to a lesser degree on BBC-2, but barely visible on BBC-1. They were two or three scanning lines wide, and took several seconds to travel up or down the screen. They simultaneously slipped across the screen horizontally, taking less than a second to go from left to right or vice versa. Sometimes they almost disappeared.

The installation man booked a service call, and a field engineer called to investigate. Some sort of interference was initially suspected, but a Sony colour loan set displayed none of the offending lines. The Decca set was brought into the workshop therefore. On test the picture was perfect, free from grain and with no white bars: the symptoms had still not shown after a two day soak test. We decided therefore to take another new, boxed receiver of the same type to the customer, who was by now rather disgruntled. This time the service engineer called to deliver the set, but to everyone's dismay the symptoms were the same as before. The customer was anxious to have this particular model, so we decided to carry out a thorough investigation, consulting the manufacturers. Their suggestions regarding tuner decoupling, internal earthing arrangements and mains filtering were carried out, but still without improvement. As the interference effect seemed to drift over the screen at mains rate, further filtering in the mains input circuit was tried, again without any improvements.

By this time the senior technician had become involved. On his visit the effect of an attenuator in the aerial lead was tried. This stopped the interference effect at once, but the already grainy pictures were of course even worse. He eventually discovered the source of the trouble, and was able to eliminate the fault without recourse to an attenuator. He was also able to remedy the snowy BBC-1 and ITV pictures. Where was the source of the problem? See next month for the solution and another item in the series.

SOLUTION TO TEST CASE 209
– page 388 last month –

The trouble described last month was lack of height in a set fitted with the GEC hybrid colour chassis. You will remember that the height circuit feed resistor R526 was cooking, so excessive current must have been flowing through it, although no significant leakage to chassis could be detected. Since the resistor is fed from the boost rail however, its wattage rating would soon be exceeded by abnormal operating conditions – which might well not show up using an ordinary test meter. A voltage measurement made across the resistor however produced a reading not far below that of the boost voltage.

The only component in the circuit that hadn't been checked was the voltage dependent resistor VDR500, which forms a potential divider with R526 to regulate the supply to the height control. As a quick test VDR500 was disconnected. This immediately restored the height, the bottom compression vanishing at the same time. A replacement VDR completely cured the trouble, correct height plus good linearity being obtained on readjusting the field timebase controls. It's unusual for a VDR to fail, but it's something to bear in mind when confronted with symptoms of this kind.

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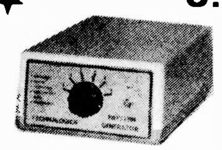

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★ **PG6RF OWNERS; Buy Add-On 'C6' Unit!**

In response to demand we have produced an add-on Colour Bar unit C6 to upgrade the PG6RF to PAL COLOUR. A MUST for TV construction or servicing! Available as a KIT or BUILT & TESTED. Kit includes all components and ready built modulator etc. Hundreds sold, reliable design.

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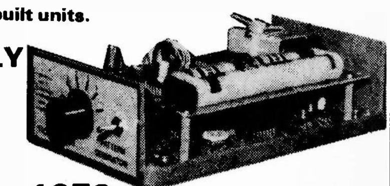

ORDER NOW!

PG6RF KIT £25.87 BUILT £33.35 – As per TV Review, Jan. 1979
C6 KIT £18.98 BUILT £26.45 – Add-on Colour to PG6RF
CPG6RF KIT £42.55 BUILT £63.25 – Both above combined.

These prices INCLUDE P & P and 15% VAT. Export VHF versions available.

ACCESS ORDERS WELCOME

PLEASE NOTE OUR NEW ADDRESS. ORDER FROM:—

TECHNALOGICS LIMITED (DEPT. TV)

WINDMILL WORKS, STATION ROAD,
SWINTON, MANCHESTER M27 2BU.

Manufacturers Surplus Components
FIT THE RIGHT PART

300 mixed ⅛ and ¼ watt resistors £1.50
150 mixed **1** and **2** watt resistors £1.50
300 mixed **Capacitors,** improved pack, most types £3.75
100 mixed **Electrolytics** £2.20
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100 mixed miniature Ceramic and Plate Caps £1.50
100 mixed polystyrene capacitors £2.20
25 mixed **Pots** and **Presets** £1.20
25 mixed **TV Presets** £1.00
20 assorted **TV VDRs** and **Thermistors** £1.20
10 assorted TV **Convergence Pots** £1.00
20 assorted **TV knobs,** includes push button, chrome, control types etc. Mostly Thorn and ITT £1.00
10 **assorted Valve Bases,** B9A, ceramic, EHT, etc. £1.00
20 assorted **Sync Diodes** blocks for various TVs £1.00
25 assorted **Pulse Caps** high voltage £1.25
10 **Spark Gaps** £1.00
20 assorted **Zener Diodes** 1 watt and 400MW £1.50
100 **Mixed Diodes,** includes zener, power, bridge, varicap, germanium, silicon etc. All full spec. £4.95

NEW
4·433 C.T.V. Crystals
Long Leads £1.00 each
3 for £2.50

Why Buy Expensive Triplers! Repair your old 5 and 3 sticks **at a Fraction of the Cost.**
10 Replacement Rectifier Sticks (Thorn). **£1.00**

Special TV Bargain Parcels

Lots of useful parts including damaged panels, tuners, components etc. 10lb for £7.50

Hardware Pack
Includes BA nuts and bolts, nylon, posidrive, self-tapping "P" clips, cable markers, clamps, fuse holders etc. **£1 per lb.**

THORN SURPLUS

3500 Series **Scan Coils,** new and boxed, complete with convergence yoke, purity assembly, static controls, leads and sockets £5.25
3500 Focus units with metrosil £1.50
3500 "625" line **VHF Kit** for wired systems £9.50
4 Knobs black with chrome caps to fit ITT, Thorn, GEC and most small diam. shafts **60p** per set
950 bottom panel complete with i.f.'s switch etc. £3.00
950 line transformer (not Jellypot) £2.50
Convergence Pots with knobs. 5Ω, 10Ω, 20Ω, 30Ω. 8 of 1 type £1.00. 8 of each £3.50

SAVE THAT TUBE.

