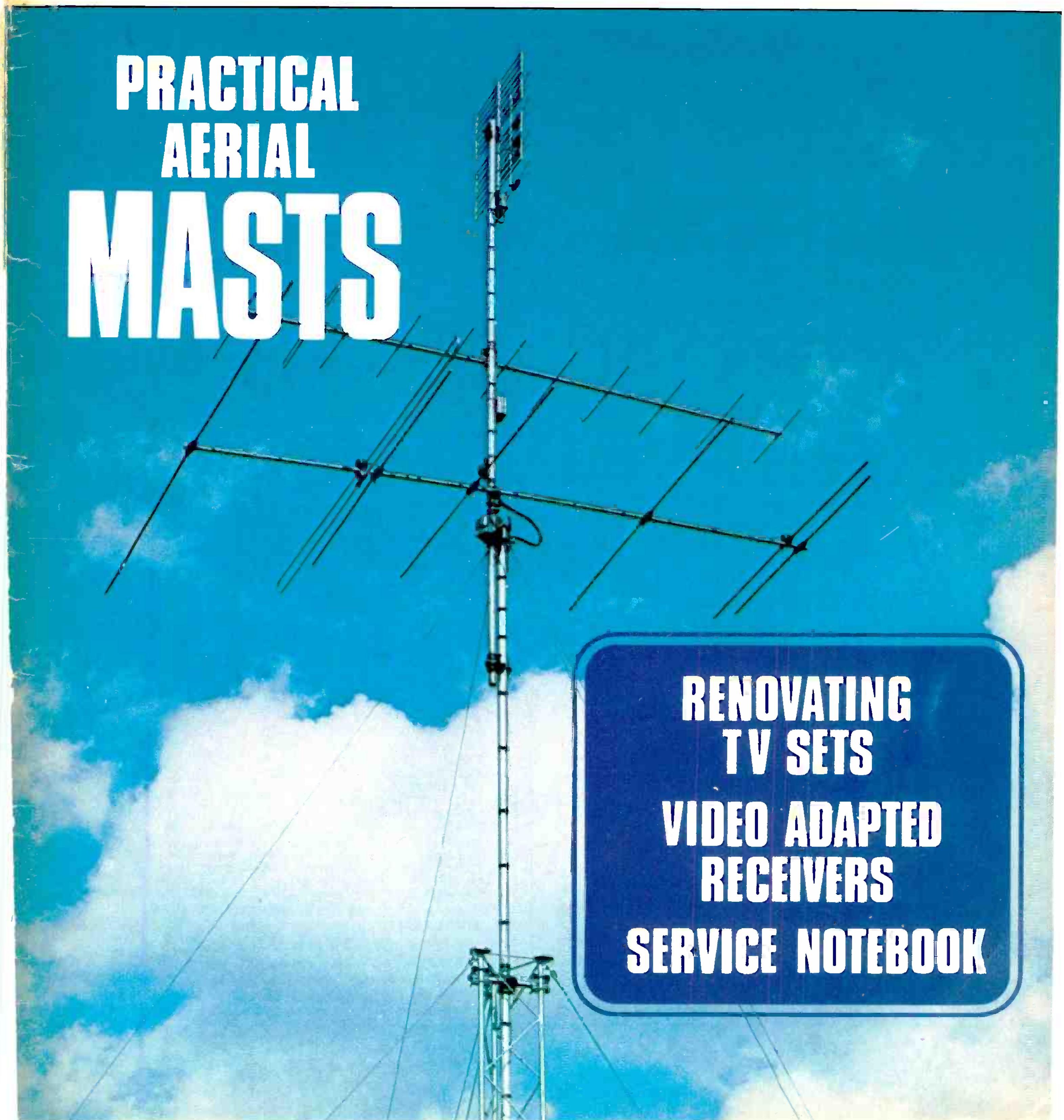
MARCH 1978

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

50p

TELEVISION

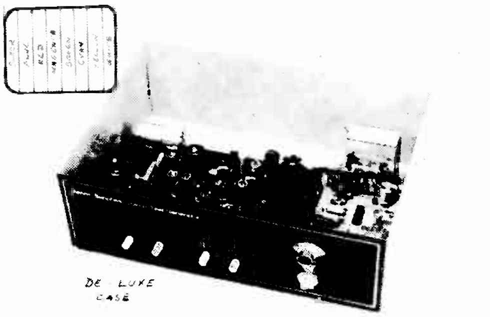
SERVICING · VIDEO · CONSTRUCTION · DEVELOPMENTS



MANOR SUPPLIES

COLOUR BAR GENERATOR

plus CROSS HATCH KIT (Mk. 4)



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

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

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

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

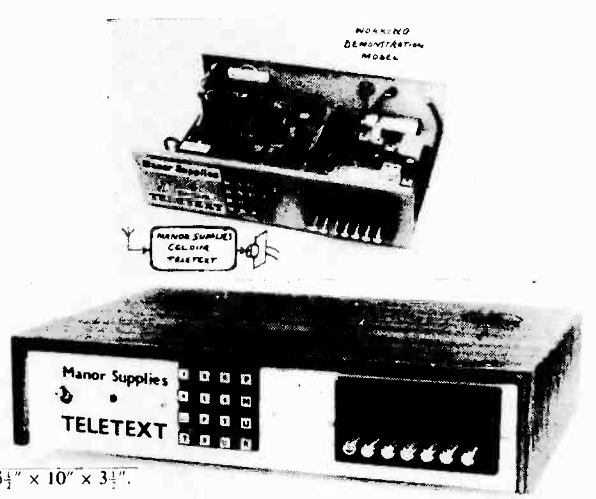
- ★★ Kits include drilled P.C. board, with full circuit data, assembly and setting up instructions.
- ★★ All special parts such as coils and modulator supplied complete and tested, ready for use.
- ★★ Designed to professional standards.
- ★★ Demonstration models at 172 West End Lane, NW6.
- ★★ Every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

ALSO NOW AVAILABLE

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

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

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



15½" × 10" × 3½".