Fit our **C.R.T. Isolating Transformer.** Ideal for HTR./Cath. Shorts. 200-220-240 inputs. 750-900 MA outputs with thermal cutout. Made for **Thorn 4000** C.T.V. but works O.K. on other sets.
£2.00 each 3 for £5.00

MISCELLANEOUS

Philips G8 Tube Base Panels Complete, but PCB's cracked, ok for spares. Focus, base, leads, plugs etc. 2 for £1
Bush CTV 25 Quadrupler Remo type Q25B. equiv. to ITT. TU25 3QK. with mounting brackets. **£4.25 each. 3 for £10**
GEC single standard, hybrid chassis. convergence panel. Brand new, complete with plugs and leads £2.50
Focus unit with lead, for above chassis £1.50
ITT Featherlight Super. Side Chassis, with controls, V. Cap Tuning Panel, Regulator, P/Button Switches, Bridge Rec. etc., etc. £3.50
I.C. for above £1.00

SPECIAL OFFER
GEC transistor rotary tuners with slow drive, AE Skt. and leads **2010** Series £1.50

KB VC3 VHF tuner with valves £1.50
KB VC3 transistor tuner "UHF" £1.50
ITT VC200 transistor tuner (Philips type) £1.50
ITT CVC5 power panel. New but five resistors never fitted £1.50
Pye mono mains droppers with fusible link.
147Ω + 260Ω 50p 3 for £1.00
69Ω+161Ω 50p 3 for £1.00

R2010B	**£1 each**

0·2" LED's
Red 10 for £1
Green or yellow 8 for £1

Portable TV EHT Sticks "Siemans TV 18 KV". Fit most portables 50p each 3 for £1.00
Pye 18" CT200 V. Cap P/B Assembly with leads and £3.90
G.E.C. S/S Hybrid Focus Assembly with lead £1.50
2 x **Coax Sockets** on plates suitable for various Continental T.V.s 50p

SHOPKEEPERS LOOK
Philips "Antistatic Disc1eaners" individually packed **RECORD CLEANERS** 10 for **£2.** 100 for **£15.** 1000 for **£100.** R.R.P. over 50p. Sample 50p inc. p.&p.

White Ceramic TV Resistors
20Ω 16W, 180Ω 11W, 13Ω 11W.
10 of any one type £1.20
10 of each type £3.00
2·2k fusible, vertical mounting **Screen Feed** resistors 9 watt 8 for £1.00
0·47Ω ½ watt emitter resistors 40 for £1.00
10μF 400V modern Small Type 8 for £1.00
47μF 63V 20 for £1.00
1000μF 16V 10 for £1.00
Bias Caps
330μF 25v 10 for £1.00
470μF 25V 10 for £1.00
4,500μF 35V cans 80p each
R.B.M. 100μF + 32μF + 32μF 300V 50p each

Avoid Lethal Shocks
Buy our specially designed **EHT Probe,** removes high voltage charges from tubes, caps, etc. Heavily insulated with lead and earth connector **60p** each
B9A P.C. valve bases 20 for £1.00
EY87/DY87 **EHT** bases 10 for £1.00
C.T.V. Tube bases 5 for £1.00
20mm Antisurge Fuses. 630Ma 800MA, 1A, 1·25A, 1 6A, 2A, 2 5A, 3·15A 12 for £1.00 100 for £7.00
TH1 thermistors 6 for £1.00
TH3 thermistors 10 for £1.50
Aluminium **Coax Plugs** 8 for £1.00
Metal Coax Couplers 6 for £1.00
200V 1A Diodes 10D2 (equivalent to 1N4003) 20 for £1.00
Miniature **"Terry" clips** ideal for screwdrivers and small tools etc. 40 for £1.00
Low profile 16 pin quill **I.C. Sockets** (to fit most "Q" series I.C.) 12 for £1.00

Sankyo 6V Cassette Motors with pulley and seperate electronic speed control module. **£2 each**

Rediffusion/Doric Mk 13 5 stick **Triplers** can be modified for other sets £1.00
Miniature Level/Batt. Meters as fitted to many cassette recorders 90p
Also:- **Miniature Mains Transformers** 4·5V-0-4·5V at 250Ma **90p each. 3 for £2.50**
Miniature **Reed Switches** 20 for **£1.20.** 100 for **£4.**

ULTRASONIC TRANSDUCERS

Transmitter and receiver. 40 kHz 14 mm diam. **£4.25 pair**

PUSHBUTTON KNOBS

Type 1 15mm long × 11mm diam. Brushed Aluminium Finish **10 for £1**
Type 2 10mm long × 10 mm diam. Chrome Finish **10 for £1**
Both types fit standard 3½mm square shafts as used on most music centres etc. **100 for £7** **1000 for £50**

STANDARD STEREO JACK PLUG
on 6 feet of 3 core lead **5 for £1**

BD131	**4 for £1**
BD132	**4 for £1**
BF181	**6 for £1**

ZENERS
400MW. 4·3V, 4·7, 6·8, 7·5, 30V 10 of one type 80p, 10 of each type £3.00
1·3W. 12V, 13V, 18V, 10 of one type £1.00, 10 of each type £2.50
DIACS BR100 6 for £1.00
STABILIZERS
TAA550 4 for £1.00
GEN. PURPOSE DIODES
IN4000 30 for £1.00 IN4003/10D2 20 for £1.00
IN4002 25 for £1.00 IN4148 20 for £1.00

SPECIAL SCOOP PURCHASE OF MULLARD CAPACITORS

Spillages, Floor Sweepings, Cosmetic Imperfects etc.
All mixed up. Factory clearance.

UNREPEATABLE OFFER

Polyester C280's (Liquorice Allsorts)
100 mixed £2. 1000 mixed £12
Miniature Electrolytics (Blue Type)
100 mixed £2. £1000 mixed £12

TRANSISTOR PACKS

Our Transistor Packs are even better than before! **100 NEW AND MARKED TRANSISTORS** including BC238, ME0412, BF274, BC148, BC182L, BC338 and, or other similar types. A random analysis of these packs yeilded between 98 and 106 transistors of 17 to 20 different types with an average total retail value of £14 – £16. **OUR PRICE ONLY £4.95**

200 transistors as above but including BD131, 2N3055, AC128, BFY50, BC154, BF394, BC184L, etc.
ONLY £9.95

BY476 (BY176) **18kV. 2·5Ma EHT REC** 60p each 3 for £1.50

De Luxe Fibre Glass Printed Circuit Etching kits
Includes 150 sq. ins. copper clad F/G. board. 1 lb ferric chloride 1 dalo etch resist pen. Abrasive cleaner. Etch tray plus instructions.
Special Price £4.95.
1 lb F.E. C1 To mil. spec. **£1.25**
5 lb FE. C1. To mil. spec. **£5.00**
150 sq. in. **Single sided** board **£2.00**
150 sq. in. **Double sided** board **£3.00**

500 Watt Dimmer Switch
Toroidal mains suppression, fused with satin aluminium knob, white.
ONLY £3.45.

Send **40p P. & P.** on all above items; send Cheque or P.O. with order to:–

SENTINEL SUPPLY
DEPT. TV
149a Brookmill Rd., Deptford, London SE8
(Mail Order address only. Callers by appointment)
Trade enquiries for quantity welcome.
Surplus stocks purchased for cash.

LEDCO THE PANEL PEOPLE ARE ON THE MOVE!

LONDON ELECTRONIC DEVELOPMENT CO. LTD.

To cope with the ever increasing demand for LEDCo products we are moving to larger premises. All orders and enquiries should now be addressed to:

LEDCo, 21 CLIFFORD ROAD, SOUTH NORWOOD, LONDON SE25 5JJ Tel. No. (New) 01-656 7014

NEW The highly successful and popular solid state CDA panel for the Pye hybrid colour receiver (691-693-697) is now available in kit form. All you require are basic tools and 2-3 hours spare time to build this professional panel which will improve the picture quality and reliability of your receiver. No special equipment or knowledge needed. We supply every component and detailed instructions **£16.95** complete

ALSO AVAILABLE READY BUILT

Solid State CDA Panel for Pye hybrid receiver	**£21.00**
Module 702 Audio (LP1162 equiv.) for Pye hybrid receiver	**£6.60**
Module 920 Detector for Philips 570 & Pye 713-715-735 etc	**£10.30**
Module 915 I.F. Filter/Gain for Philips 570 & Pye 713-715-735 etc	**£11.45**
Module 030 A.F.C. for Philips G8 series	**£6.50**

All prices include VAT and despatch by 1st class post. Cash with order. Quantity discounts and credit facilities available. Ask for details.

All **LEDCo** products are available to personal callers and also from many stockists and distributors.

LEDCo products are approved and used by most major TV rental and maintenance companies. We are the originators of all these advertised items and have no connection with any other companies making similar products. You want the best. Choose **LEDCo!**

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Every week, millions of advertisements appear in the press, on posters or in the cinema.

Most of them comply with the rules contained in the British Code of Advertising Practice and are legal, decent, honest and truthful.

But if you find one that, in your opinion, is wrong in some way, please write to us at the address below.

We'd like you to help us keep advertising up to standard.

The Advertising Standards Authority.

A.S.A. Ltd., Brook House, Torrington Place, London WC1E 7HN

WELLVIEW TUBES

THE QUALITY REBUILDERS

Exchange Mono

	our price	+VAT 15%	total price
CME 1601-1602	£9·30	£1·39	£10·69
A44/120WR	£9·30	£1·39	£10·69
A50/120WR	£9·30	£1·39	£10·69
AW59/23W	£11·00	£1·65	£12·65
A61/120WR	£11·00	£1·65	£12·65

NEW MONO TUBES
20" = £15.80 inc. VAT 24" = £17.20 inc. VAT

Exchange Colour

	our price	+VAT 15%	total price
A44/270X-271X	£27·00	£4·05	£31·05
A47/342X-343X	£27·00	£4·05	£31·05
A49/120X	£27·00	£4·05	£31·05
A51/110X	£27·00	£4·05	£31·05
A55/14X	£32·00	£4·80	£36·80
A56/120X	£32·00	£4·80	£36·80
A63/120X	£36·00	£5·40	£41·40
A66/120X	£36·00	£5·40	£41·40
A67/120X	£36·00	£5·40	£41·40
A67/200X	£36·00	£5·40	£41·40

18 month full guarantee (Established ten years).

Send cash or cheque together with old tube with your order.
Carriage=£4·50 including VAT

ALSO YOUR VALVE SUPPLIER NEW AND BOXED
(inclusive of VAT)

DY802=74p	ECC82=64p	EF183=78p
EF184=64p	PCC89=72p	PCF802=98p
PCL82=78p	PCL84=92p	PCL805=97p
PFL200=£1·15	PCL86=97p	PL504=£1·38
PL509=£2·82	PL519=£2·92	PY88=70p
PY800=70p		PY500A=£1·52

Postage and Packing 10p per valve. All orders over £10 Free of charge.

WELLVIEW TUBES LTD.,
Unit 7, KING ROAD,
CHARFLEET INDUSTRIAL ESTATE,
CANVEY ISLAND,
ESSEX
TELEPHONE CANVEY ISLAND 65372

BIRMINGHAM AND DISTRICT DEALERS/ENGINEERS

NEWS FLASH

HIGH VACUUM QUALITY REBUILT TELEVISION PICTURE TUBES

COMPETITIVE PRICES

CONTRACT TERMS AVAILABLE

2 YEAR GUARANTEE

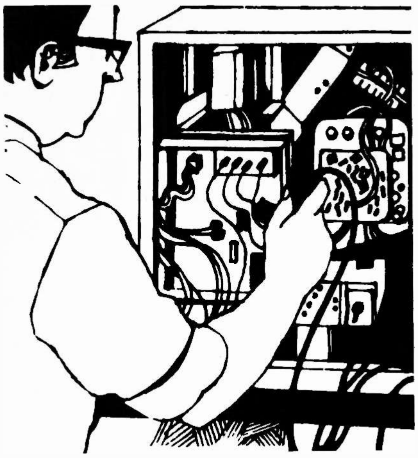
E.G.