COLOUR, UHF & TELEVISION SPARES

T.V. PORTABLE PROJECT LOPT, SCAN COILS, DRIVER £12.50; EHT RECT. £1.20; ELC1043/05 £5.50, CONTROL UNIT £1.00; VIS GAIN, VIS SELECT (TESTED) £3.80; PACKS: I.C. £5.20, CAPS TANT £2.75, ELECTROLYTICS £3.20, CERAMICS £2.00, POLYESTER ETC. £1.35; PRESETS 90p, TRANSISTORS £3.90, SEMICONDS £3.80, BRIDGE REC. £1.95, C106 90p; BYX71/600 (2) £2.40; RELAY £2.25, CONTROLS £1.18; 6MHz FILTER 68p, COIL £1.00; 3A CHOKE 18p; POST & PACKING 85p. MAINS TRANSFORMER £6.80 p.p. £1.00. OTHER PARTS AVAILABLE. DEMONSTRATION MODEL WORKING AND ON VIEW AT 172 WEST END LANE, NW6.

CROSS HATCH UNIT KIT, AERIAL INPUT TYPE, INCL. T.V. SYNC AND UHF MODULATOR. BATTERY OPERATED. ALSO GIVES PEAK WHITE & BLACK LEVELS. CAN BE USED FOR ANY SET £11.00 + 45p. p.p.* (ALUM. CASE £2.00 p.p. 75p.*) COMPLETE TESTED UNITS, READY FOR USE (DE-LUXE CASE) £19.80 p.p. 90p.* ADDITIONAL GREY SCALE KIT £2.90 p.p. 30p.*

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

CRT TESTER & REACTIVATOR PROJECT KIT £18.80 p.p. £1.30*

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

SPECIAL OFFER I.F. Panel, leading British maker, similar design to "Television" panel. Now in use as alternative inc. circuit and connection data. checked and tested on colour **£14.80** p.p. 95p. Also **DECODER** panel checked and tested on colour. full details. **£19.80** p.p. 95p.

"FIVE in ONE" PANEL replaces Tuner IF. Decoder. RGB. and sound boards of original project. Tested on colour, with all data. **£35.00** p.p.£1.20

TRIPLER £6.00 p.p. 75p. **ERIE FOCUS £2.20,** p.p. 30p. **NEW AUDIO UNIT £2.60** p.p. 35p. **AT2055 LOPT £7.80** p.p. £1.00.

STABILISER UNITS, "add on" kit for either 40V or 20V. **£2.80 p.p. 35p.**

BUSH A823 (A807) Decoder Panel **£7.50** p.p. £1.00.

BUSH 161 TIMEBASE PANEL A634 **£3.80** p.p. 90p.

BUSH 161 I.F. PANEL A583 **£3.80** p.p. 90p.

GEC 2040 Surplus Panels, ex-rental. Decoder **£5.00.** T.B. **£5.00** p.p. 90p

GEC 2010 Series IF, TB panels for spares **£1.00** p.p. 85p.

BRC 3000 Surplus/Salv Panels, Decoder **£7.50, Video £7.50** p.p. 90p

DECCA Colour T.V. Thyristor Power Supply. HT, LT etc. **£3.80** p.p. 95p.

BUSH CTV25 Power Supply Unit **£3.20** p.p. £1.50.

BUSH CTV174 Decoder plus C.D.A. **£8.50** p.p. £1.00

BUSH TV Portable IIV Stab. Power Supply Unit **£4.80** p.p. £1.00.

PYE 697 Line T.B. P.C.B. for spares. **£1.50** p.p. £1.00.

MULLARD AT1023/5 convergence yoke. New **£2.50** p.p. 75p.

DLIF delay line. New **90p** p.p. 40p. AT1025/06 blue lat. **75p** p.p. 30p.

PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits **£3.75** p.p. 85p, or incl. yoke, **£5.00. PHILIPS G8** panels for spares. decoder **£2.50** p.p. 85p.

VARICAP. Mullard ELC1043 UHF tuner **£4.50,** ELC1043/05 **£5.50,** G.I. type (equiv. 1043/05) **£3.50** p.p. 35p. Control units, 3PSN **£1.25,** 4PSN **£1.50,** 5PSN **£1.80. Special offer** 6PSN **£1.00,** 7PSN De-Luxe **£1.80** p.p. 35p. TAA 550 **50p** p.p. 15p. Salvaged UHF varicap tuners **£1.50** p.p. 35p.

VARICAP VHF PHILIPS £3.80, ELC 1042 **£4.80,** p.p. 35p. ELC 1042 on PYE P.C.B. **£5.40,** p.p. 65p.

VARICAP UHF/VHF ELC 2000S **£10.50** p.p. 65p.

UHF/625 Tuners, many different types in stock. Lists available. **UHF** tuners transistd. incl. s/m drive, indicator **£2.85;** 4 position push button **£2.50,** 6 posn. push button **£4.50** p.p. 90p. AE ISOL **30p** p.p. 20p.

TRANSISTORISED 625 IF for T.V., sound, tested. **£6.80** p.p. 65p.

PHILIPS 625 I.F. Panel incl. cct **50p** p.p. 50p.

TURRET TUNERS, KB "Featherlight" VC11. Philips 170 series, GEC 2010 **£2.50.** GEC 2018, 2019, 2038, 2039 5 position **£4.20** p.p. 85p.

TBA "Q" I.C.s. 480, 530, 540, **£2.20,** 550, 560C, 920 **£3.20** p.p. 15p.

HELICAL POTS, 100K. 4 for **£1.20** p.p. 20p.

PHILIPS 19TG170 Mains Droppers, two for **90p** p.p. 50p.

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

BUSH 145 to 186SS, etc. **£6.80**
DECCA DR1, 2, 3, 121/123, 20/24, MS1700, 2001, 2401 .... **£6.40**
DECCA MS2000, 2400 .... **£4.80**
FERG., HMV, MARCONI, ULTRA 850, 900, 950 Mk. 1 ...... **£7.30**
9500, 1400, 1500, 1590 .... **£5.90**
GEC 2000, 2047 series, etc. **£6.40**
INDESIT 20/24EGB **£6.40**
ITT/KB VC2 to 53, 100, 200, 300 **£6.40**
MURPHY 1910 to 2417, etc. **£6.80**
PHILIPS 19TG121 to 19TG156 . **£4.80**
PHILIPS 19TG170, 210, 300 ...... **£6.40**
PYE 11U, 368, 169, 769 series **£6.40**
PYE 40, 67 series (36 to 55) **£3.80**
PAM, INVICTA, EKCO, FERRANTI equivalents as above.
SOBELL 1000 series **£6.40**
STELLA 1043/2149 .... **£6.40**

SPECIAL OFFERS

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

COLOUR LOPTS p.p. £1.00.

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

THORN 850 Time Base Panel, Dual Standard **50p** p.p. 80p.

MULLARD Scan Coils Type **AT1030** for all standard mono 110° models, Philips, Stella, Pye, Ekco, Ferranti, Invicta **£2.00** p.p. 85p.