17" 18" 19"	**£29.50 + VAT £4.43**
20"	**£32.50 + VAT £4.86**
22"	**£34.00 + VAT £5.10**
25"	**£37.00 + VAT £5.55**
26"	**£40.00 + VAT £6.00**

PIL Tubes our speciality.
All Prices For Tubes available on a Sound "Glass for Glass" basis otherwise **£20** surcharge

Build up to a standard not down to a price.

TUBESURE LTD.
Unit 111, Middlemore Industrial Estate,
Middlemore Road, Smethwick,
West Midlands. Telephone: 021-558 7777.



SETS & COMPONENTS

SMALL ADS

The prepaid rate for classified advertisements is 21p per word (minimum 12 words), box number 60p extra. Semi-display setting £4.00 per single column centimetre (minimum 2·5 cms). All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Television, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5846).

NOTICE TO READERS

Whilst prices of goods shown in classified advertisements are correct at the time of closing for press, readers are advised to check with the advertiser to check both prices and availability of goods before ordering from non-current issues of the magazine.

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Rebuilt with new electron gun, to British Standard. High temperature pumping.

Here is what you pay.		VAT
17-18-19 inch	£29	4.35
20 inch	£30	4.50
22 inch	£31	4.65
25 inch	£34	5.10
26 inch	£35	5.25

Guarantee 2 years.
Exchange basis.

CALLERS ONLY

TELESTAR TUBES
575c Moseley Road, Birmingham B12 9BS.
Tel: 021-440 5712.

DXTV. Band I sound and vision notch filters **£17.90** inc. post. Band I/II Mosfet aerial preamplifier (tuneable). Ideal in local overload areas, **£28** inc. post. SAE data. H. Cocks, Bre Cottage, Staplecross, Robertsbridge, Sussex. Tel: 058083-317.

TV PATTERN GENERATOR

UHF output, plugs straight into aerial socket, 5 patterns, battery powered, size 3¼"×3"×1½".

£17.45 including VAT
Please add 30p towards P&P.

Measurement of capacitance with a multimeter is made possible with our NEW ADD ON UNIT. Send S.A.E. for details.

C. L. JERVIS
15 Mercer Grove,
Wolverhampton WV11 3AN

DECCA 18" CS1830 CTVs with Varicap Tuning 100 sets available at £86·25 each. (Price includes VAT.) Quantity discounts and delivery by arrangement. All sets tested and working. J. M. Pearson Trade TVs, 123 Sandy Lane, Middlestown, Wakefield. Phone 0924 260615. Overseas Orders Welcome.

PYE HYBRID SPARES!

COMPARE THESE PRICES:

CDA panels	£3.95
Frame T/B	£2.95
Tuner (697)	£2.95
Push/B unit	£2.95
Control Panel	£2.95
Focus Rod	£1.95
CRT base	£1.95
IF panel	£4.50
Convergence	£4.95
Decoder	£5.95
Convergence Yoke	£2.95
Speaker	£2.95

Please specify model number, and give full information when ordering.
Prices include postage and VAT **EXCEPT** orders under £10 please add 75p postage per order. All tested and working.

CASTLEGATE TV,
64 Castlegate,
Grantham, Lincs.
Tel: 0476 66869.

BUSH CTVS FOR SALE

Over 1000 Colour and Mono TVs for disposal
Many working ★ All complete
Good cabinets ★ All screen sizes
Large or small quantities sold.
Regular supplies available.
Deliveries arranged if necessary.
Also many other makes in stock.

TV WHOLESALE SUPPLIES LTD.
35 Shipton Road, Stratford-on-Avon.
Tel: 0789-4424.
Open 9.30 till 7.00 6 days a week.

RE-BUILT COLOUR TUBES

19" £29.50, 20" £29.50, 22", 25", 26" £30, one year guarantee.

Colour TV's from £55 per week.

MATRIX TV LTD.,
112 Essex Road, London N1. Tel: 226 1111

PHILIPS G6 tuners **£5.50.** 100 mixed components £2.50. Lists SAE. Sole, 37 Stanley Street, Ormskirk, Lancs. L39 2DH.

MAINS DROPPERS AND CAN CONDENSERS

Philips G8 47Ω	43p
Philips G8 2·2-68Ω	63p
Philips 210 118-148-LoopΩ	63p
Philips 210 30-125-2K85Ω	74p
Philips GT23 6-124-84Ω	74p
Thorn 3500	75p
Thorn 1500 350-20-148-1500-317Ω	90p
Thorn 1400	85p
Thorn 8000 56-1K-47-12Ω	90p
Pye 725 27-56Ω	65p
R.B.M. TV161 250-14-156Ω	72p
GEC 2010 8-15-17-70-63-188Ω	95p

2010 Covers 2013 2014 2017 & Sobell 1010 10A 13 & 1014
Bush TV165-166 171-175-176-178 72p
Murphy V1910-1913-1914-2014-2310-2311-2312 2314 72p
Bush A823 68-56Ω 90p

1V Condensers:	200 + 200 ± 100 mfd 300V	75p each
	150–100–100–100–150M 325V	£2.00
	150–150–100M 300V	£1.60
	175M 400V 100–100M 350V	£1.70

All Can Cond — 2 or more Droppers LESS 10%.

2500–2500m 30V	80p	100–300–100–16m 300V	
1000m 63V	63p		£1.00

S.S. C.D.A. Panel for Pye-Ekco-Invicta Dynatron Chassis 691-2-3 & 697 £18.70.

Post Free, Cash with order, VAT paid.

Durham Supplies
367 Kensington Street, Bradford 8, West Yorkshire

TV TUBE REBUILDING

Faircrest Engineering Ltd., manufacture a comprehensive range of equipment for processing all types of picture tubes, colour and mono. Standard or custom built units for established or new businesses. We export world-wide and have an excellent spares service backed by a strong technical team.

Full training courses are individually tailored to customers requirements.

For full details of our service contact Neil Jupp

FAIRCREST ENGINEERING LTD.

Willis Road, Croydon CR0 2XX
Tel: 01-689 8741 01-684 1422/3

TELESCREEN WHOLESALE LTD BRISTOL AND NORTHERN IRELAND

Due to a New Policy in purchasing we are able to OFFER most makes of Colour & Mono at Lower Prices than ever before.
We can supply any quantity, nothing too big or too small. *Trade only.*

BRISTOL
Unit 3 Whitby Road,
Brislington,
Bristol.
Phone 0272 712569

NORTHERN IRELAND
Bellanaleck
Co' Fermanagh,
Northern Ireland.
Phone Florencecourt 388

EDUCATIONAL

BETTER JOB!
BETTER PAY!

GET QUALIFIED WITH ICS IN:

COLOUR & MONO TV SERVICING
COLOUR & MONO TV ENGINEERING
COLOUR & MONO TV MAINTENANCE

PLUS: Telecommunications, radio, electronics, electrical engineering, technical communications, radio communications, etc., etc.,

NEW: Self-build radio courses with free kits

Train in your own home, in your own time with ICS, the world's most experienced home study college.

RETURN THIS COUPON TODAY FOR FREE BROCHURE!

ICS Int. Correspondence Schools
V284 Intertext House, Stewarts Rd.
London SW8 4JJ. Tel: 01-622 9911

Name ....

Address...

....

TELEVISION & VIDEO SYSTEMS SERVICING

18 MONTHS full-time Diploma course to include a high percentage of practical work.

- ELECTRONIC PRINCIPLES
- MONO & COLOUR TELEVISION
- CLOSED CIRCUIT TELEVISION
- VIDEO CASSETTE RECORDING
- DIGITAL TECHNIQUES & TELETEXT
- COMPUTERS & MICROPROCESSORS

Shortened courses for applicants with suitable electronics background.

Next session starts September 15th.

(Also available $2\frac{1}{2}$ year course in Marine Electronics & Radar for employment as ships Radio Officer.)

Prospectus from:

LONDON ELECTRONICS COLLEGE

Dept: TT6, 20 Penywern Road, London SW5 9SU. Tel: 01-373 8721.

MISCELLANEOUS

RIGONDA AGENTS. For all spares and repairs. Fast despatch trade service available. 01-476 1928. Star Radio, 272 Barking Road, London, E13.

BURGLAR ALARM EQUIPMENT. Latest Discount catalogue out now. Phone C.W.A.S. Alarm. 0274 682674.

SECOND HAND PHILIPS N1500/01 VCR's and Spares Available. Videorecorder Service and Technical consultancy. B & B Electronics, Newark 76895. Call Steve Beeching.

DESPERATE FOR ADVICE in servicing your TV? We have hundreds of case histories on our files. Give full details of the fault and the model/chassis concerned. Send 50p plus S.A.E. to Dennis Electrical Services, 38 Harrow Road, West Bridgford, Nottingham NG2 7DU.

IN-CIRCUIT Transistor Tester. Also Test Out of Circuit Transistors, FETs, UJTs, Thyristors, Diodes. £10 or SAE for TV2 list. Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

MANCHESTER PHILIPS 1500 Video's converted to 3 Hours Long Play **£99.** inc. New Heads. 061 7990854.

PROTOTYPE? Can you build circuitry to generate Three-Dimensional TV Pictures. Ring 660-6279 to talk about the plans.

NOTICE TO READERS

When replying to Classified Advertisements please ensure:

(A) That you have clearly stated your requirements.
(B) That you have enclosed the right remittance.
(C) That your name and address is written in block capitals, and
(D) That your letter is correctly addressed to the advertiser.

This will assist advertisers in processing and despatching orders with the minimum of delay.

WANTED

NEW VALVES and CRT's required, PCL805, PL504, PL509, PY500A etc. Cash waiting. Bearman, 6/8 Potters Road, New Barnet, Herts. Tel: 01-449 1934/5.

JAPANESE TV manuals and sheets required any quantity, write Mason, 15 Alton Ride, Blackwater, Camberley, Surrey.

COLLECTOR SEEKING BAIRD Mechanical T.V. Wireless Sets Pre 1930 good cash offers. Torquay 62338.

WANTED MAINS Transformer No. 295089 for Solartron CD1014-3 scope. Reasonable price. Tel: Brooke 50648.

REPAIRS

HOME REPAIRS, Free estimates North/East London, private TV Engineer 01-729 1028.

VETERAN AND VINTAGE

"SOUNDS VINTAGE"

The only magazine for all vintage sound enthusiasts, packed with articles by top writers, covering gramophones, phonographs, 78s, wireless, news, history, reviews, etc.
Bi-monthly. Annual subscription £6.00 (airmail extra). Send 75p for sample copy.
28 Chestwood Close, Billericay, Essex.

ORDER FORM PLEASE WRITE IN BLOCK CAPITALS

Please insert the advertisement below in the next available issue of Television for .... insertions. I enclose Cheque/P.O. for £ ....
(Cheques and Postal Orders should be crossed Lloyds Bank Ltd and made payable to Television)

NAME...

ADDRESS ....

....

Send to: Classified Advertisement Manager,
TELEVISION,
GMG, Classified Advertisement Dept., Rm. 2337, King's Reach Tower, Stamford Street, London SE1 9LS. Telephone 01-261 5846.
Rate
21p per word, minimum 12 word, Box No. **60p** extra.