PHILIPS G8 Tripler (1174) **£6.00** p.p. 75p. Others available.

6·3V CRT Boost Transformers **£2.90** p.p. 75p., Auto type **£1.80** p.p. 45p.

CALLERS WELCOME AT SHOP PREMISES

THOUSANDS OF ADDITIONAL ITEMS AVAILABLE NOT NORMALLY ADVERTISED

MANOR SUPPLIES

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

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

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

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

TELEVISION

March 1978

Vol. 28, No. 5
Issue 329

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

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

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

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

this month

OUR NEXT ISSUE DATED APRIL WILL BE PUBLISHED ON MARCH 20

BI-PAK GREAT SPACE

AUDIO MODULES—ALL REDUCED! TRANSISTOR PRICES SLASHED! MANY PAKS 33⅓% OFF

WE NEED THE SPACE

THYRISTORS

No. THY1A/50	1 Amp.	50 volt	TO5	18p
No. THY1A/400	1 Amp.	400 volt	TO5	32p
No. THY3A/50	3 Amp.	50 volt	TO64	25p
No. THY3A/200	3 Amp.	200 volt	TO64	32p
No. THY3A/400	3 Amp.	400 volt	TO64	40p
No. THY5A/50	5 Amp.	50 volt	TO66	25p
No. THY5A/400	5 Amp.	400 volt	TO66	40p
No. THY5A/600	5 Amp.	600 volt	TO66	50p
No. C106/4	6 Amp.	400 volt	TO220	42p

TRIAC

S84 8 Amp. 400 volt TO220 Plastic 80p
(Non Isolated Tab)

DIACS

BR100 15p
D32 15p

SWITCHES

No 16178	5 x Mains Slide Switches	40p*
No S17	5 x Miniature Slide Switches	40p*
No S18	4 x Standard Slide Switches	40p*
No S19	4 x Miniature Push to Make single hole mounting	40p*
No. S20	3 x Miniature Push to Break single hole mounting	40p*
No. S21	Push button Switch Pak 4 x Assorted types multi bank and singles Latching and non-Latching	£1.00*

CAPACITOR PAKS

16201	18 Electrolytics	4.7µF - 10µF
16202	18 Electrolytics	10µF - 100µF
16203	18 Electrolytics	100µF - 680µF

All 3 at SPECIAL PRICE of £1.20*

16160	24 Ceramic Caps	22pF - 82pF
16161	24 Ceramic Caps	100pF - 390pF
16162	24 Ceramic Caps	470pF - 3300
16163	21 Ceramic Caps	4700pF - 0.047µF

All 4 at SPECIAL PRICE of £1.60

RESISTOR PAKS

Order No.		
16213	60 ⅓W.	100 ohm - 820 ohm
16214	60 ⅓W.	1K - 8.2K
16215	60 ⅓W.	10K - 82K
16216	60 ⅓W.	100K - 820K

All 4 at SPECIAL PRICE of £1.60*

16217	40 ½W	100 ohm - 820 ohm
16218	40 ½W.	1W - 8.2K
16219	40 ½W.	1K - 8.2K
16220	40 ½W.	100K - 820K

All 4 at SPECIAL PRICE of £1.60*

TRANSISTOR *FALL-OUT* PACK, GERM, SILICON, POWER, NPN, PNP. ALL MIXED. YOURS TO SORT AND TEST. Approx. 500 Pieces.
Order No. S23
£1.25 per pack.

VOLTAGE REGULATORS

Positive

No MVR7805	µA7805	TO220	85p
No. MVR7812	µA7812	TO220	85p
No. MVR7815	µA7815	TO220	85p
No. MVR7818	µA7818	TO220	85p
No. MVR7824	µA7824	TO220	85p

Negative

No MVR7905	µA7905	TO220	£1.10
No. MVR7912	µA7912	TO220	£1.10
No. MVR7915	µA7915	TO220	£1.10
No. MVR7918	µA7918	TO220	£1.10
No. MVR7924	µA7924	TO220	£1.10

µA723C TD99 38p 72723 14 pin Dil 38p
LM309K TD3 £1.20

MICROPHONES

DYNAMIC DUAL IMPEDANCE UNI DIRECTIONAL CARDIOID MICROPHONE
Impedance 600 ohms and 50K Response 50-14,000 Hz Sensitivity 54db at 50K.
Size 1½" Dia x 6½" Long
Order No. 1328 **£7.50***

DYNAMIC CASSETTE MIC

Fitted with On/Off switch 1 metre of tough lead with floating 2.5 and 3.5 mm plugs
Impedance 200 ohms Sensitivity 90db.
Frequency 90-10,000 Hz
Size 20mm Dia. x 120mm Long
Order No. 1326 **£1.15***

LOGIC PROBE

A pocket size instrument capable of detecting T.T.L. D.T.L. Flip Flop and other pulse circuits. It is easy to use and operates from the 5V. D.C. supply of the circuit under test. The logic levels are indicated by 2 red LED's one for High and the other for Low. There is also a green LED for the Pulse Mode of the unit.
No. S59 **Our Special Price £15.95.**