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

Co.ax Plugs 12p
BU124 Portable T/V Line Scan Trans. 50p
UHF Aerial Socket and Leads PYE, ITT & THORN 35p
BD386 30p
DE Solder Pumps £4.00
NEW VHF/UHF on panel ELC2060 £4.50
Philips T/Units UHF New £2.00
New Circuit Supplied UHF 8 C.H. Light action unit 4 I/C for V/cap tuning G.E.C. C2001/C2201 £5.00
VHF Varicap Units NSF AEG removed from Print Panels £1.00 New 49.00 21.900MHz
ELC 1043/05 V/cap £5.00
4 Push Button T/Units UHF MULLARD £2.00
AE Isolating Sockets UHF & Lead PYE & THORN ITT 35p
Transistor UHF Units with AE Socket and Leads GEC 2000 Rotary type NEW £2.00
7 button Varicap tuning heads Variable Resistor with Fascia Plate 7 Lamps G.E.C. £3.00
PYE 6 push button unit for Varicap Tuning with Pot £2.50
6 Push Button VHF/UHF units for V/cap £2.50
New N.S.F. UHF/VHF V/cap units £3.50
G.E.C. 6 Push Button UHF for V/cap tuning £2.50
200 + 200 + 150 + 50 300V 75p
4 push button unit (for Varicap Tuning) 20K New 50p
DECCA Bradford Tuner 5 Button New (4 push) £2.75
BB 105 UHF BA182 5p each
BB 103 VHF Varicap diodes
BTY80 20p
3 amp Diodes 300V 10p
3 amp Diodes 100V 7p
1 amp Bridges 100V 20p
1 amp 400V 20p
3 amp Bridge 25p
W005M Bridge 15p
194-N30 Replacement for BU204 50p
121-1015 Replacement for BU208A £1.00
1 LBs Mixed Components £1.50

300 Mixed condensers £1.50
300 Mixed resistors £1.50
30 Pre-Sets £0.50
100 W/W Resistors £1.50
40 Mixed Pots £1.50
20 Slider Pots £1.50
10 Different Types

Mixed Electrolytics 150 £2.00
ITT Mains on/off switches Push-button 25p
DP Push Button Switch ON/OFF 10p
Mains ON/OFF Push Button T/V 20p
Mains ON/OFF Rotary T/V 12½p
Main Dropper THORN 6R+1R+100R 35p
Mains Droppers 69R+161 PYE 40p
AD 161 AD 162 Pair 60p
147+260 PYE 40p
(731) 3R+56R+27R 50p
100 Mixed Diodes £1.00
Mixed Bulbs (15) 45p
RCA 16572
RCA 16573
O/P Trans Pair 40p
ZTK 33B 6p
5×3 Speaker 80R or 50R 50p
G9 Seakers 70R £1.00
BF355 300V 30p
BD 681 25p
BD 228 25p
BD 207 30p

For V/Cap 7 Push button unit VHF/UHF £3.00
Hitachi 12" tubes new A31/300W £12.00
3 amp Diodes approx. 1,200 volts 7p
BY204/4 6p
BY296 10p BY299 10p
BY206 7p BY127 10p
MR501 3 amps/100V 7p
MR508 3 amps/800V 12p
IN4006 5p
IN4007 5p
BY210/400 5p
BY210/800 10p
BY176 50p
BY133 8p
BA159 7p
BY184 25p
BY187/01 (EHT Diode 11.5KV 2 M/A) 10p
TV 20 50p
TV 18 EHT 40p
Rectifiers Sticks & lead & Anode Cap
BYF3214 20KV Rectifier Sticks (TV20 Type) 25p each
BYF3123 18KV Wire ends 25p
BA 248 6p
BSS 68 20p
BYX55/350 10p
BT106 S/Type 50p
BT 106 95p
BT 116 95p
BT 119 95p
BT 109 70p
BT 146/750V MULLARD THYRISTOR 25p
Thyristors 8A/800V 2N6399A 30p
Thyristors 7A/400V 52600D 30p
Y827 Diodes 30p
Bridge Rec B30C 600A6 12p
B30C 500 12p

BC147C	2N3566
BC148B	BF198
BC149C	BF274
BC195	BSY79
BC108	BC327
BC107	BC213LA
BF594	BC212LT
BC158	BF195
2N2222	BC182L
2N390	BF594
2N4355	BC183
T1591	BC238A
2SK30A	BC454
BC455	BC559
BC337	7p each

TIS90 15p
200+200+100 325V 70p
BY 127 10p
1N4005 4p
New Circuit Supplied G.E.C. VHF/UHF 8 C.H. Tuch. Tune Units 4 I/C 1 SN29862N. 2 CBF16848N 1 SN16861NG £5.00
100 mixed 20mm Fuses £2.00
210PF/8KV 10p
330PF/8KV 10p
4.7NF5KV 10p
6200PF/2000V 10p
180PF/6KV 10p
1000PF/10KV 10p
1000PF/12KV 10p
1200PF/12KV 10p
270PF/8KV 10p
160PF/8KV 10p
5 Diodes I.T.T. Earth Input Focus D.P. 25KV Tripler & Anode Cap £2.00 New (Silicon Diodes)
G2100 GEC Tripler TVM25 £2.00
THORN 3500
THORN 8500 Focus Unit
DECCA Focus Unit (Large or small) £1.00 each
4 Push Button Units 1400-1500 THORN £3.50
Used in G.E.C. T/V small neon lamps NE-2B6H-2 3p
TCE527 20p
TCE340 20p

TIP 31B 20p
BU204 50p
BU105 50p
BU137T £1.00
Thorn V/cap with AE Lead T/units 1043/05 £4.00
BD253/B 35p
BD124 £1.50
BU105/04 £1.00
AU 113 £1.00
BU 205 £1.00
BU 108 £1.00
BU 208 £1.00
BU 500 £1.00
BU 126 £1.00
R2008B £1.00
R2010B £1.00
BU208/02 £1.00
BU208A £1.00
EHT Rectifier BY212 10p
3 OFF G770/HU37 EHT 10p
12KV 2 M/A Small EHT RECS 20p
12KV 2 M/A Large EHT RECS 30p
EHT REC USED IN THORN 1400.1500 Triplers (×80/150) 10p
CSD 118×MH Rec THORN 3500 10p
220M/450V THORN 50p
700M/250V THORN 35p
175+100+100 350V 3500 THORN £1.50
400+400.350V DECCA 80p
470+470.250V 40p
100+200 325V 40p
200+200+100+32 350V 70p
150+200+200.300V 70p
200+200+100 325V 60p
731 PYE 600/300V & BUSH 75p each
200+200 350V 60p
400M 400V 40p
400M 350V 50p
800M 250V 30p
AE Power supplys 15V £1.00