TRANSISTORS

BRAND NEW – FULLY GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	25p	BC177	12p	BF194	*9p	TIP32A	34p	2N1613	15p
AC126	14p	BC178	12p	BF195	*9p	TIP32B	35p	2N1711	15p
AC127	16p	BC179	12p	BF196	*12p	TIP32C	38p	2N1893	28p
AC128	16p	BC182	*9p	BF197	*12p	TIP41A	34p	2N2218	15p
AC128K	24p	BC182L	*9p	BF200	25p	TIP41B	35p	2N2218A	18p
AC176	16p	BC183	*9p	BFX29	22p	TIP41C	36p	2N2219	15p
AC176K	24p	BC183L	*9p	BFX84	18p	TIP42A	36p	2N2219A	18p
AC187	16p	BC184	*9p	BFY50	12p	TIP42B	37p	2N2221	15p
AC187K	26p	BC184L	*9p	BFY51	12p	TIP42C	38p	2N2221A	16p
AC188	16p	BC212	*10p	BFY52	12p	TIP2955	65p	2N2222	15p
AC188K	26p	BC212L	*10p			TIP3055	42p	2N2222A	16p
AD161/		BC213	*10p	MPSA05	*22p	ZTX107	*6p	2N2369	10p
162 MP	80p	BC213L	*10p	MPSA06	*22p	ZTX108	*6p	2N2904	14p
AF139	30p	BC214	*10p	MPSA55	*22p	ZTX109	*7p	2N2904A	15p
AF239	30p	BC214L	*10p	MPSA56	*22p	ZTX300	*7p	2N2905	14p
BC107	6p	BC251	*10p	OC44	12p	ZTX301	*7p	2N2905A	15p
BC108	6p	BCY70	12p	OC45	12p	ZTX302	*9p	2N2906	12p
BC109	6p	BCY71	12p	OC71	9p	ZTX500	*8p	2N2906A	14p
BC118	*10p	BCY72	12p	OC72	12p	ZTX501	*10p	2N2907	12p
BC147	*8p	BD115	40p	OC75	10p	ZTX502	*12p	2N2907A	13p
BC148	*8p	BD131	*35p	OC81	14p	2N696	10p	2N2926G	*8p
BC149	*8p	BD132	*37p			2N697	10p	2N2926Y	*7p
BC154	*16p	BF115	17p	TIP29A	35p	2N706	7p	2N3053	12p
BC157	*9p	BF167	19p	TIP29B	36p	2N706A	8p	2N3055	35p
BC158	*9p	BF173	20p	TIP29C	38p	2N708	8p	2N3702	*7p
BC159	*9p	BF180	25p	TIP30A	36p	2N1302	12p	2N3703	*7p
BC169C	*10p	BF181	25p	TIP30B	37p	2N1303	15p	2N3704	*6p
BC170	6p	BF182	25p	TIP30C	38p	2N1304	15p	2N3903	*11p
BC171	*6p	BF183	25p	TIP31A	32p	2N1307	18p	2N3904	*11p
BC172	*6p	BF184	25p	TIP31B	33p	2N1308	22p	2N3905	*11p
BC173	7p	BF185	25p	TIP31C	34p	2N1309	22p	2N3906	*11p

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	5p	BAX16/		BYZ16	30p	OA85	7p	IS44	3p
AAZ13	4p	OA202	5p	BYZ17	28p	OA90	6p		
BA100	6p			BYZ18	28p	OA91	7p	IN5400	10p
BA115	5p	BY100	15p	BYZ19	28p	OA95	7p	IN5401	11p
BA144	5p	BY127	*10p					IN5402	12p
BA148	10p	BYZ10	32p	DA47	5p	IN34	5p	IN5404	13p
BA173	10p	BYZ11	32p	DA70	5p	IN60	6p	IN5406	16p
BAX13/		BYZ12	32p	OA79	7p	IN914	4p	IN5407	17p
OA200	5p	BYZ13	30p	OA81	7p	IN4148	4p	IN5408	19p

LINEAR I.C.'s

TBA800	12 pin QIL	*75p	UA711C	TO99	25p	UA748	TO99	28p
TBA810	12 pin QIL	*£1.00	UA703	TO99 (Plastic)	20p	72558	(Dual 748) TO99	45p
TBA820	14 pin QIL	*80p	741P	8 pin OIL	18p	MC1310P	14 pin DIL	*£1.25
LM380	14 pin DIL	*80p	72741	14 pin DIL	20p	76115	14 pin QIL	*£1.25
LM381	14 pin DIL	*£1.35	UA741C	TO99	20p	NE555	8 pin DIL	32p
72709	14 pin DIL	28p	72747	14 pin DIL	55p	NE556	14 pin DIL	60p
UA709	TO99	28p	748P	8 pin DIL	28p	SL414A	10 pin	*£1.80

NEW CONSIGNMENT ZN 414 RADIO CHIP 75p*

OPTOELECTRONICS

Displays

No. 1510	707 LED Display	70p each
No. 1511	747 LED Display	£1.50 each
No. S53	DL33 Triple 7 Segment LED Display Character height .11" Common Cathode 12 pin DIL	30p each

LED's

No. S51	Red TIL209 (5 x .125")	50p
No S52	Red FLV117 (5 x .2")	50p
No. 1502	Green .125"	18p each
No. 1505	Green .2"	18p each
No. 1503	Yellow .125"	18p each
No. 1506	Yellow .2"	18p each
No S82	Clear .2" (illuminating red)	12p

2nd QUALITY LED PAKS

No. 1507 10 x LED's Assorted 75p

LED CLIPS

No. 1508/.125	.125	5 for 12p
No. 1508/.2	.2	5 for 15p

SPECIAL REDUCTIONS

No. 1514	NORP 12	45p each
No. S76	OCP71	5 for £1.00
No. S83	5. NIXIE Tubes ITT 5870 ST (including Data)	£2.00
No. S77	Neon Indicator Lamps 230V A.C State Colour (Red, Amber and Green.)	25p each

D.I.Y. PRINTED CIRCUIT KIT

Contains 6 pieces of copper laminate board, box of etchant powder, measure, tweezers, marker pen, high quality pump drill, Stanley knife and blades and 6 in. metal rule
Full easy to follow instructions.
Order No. S64 **Sale Price £5.50**

P.C.B. BOARDS

S61	8 pieces 8" x 3½" (approx.) single sided paper	50p
S62	4 pieces 8" x 3½" (approx.) single sided fibreglass	50p
S63	3 pieces 7" x 3½" (approx.) double sided fibreglass	50p

ETCH RESIST PENS

Order No. 1609 **50p each**

SOLDER

5m of 18 sw Multi-core Solder.
Order No. S60 **50p**

I.C. INSERTION EXTRACTION TOOL

Order No. 2015 **30p**

MAMMOTH I.C. PAK

Approx. 200 Pieces. Assorted fall-out integrated circuits, including: Logic, 74 series, Linear, Audio and D.T.L. Many coded devices, but some unmarked – you to identify
Order No. 16223 **£1.00**

POWER SUPPLY STABILIZER BOARD

Unused ex-equipment stabilizer board. Input 30V. D.C Output 20V. Complete with circuit diagram.
Order No S81 **£1.25**

P.O. RELAYS

S85 – 2 Off Post Office relays 40p

BATTERY HOLDERS

to take 6 x HP7's
Order No. 202 **10p each**

EX. G.P.O. MICROSWITCHES

Order No. S84A. 4 for **50p**

CABLE CLIPS

S84 – 50 2.5mm round single pin fixing 30p

SPECIAL OFFER!

UNTESTED SEMICONDUCTOR PAKS

Code No's shown below are given as a guide to the type of device. The devices themselves are normally unmarked.

No. 16130	100 Germ. Gold bonded diodes like OA47	40p
No. 16131	150 Germ. Point contact diodes like OA70/81	40p
No. 16132	100 200mA Sil. diodes like OA200	40p
No. 16133	150 75mA Sil. Fast switching diode like IN4148	40p
No. 16134	50 750mA Sil. top hat Rects.	40p
No. 16135	20 3 amp Sil. stud Rect.	40p
No. 16136	50 400mw Zeners D.O.7 case	40p
No 16137	30 NPN Plastic trans. like BC107/8	40p*
No. 16138	30 PNP Plastic trans. like BC177/8	40p*
No. 16139	25 NPN trans. like 2N697/2N1711 TO39	40p
No. 16140	25 PNP trans. like 2N2905 TO39	40p
No. 16141	30 NPN trans. like 2N706 TO18	40p
No. 16143	30 NPN Plastic trans. like 2N3906	40p*
No. 16144	30 PNP Plastic trans like 2N3905	40p*
No. 16145	30 PNP Germ. trans. like OC71	40p
No. 16147	10 NPN to 3 Power trans. like 2N3055	80p

I.C. SOCKET PAKS

No S66	11 x 8 pin DIL Sockets	£1.00
No. S67	10 x 14 pin DIL Sockets	£1.00
No. S68	9 x 16 pin DIL Sockets	£1.00
No. S69	4 x 24 pin DIL Sockets	£1.00
No. S70	3 x 28 pin DIL Sockets	£1.00

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No. S71	15 x TO18 Sockets	£1.00
No. S72	10 x TO5 Sockets	£1.00

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No. S73 50 Mixed Transistor Pads TO18 and TO5 40p

TRANSISTOR HEATSINK PAK

20 Assorted types, TO1, TO5, TO18, TO92
Our Mix
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Mica washers and bushes assorted types i.e. TO220, TO66, TO3 etc. Approx. 100 pieces. (Approx. 40 sets).
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70 watt 8 amp NPN and PNP in plastic case 199 High Voltage (Typ. 80V). High gain 10 pieces 5 NPN and 5 PNP. Data Sheet supplied.
Order No. S78 **£1.00 per Pak**

MATCHED PAIRS OF PNP GERMANIUM MED. POWER TRANS

2 amp 750mW

	VCE	VCB	HFE	
NKT301	40	60	30-100	35p per pair
NKT302	40	60	50-150	35p per pair
NKT303	20	30	30-100	25p per pair
NKT304	20	30	50-150	25p per pair

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No S55	20 mixed values 400mW Zener diodes 3-10V	£1.00
No. S56	20 mixed values 400mW Zener diodes 11-33V	£1.00
No S57	10 mixed values 1W Zener diodes 3-10V	£1.00
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UT46 TIS43 20p

FET's

2N3819 15p 2N5458 18p

2 AMP. BRIDGE RECTIFIERS

Metal Stud Mounting

No. S45	50V	(KBS 005)	28p
No. S46	100V	(KBS 01)	30p
No. S47	200V	(KBS 02)	34p

10 AMP. BRIDGE RECTIFIERS 200V ON HEATSINK – SPECIAL CLEARANCE ORDER NO. S22 – £1.00

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SIMILAR IN4000 SERIES

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No. S42	20 Like IN4002	(1A/100V)	60p
No. S43	18 Like IN4003	(1A/200V)	60p
No. S44	15 Like IN4004	(1A/400V)	60p

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No. S50	20 x 700V	60p

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16191	6 x 470 Ohm	LIN Single	40p*
S24	6 x 1 K	LIN Single	40p*
S25	6 x 5 K	LIN Single	40p*
16192	6 x 10 K	LIN Single	40p*
S26	6 x 10 K	LOG Single	40p*
16193	6 x 22 K	LIN Single	40p*
16195	6 x 47 K	LOG Single	40p*
16194	6 x 47 K	LIN Single	40p*
S27	6 x 100 K	LIN Single	40p*
S28	6 x 100 K	LOG Single	40p*
S29	6 x 500 K	LOG Single	40p*

Slider 60mm TRAVEL

S30	6 x 2.5 K	LOG Single	40p*
S31	6 x 10 K	LIN Single	40p*
S32	6 x 50 K	LIN Single	40p*
S33	6 x 250 K	LOG Single	40p*
S34	4 x 5 K	LOG Dual	40p*
S35	4 x 10 K	LIN Dual	40p*
S36	4 x 100 K	LOG Dual	40p*
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A range of wirewound single gang pots. with linear tracks of 1 watt rating

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S4	2 x Stereo Jack Plugs	30p*
S5	5 x 5 Pin 180° DIN Plugs	50p*
S6	8 x 2 Pin Loudspeaker Plugs	50p*
S7	6 x Phono Plugs Plastic	50p*
S8	5 x 3.5 mm Chassis Sockets (Switched)	25p*
S9	5 x 2.5 mm Chassis Sockets (Switched)	25p*
S10	4 x Metal Std. Chassis Switched Jack Sockets	50p*
S11	2 x Stereo Jack Sockets with instruction leaflet for H/Phone connection.	50p*
S12	5 x 5 Pin 180° DIN Chassis Sockets	40p*
S13	8 x 2 Pin DIN Chassis Sockets	50p*
S14	6 x Single Phono Sockets	40p*