BF 127	BC 303
BF 264	BRC 2108
BF 180	BC 336
BF 181	BF 157
BF 182	BC 161
BC 300	BC 460
AC 128	BC 350
BC 350	E1222
BF 178	BSY95A
BF 257	BFT 43
BF 137	with heat sink
BF 185	TIP 29A
BF 200	TIP 32
AC 153K	20p each

GEC Sound O.P. Panel I.C. O.P. £2.50
AC 176K
AC 153K Pair 40p

TBA 520 £1.00
TCA830S £1.00
TCE527 20p
TCE340 20p
TCE157 20p
Y716 20p
SN76226 50p
BD253 £1.00
BY190 50p
PUA758PC £1.00
MC1349P 50p
TCEP100 £1.00
TCE120CQ £1.00
TBA 625 £1.00
TBA 550Q £1.50
TBA 540 £1.00
TBA 5400 £1.00
TBA 530Q £1.00
TBA 990 £1.00
SBA 550B £1.50
SN76003 No Heat Sink £1.00
SN 76003N £1.75
SN 76023N £1.50
SN 76033 £1.50
TBA 800 60p
TBA 810S £1.00
TCA 270 £1.00
TCA 270Q £1.00
CA 270 75p
TBA 720A £1.50
TBA 510Q £1.50
SN76115N 50p
TAA 700 £2.00
TAA 570 £1.50
TBA 396 £1.00
SAS 570S £1.50
SN76666 £1.00
SN76660 50p
SN76227 50p
SN76544N 75p
TBA641BX1 £1.50
CA920 AW £1.00
TBA 750 £1.00
TAA 550 20p
SN76131N 50p
SN76001 £1.00
TBA560CQ £1.00
SN76530P 50p
SN76650N 50p
TDA1170 85p
TBA 651 75p
BTT822 £1.50
BTT8224 £1.50
6MHz Filters 25p
Bush Rank 6 push button unit for V/cap £2.50

1000+2000m/35V 25p
BU 204 50p
Bush Rank 6 push button unit for V/cap £2.50
Triplers THORN 3000-3500 9000 £5.00 each
3 amp 1¼ Fuses 2p
Long Wires 300 Mixed Carbon Film Resistors 5 of each type ¼ Watt IR to 2 Meg – ITT £1.50
Red & Green L.E.D.s mixed large and small 14 for £1.00
Convergence Panel for GEC 2040 11 pots 5 coils 2-Resistors E.T.C. New £1.50
(Reject Varicap Units) ELC1042/ELC1043 50p
ELC2000 £1.00
10 Watt LP1173 £1.00
IF LP1170 50p
AM/FM T/Unit 50p (Seconds)
AT1025/08 Blue Lateral 15p
Tip P31 A/B 20p
10 Watt Mullard Amps New £2.00
Triplers TS25 11TDT THORN £2.50
Triplers TS2511TBQ PYE £1.50
LP1174/NC ITT £3.00
GRUNDIG 3000/3010 SIEMENS TVK52 Triplers £3.00
MJE 1661 25p
XTALS T/V 4.433.610KHz 50p
BYX 38/600R 50p
BT138 Triacs 10a/600V 65p
RCA40506 Thyristors 50p
MJE 2955/15A 50p
TIP 41A-42 pair 40p
G11 Philips Thyristors 60p
PYE Thyristors 85p
2N4444-0T112 BT116
SP8385 Thorn 25p
5 amp 300V Thyristors 25p
BRC 4443 65p
SCR 957 65p
BD561-2 pair 30p
BC365 10p
BD 131-132 each 25p
BD183 PYE Frame O/P 50p
AC187-8K pair 40p
6 Way Ribbon Cable 20p per meter

3500 6 push button units for Thorn 3500 Varicap tuning £1.00
Varicap F.M. Tuner Tuning range 78.5 to 108MHz £2.00 (I.F. Panel with circuit) £2.00
6 position 12.5KV/Resistor Unit for Varicap 50p
Thorn Mains Lead & ON/OFF switch & Control Panel with Slider Pots 75p
TBA 120A 30p TBA 120AS 30p
TBA 120B 30p TBA 120SB 30p
BU208/02 £1.00
EHT Lead & Anode Cap 75p
TCE157 20p
Y716 20p
SN76226 50p
BD253 £1.00
BY190 50p
Plug and Sockets 3 & 6 Pin Printed Circuit Type pair 10p

FRONT END FOR MUSIC CENTER
VHF/M.W./L.W. Size 13"×3½
4 Push Button, Unit 7 Transistors, V/Condenser, 10 Coils, Rod Aerial, I.C. Decoder CA758E. (No Power Supply and O/P Stage).
Circuit Supplied £6.00 (New)

O/P Stage for Music Center £6.00
PYE 731 6 Push Button Unit & 100KA Pots £3.00

GEC IF Panel (204C) £7.50
GEC Mains Dropper fits model no.