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118	5 pin DIN headphone plug to stereo socket	78p*
119	2 x 2 pin plug to inline stereo socket for headphones	60p*
123	20 ft. of coiled guitar lead	£1.15*
124	3 pin to 3 pin DIN plug	50p*
125	Audio lead 5 pin plug to 5 pin DIN plug	50p*
126	Audio lead 5 pin DIN plug to tinned open ends	50p*
127	Audio lead 5 pin DIN plug to 4 phono plugs	90p*
129	Audio lead 5 pin plug to 5 pin DIN plug – Mirror Image	70p*
130	5 metre lead 2 pin DIN plug to 2 pin DIN inline socket	45p*
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7400	0.09	0.08	7448	0.70	0.68	74122	0.45	0.42
7401	0.11	0.10	7450	0.12	0.10	74123	0.65	0.62
7402	0.11	0.10	7451	0.12	0.10	74141	0.68	0.65
7403	0.11	0.10	7453	0.12	0.10	74145	0.75	0.72
7404	0.11	0.10	7454	0.12	0.10	74150	1.10	1.05
7405	0.11	0.10	7460	0.12	0.10	74151	0.65	0.60
7406	0.28	0.25	7470	0.24	0.23	74153	0.70	0.68
7407	0.28	0.25	7472	0.20	0.19	74154	1.20	1.10
7408	0.12	0.11	7473	0.26	0.22	74155	0.70	0.68
7409	0.12	0.11	7474	0.24	0.23	74156	0.70	0.68
7410	0.09	0.08	7475	0.44	0.40	74157	0.70	0.68
7411	0.22	0.20	7476	0.26	0.25	74160	0.95	0.85
7412	0.22	0.20	7480	0.45	0.42	74161	0.95	0.85
7413	0.26	0.25	7481	0.90	0.88	74162	0.95	0.85
7416	0.28	0.25	7482	0.75	0.73	74163	0.95	0.85
7417	0.26	0.25	7483	0.88	0.82	74164	1.20	1.10
7420	0.11	0.10	7484	0.85	0.80	74165	1.20	1.10
7422	0.19	0.18	7485	1.10	1.00	74166	1.20	1.10
7423	0.21	0.20	7486	0.28	0.26	74174	1.10	1.00
7425	0.25	0.23	7489	2.70	2.50	74175	0.85	0.82
7426	0.25	0.23	7490	0.38	0.32	74176	1.10	1.00
7427	0.25	0.23	7491	0.65	0.62	74177	1.10	1.00
7428	0.36	0.34	7492	0.43	0.35	74180	1.10	1.00
7430	0.12	0.10	7493	0.38	0.35	74181	1.90	1.80
7432	0.20	0.19	7494	0.70	0.68	74182	0.80	0.78
7433	0.38	0.36	7495	0.60	0.58	74184	1.50	1.40
7437	0.26	0.25	7496	0.70	0.68	74190	1.40	1.30
7438	0.26	0.25	74100	0.95	0.90	74191	1.40	1.30
7440	0.12	0.10	74104	0.40	0.35	74192	1.10	1.00
7441	0.60	0.57	74105	0.30	0.25	74193	1.05	1.00
7442	0.80	0.70	74107	0.30	0.25	74194	1.05	1.00
7443	0.95	0.90	74110	0.48	0.45	74195	0.80	0.75
7444	0.95	0.90	74111	0.75	0.72	74196	0.90	0.85
7445	0.80	0.75	74118	0.85	0.82	74197	0.90	0.85
7446	0.80	0.75	74119	1.30	1.20	74198	1.90	1.80
7447	0.70	0.68	74121	0.28	0.26	74199	1.80	1.70

Devices may be mixed to qualify for quantity price. Data is available for the above series of ICs in booklet form **price 35p.**

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.14	CD4018	£0.85	CD4035	£1.40	CD4056	£1.15
CD4001	£0.16	CD4019	£0.45	CD4037	£0.78	CD4069	£0.32
CD4002	£0.16	CD4020	£0.95	CD4040	£0.78	CD4070	£0.32
CD4006	£0.80	CD4021	£0.85	CD4041	£0.68	CD4071	£0.20
CD4007	£0.17	CD4022	£0.80	CD4042	£0.68	CD4072	£0.20
CD4008	£0.80	CD4023	£0.18	CD4043	£0.78	CD4081	£0.20
CD4009	£0.50	CD4024	£0.64	CD4044	£0.78	CD4082	£0.20
CD4010	£0.50	CD4025	£0.18	CD4045	£1.15	CD4510	£1.10
CD4011	£0.18	CD4026	£1.85	CD4046	£0.95	CD4511	£1.25
CD4012	£0.17	CD4027	£0.48	CD4047	£0.75	CD4516	£1.10
CD4013	£0.42	CD4028	£0.80	CD4049	£0.46	CD4518	£1.10
CD4015	£0.80	CD4029	£0.95	CD4050	£0.46	CD4520	£1.10
CD4016	£0.42	CD4030	£0.46	CD4054	£0.95		
CD4017	£0.80	CD4031	£1.80	CD4055	£1.60		

AUDIO MODULE SALE

Type	Description	Normal Price	Sale Price
AL30A	10W RMS Power Amp	~~£3.65*~~	£2.95*
AL60	25W RMS Power Amp	~~£4.35*~~	£3.55*
AL80	35W RMS Power Amp	~~£6.95~~	£5.95
AL250	125 W RMS Power Amp	~~£16.95~~	£14.45
SPM80	35V Power Supply	~~£3.75*~~	£3.10*
PS12	20-30V Power Supply for AL30A	~~£1.30*~~	£1.15*
PA12	Stereo Pre-Amp for AL30A	~~£6.70*~~	£5.95*
PA100	Stereo Pre-Amp for AL60/AL80	~~£13.75*~~	£12.45*
S450	Stereo F.M. Tuner	~~£20.45*~~	£18.65*
MPA30	Magnetic-Ceramic Pre-Amp	~~£2.85*~~	£2.55*
Stereo 30	Complete Audio Chassis 7W + 7W RMS	~~£16.25*~~	£14.95*

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The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12db, Max. Voltage handling 2 V RMS, T.H.D., 0.5%, input impedance 100 K, output impedance less than 10 K. Frequency response 20 Hz-20 KHz (3db). The nine gain controls are centred at 50, 100, 200, 400, 800, 1600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders. (Not supplied with the module). See Paks S31 and 16192.

ONLY £19.50

SG30 Power supply board for GE100 15-0-15 Volt **£4.50**

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16168	5 pieces Assorted Ferrite rods	40p*
16169	2 pieces Tuning gangs MW/LW	40p*
16170	50 metres Single strand wire assorted wire	40p
16171	10 Reed switches	40p*
16172	3 Micro switches	40p*
16176	20 Assorted electrolytics Trans types	40p*
16177	1 pack Assorted hardware nuts/bolts etc.	40p
16179	20 Assorted tag strips and panels	40p
16180	15 Assorted control knobs	40p*
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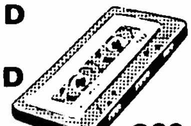

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PCL84	0.10	PCF806	0.10	PC900	0.10	DY802	0.10	30P12	0.10	GY501	0.50
PCL85	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	30FL1/2	0.25	PL508	0.50
PCL86	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC82	0.10	PCH200	0.50
PFL200	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECC81	0.10	PCF200	0.50
PCF801	0.10	PCC86	0.10	EF184	0.10	PL81	0.10	ECH81	0.10	CEY51	0.15
30C1	0.10	30C15	0.10	6BW7	0.10	6/30L2	0.10	ECL80	0.10		
30C17	0.10	30C18	0.10	ECC85	0.10	U26	0.10	ECL82	0.10		
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Please note there is 25p p.p. per order

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GEC/Sobell	6.50	7.50	–	–	–	6.50	–	–	–	7.50
Philips	6.50	9.50	–	–	–	7.50	–	–	–	6.50
Decca	6.50	12.50	12.50	–	–	6.50	2.00 (19" only)	8.00	–	6.00
Thorn 2000	6.50	7.50	7.50	6.50	6.50	7.00	–	8.00	9.50	6.50
Pye	7.50	7.50	9.50	–	–	6.50	–	–	–	4.00
Baird	6.50	8.50	8.50	–	–	6.50	–	–	–	6.00

Postage & Packing £1.25

S/STANDARD COLOUR SPARE PANELS

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GEC Hybrid	9.50	9.50	15.00	–	6.00	–	–	12.00
Philips G6 S/S	9.50	–	15.00	–	9.00	–	–	10.00
Thorn 3000	10.00	9.00	18.00	10.00	6.00	20.00	20.00	10.00
Pye 691/693	15.00	7.50	18.00	–	15.00	–	28.00	7.50
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19", 25" from £30
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AC117	0.38
AC126	0.36
AC127	0.40
AC128	0.35
AC128K	0.35
AC141	0.35
AC141K	0.40
AC142	0.34
AC142K	0.39
AC151	0.31
AC152	0.34
AC153	0.42
AC153K	0.43
AC154	0.31
AC176	0.42
AC178	0.42
AC179	0.48
AC187	0.42
AC187K	0.45
AC188	0.42
AC188K	0.42
AC193K	0.48
AC194K	0.52
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.07
AD140	0.68
AD142	0.69
AD143	0.71
AD149	0.86
AD161	0.65
AD162	0.70
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.32
AF118	0.98
AF121	0.50
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.45
AF139	0.48
AF147	0.52

Type	Price (£)
AF149	0.45
AF178	0.75
AF179	0.78
AF180	0.75
AF181	0.72
AF186	0.99
AF202	0.27
AF239	0.60
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.52
AU103	2.10
AU107	1.90
AU110	1.90
AU113	2.40
BC107*	0.16
BC108*	0.15
BC109*	0.17
BC113	†0.16
BC114	†0.20
BC115	†0.21
BC116*	†0.21
BC117	†0.20
BC118	†0.17
BC119	0.32
BC125*	†0.22
BC126	†0.24
BC132	†0.17
BC134	†0.20
BC135	†0.19
BC136	†0.20
BC137	†0.20
BC138	†0.30
BC140	0.90
BC141	0.95
BC142	0.29
BC143	0.35
BC147*	†0.12
BC148*	†0.11
BC149*	†0.13
BC152	†0.25
BC153	†0.20
BC154	†0.20
BC157*	†0.13
BC158*	†0.12

Type	Price (£)
BC159*	†0.14
BC160	0.78
BC161	0.80
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*	†0.14
BC182L*	†0.14
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.14
BC184L*	†0.14
BC186	0.25
BC187	0.27
BC192	0.56
BC207*	†0.14
BC208	†0.12
BC212*	†0.17
BC212L*	†0.17
BC213*	†0.16
BC213L*	†0.16
BC214*	†0.17
BC214L*	†0.17
BC237*	†0.16
BC238*	†0.15
BC239C	†0.23
BC251A & B	†0.27
BC252A*	†0.25
BC253B	†0.38
BC261A	0.28
BC262A*	0.26
BC263B	0.27
BC267	0.16
BC268C	0.14
BC294	†0.37
BC300	0.60

Type	Price (£)
BC301	0.35
BC303	0.60
BC307A & B	†0.17
BC308 & A	†0.17
BC309*	†0.17
BC317*	†0.22
BC318C	†0.23
BC319C	†0.26
BC320	†0.28
BC322	†0.24
BC323	0.68
BC327	†0.23
BC328	†0.23
BC337	†0.24
BC338	†0.19
BC347A*	†0.17
BC348A & B	†0.17
BC349A & B	†0.17
BC350A*	†0.20
BC351A*	†0.18
BC352A*	†0.24
BC360	0.24
BC377	0.22
BC441	0.59
BC461	0.78
BC477	0.20
BC478	0.19
BC479	0.19
BC547*	†0.13
BC548*	†0.12
BC549*	†0.15
BC550	†0.15
BC556	†0.18
BC557*	†0.14
BC558*	†0.13
BC559*	†0.15
BD115	0.93
BD123	0.98
BD124	0.88
BD130Y	1.56
BD131	0.48
BD132	0.54
BD133	0.51
BD135	0.42

Type	Price (£)
BD136	0.46
BD137	0.48
BD138	0.52
BD139	0.55
BD140	0.59
BD144	2.24
BD145	0.75
BD157	0.51
BD160	1.65
BD163	0.67
BD177	0.58
BD178	0.59
BD181	1.04
BD182	0.90
BD183	1.18
BD184	1.43
BD187	0.61
BD188	0.86
BD189	0.71
BD201	1.15
BD202	1.50
BD222	0.78
BD225	0.91
BD232	2.20
BD233	0.52
BD234	0.75
BD235	0.69
BD236	0.62
BD237	0.69
BD238	0.70
BD253	2.58
BD410	1.65
BD437	0.98
BD438	1.17
BD517	0.41
BD518	0.43
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BDX14	1.02
BDX18	1.55
BDX32	2.75
BDX64A	1.89
BDX65A	1.69
BDY16A	0.43
BDY18	1.55

Type	Price (£)
BDY20	1.07
BF115	0.30
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.58
BF125	0.55
BF127	0.68
BF137F	0.78
BF152	†0.19
BF157	0.32
BF158	†0.25
BF159	†0.27
BF160	†0.22
BF161	0.45
BF162	†0.65
BF163	†0.65
BF164	†0.95
BF166	0.38
BF167	0.52
BF173	0.30
BF177	0.36
BF178	0.38
BF179	0.42
BF180	0.36
BF181	0.35
BF182	0.44
BF183	0.52
BF184	0.31
BF185	0.28
BF194*	†0.12
BF195*	†0.11
BF196	†0.14
BF197	†0.15
BF198	†0.29
BF199	†0.29
BF200	0.65
BF218	0.42
BF224J	†0.20
BF240	†0.32
BF241	†0.31
BF244	†0.37
BF245B	†0.68
BF255	†0.58
BF256L*	†0.49
BF257	0.49
BF258	0.53