C2001H	C2118H	C2113H
C2110H	C144H	C2601H
C2136H	C2202H	C2015H
C2219	C2611H	20p

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2.7/63V	220/10V	4700/10V
4.7/63V	220/16V	1/250V
10/250V	470g-25V	10/40V
22/40V	680/40V	330/63V
160/25V	680/25V	.47/160V
1/63V	33/100V	8/300V
100/100V	33/63V	.47/250V
2.2/160V	33/35V	.01/100V
100/16V	100/63V	.005/1,500V
330/25V	22/160V	.01/600V
3.3/250V	100/40V	
330/10V	47/40V	
5p each	47/63V	**5p** each

4700/40V	**30p**	33/350V	**6p**
1000/50V	**10p**	2000+2000/35V	**30p**
220/63V	**8p**	.01/1000V	**8p**
1500/40V	**8p**	.047/1000V	**8p**
470/63V	**8p**	.47/1000V	**30p**
106/350V	**20p**	.1/800V	**8p**
100/450V	**40p**	.1/400V	**5p**
220/450V	**40p**	.0047/1,500V	**8p**
470/40V	**8p**	2N2/1,500V	**8p**
8/350V	**6p**	1N8/1,500V	**8p**
10/500V	**10p**	.1/2000V	**15p**
33/500V	**10p**	2500+2500	**50p**
33/450V	**10p**	B9A Print	**5p**
4700/25V	**25p**	V/Holders	
4700/30V	**25p**	PYE 697	
22/350V	**6p**	(Long)	**15p**

PRE/AMP PANEL
4 Pots Transistor etc.
PVLUGS & Sockets **£1.00**
I.F. Pawle **£1.00**
20 watt O/P stage **£1.00**

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ITT PT266 3W12
(Thermistor Degause-ing)
Fits Most Sets **15p**

PHILIPS SNIPS CUT MOST THINGS **£2.00**

Speaker 5×3 35 ohm **75p**

Speaker 6×4 15 ohm **£1.00**

100kΩ 40 Turn Pots for V/Cap tuning	**20p**
SAA 1025	**£6.00**
SAA 1024	**£6.00**
SAA 1020	**£6.00**
TBA 120u	**40p**
AF 139	**25p**

697 H.T. transistors **30p**
BYF 3126 EHT REC 30Kv **50p**
NSF UHF VHF new AEG V/cap **£3.50**

NSF UHF 1043/05 Removed from new panels **£3.75**

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ELC 2000 and IF and Chroma panel TV UHF/VHF chassis 5.5 mc/s front end **£15.00**

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BU 326	**£1.00**
TAA 320A	**£1.00**
TBA 673	**£1.00**
TCA 640	**£1.00**
TCA 650	**£1.00**
TCA 660	**£1.00**
TCA 740	**£1.00**
2N 3055	**25p**
TBA 120BA	**60p**
TBA 120U	**60p**
BA 159	**7p**
BD238	**20p**

BY 179 bridge 800V/1Amp rectifier **35p**

SN 29848	**50p**
SN 76532	**50p**
SN 76115AN	**50p**
SN 76550 3R	**15p**
SN 76707N	**50p**
SN 76570N	**50p**
SN 76660N	**50p**
SN 16964	**50p**

NPN TIP 33 40V/10A **30p**

1400-1500 T/units **£4**

SN 76018 KE	**£1.00**
SN 76008 KE	**£1.00**

ITT Control Panel with Mains Lead, 4 Slider Pots & Mains Filter **£2.50**

NPN TIP 130 60V/8A Darlington 2230 **30p**

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4 Pots & 6 Push Button Unit for V/Cap. Mains on-off switch & Mains Filter. ITT **£3.50**

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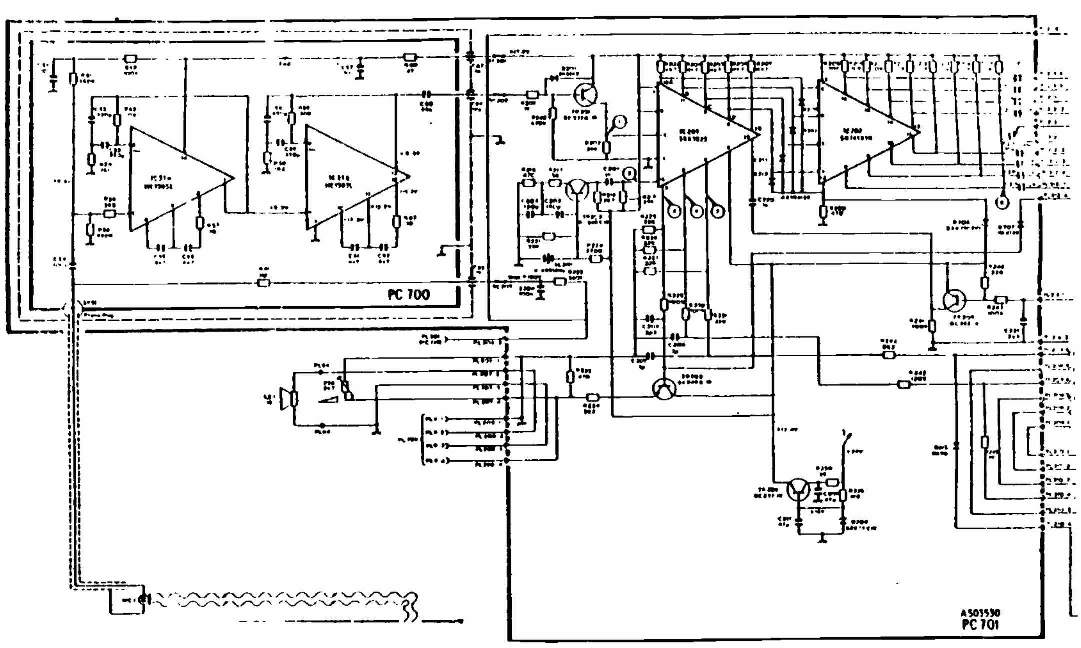

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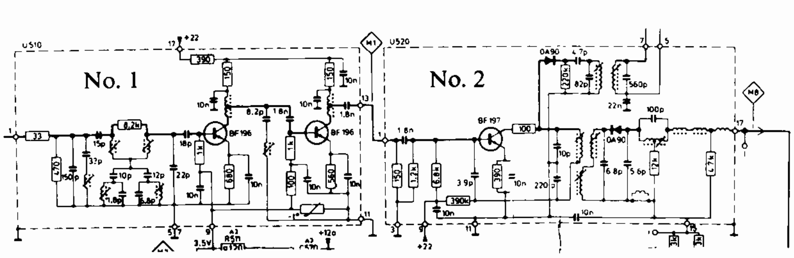

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