Type	Price (£)
BF259	0.61
BF262	0.64
BF263	0.62
BF270	0.47
BF271	0.52
BF273	†0.33
BF274	†0.34
BF333	0.67
BF336	0.43
BF337	0.46
BF338	0.58
BF355	0.52
BF362	†0.62
BF363	†0.62
BF457	0.68
BF458	0.84
BF459	0.91
BF594	†0.16
BF596	†0.17
BF597	†0.17
BFR39	0.33
BFR40	0.29
BFR41	0.26
BFR60	0.35
BFR61	0.29
BFR62	0.28
BFR79	0.36
BFR80	0.32
BFR81	0.28
BFT41	0.48
BFT43	0.55
BFW11	0.66
BFW30	2.17
BFW59	†0.19
BFW60	†0.20
BFW90	0.28
BFX29	0.33
BFX84	0.30
BFY18	0.53
BFY50	0.33
BFY51	0.31
BFY52	0.30
BFY90	1.37
BLY15A	1.09
BR101	0.47
BRC4443	0.76
BRY39	0.58

Type	Price (£)
BRY55	†0.48
BRY56	†0.44
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	2.85
BU105	1.95
BU105/02	1.95
BU108	3.15
BU126	2.18
BU133	1.77
BU204	2.02
BU205	2.24
BU206	2.97
BU208	3.15
BU407	1.12
BUY78	2.65
BUY79	2.85
C106D	0.89
E1222	0.47
E5024	†0.19
GET872	0.46
MC140	†0.36
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	0.78
MPF102	†0.40
MPS6566	†0.31
MPSA05	†0.47
MPSA06	†0.48
MPSA55	†0.50
MPSA56	†0.53
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
OC26	0.90
OC28	1.19
OC35	0.93
OC36	0.88

Type	Price (£)
OC42	0.55
OC44	0.34
OC45	0.32
OC71	0.73
OC72	0.73
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.34
OC171	0.34
ON236A	0.72
R2008B	2.25
R2010B	2.65
TIC44	†0.29
TIC46	†0.44
TIP29A	0.49
TIP30A	0.58
TIP31A	0.62
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIP2955	1.78
TIP3055	0.67
TIS43	†0.38
TIS73	†1.36
TIS90	†0.23
TIS91	†0.25
ZTX108	†0.13
ZTX109	†0.14
ZTX213	†0.21
ZTX300	†0.16
ZTX304	†0.24
ZTX500	†0.17
ZTX502	†0.19
ZTX504	†0.30
2N696	0.30
2N697	0.36
2N706	0.16
2N708	0.35
2N914	0.21
2N916	0.24
2N1164	3.60
2N1304	0.55
2N1711	0.45

Type	Price (£)
2N1893	0.40
2N2102	0.51
2N2221A	0.50
2N2222A	0.52
2N2369A*	0.44
2N2484	0.55
2N2646	0.75
2N2696	1.36
2N2904*	0.42
2N2905*	0.33
2N2926G	†0.15
2N2926O	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.25
2N3054	0.62
2N3055	0.70
2N3702	†0.19
2N3703	†0.18
2N3704	†0.18
2N3771	1.85
2N3772	1.92
2N3773	2.90
2N3819	†0.35
2N3866	1.72
2N3904	†0.24
2N3905	†0.26
2N4032	0.57
2N4036	0.60
2N4058	†0.18
2N4291	†0.27
2N4392	2.84
2N4902	2.40
2N4921	0.61
2N5060	†0.32
2N5294	0.46
2N5296	0.62
2N5496	1.05
2N6178	0.71
2N6180	1.39
2SC643A	1.36
2SC1172Y	2.80
2SD234	0.89
40361	0.48
40362	0.50
40595	1.39
40654	0.81

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA3005	1.80
CA3012	1.45
CA3014	2.23
CA3018	1.06
CA3020	1.86
CA3028A	1.06
CA3028B	1.26
CA3045	1.35
CA3046	1.02
LM309K	1.98
MC1307P	†1.32
MC1310P	†2.94
MC1312P	2.20
MC1314P	3.85
MC1315P	4.15
MC1327P	†1.86
MC1327PQ	†1.86
MC1330P	†0.93
MC1350P	†0.85
MC1351P	†0.90
MC1352P	†0.90
MC1353P	0.92
MC1355P	1.82
MC1357P	1.42
MC1358P	†1.80
MC1358PQ	†1.85
MC1458G	0.98
MC1496L	0.88
MC3051P	0.58
MFC4000B	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	†2.58
ML231	†4.60
ML232	†4.60
NE555	0.72
SAS560A	†2.01
SAS570	†2.01

Type	Price (£)
SC9503P	†1.46
SC9504P	†1.42
SL414A	1.91
SL432A	2.52
SL439	1.50
SL901B	†4.10
SL917B	†5.50
SN72440N	†2.21
SN76001N	†1.45
SN76003N	2.24
SN76013N	1.50
SN76013ND	1.25
SN76023N	1.50
SN76023ND	1.25
SN76033N	2.24
SN76110N	†2.30
SN76226N	†3.15
SN76227N	†1.85
SN76502N	†1.92
SN76530P	†1.85
SN76533N	†1.20
SN76544N	†1.85
SN76660N	†0.60
SN76666N	†0.90
TA7073P	†3.51
TAA300	†3.85
TAA320	0.94
TAA350A	†1.96
TAA435	†1.70
TAA450	†3.39
TAA550	†0.60
TAA570	†2.30
TAA611A	1.70
TAA611B	1.85
TAA621AX1	2.43
TAA630Q	3.91
TAA630S	4.18
TAA661B	1.75
TAA700	†3.90
TAA840	†3.38
TAA861A	0.95

Type	Price (£)
TAA960	†1.35
TAD100	†2.66
TBA120A	†0.90
TBA120S	†0.99
TBA240A	†3.98
TBA281	†2.07
TBA395	†2.58
TBA396	†2.40
TBA480Q	†1.84
TBA500	†1.99
TBA500Q	†2.00
TBA510	†1.99
TBA520Q	†2.98
TBA530	†1.98
TBA530Q	†2.50
TBA540	†3.21
TBA540Q	†3.22
TBA550Q	†4.10
TBA560C	†3.13
TBA560CQ	†3.22
TBA570	†1.29
TBA641A12	2.55
TBA673	†2.19
TBA700	†2.50
TBA720AQ	†2.38
TBA720Q	†2.38
TBA750A	†2.07
TBA750Q	†2.07
TBA800	2.40
TBA810AS	1.95
TBA920Q	†3.68
TBA940	†1.95
TBA950	†3.88
TBA990	†2.90
TBA990Q	†3.35
TCA270A	†3.55
TCA270CQ	†3.55
TCA270Q	†3.55
TCA800	5.55
TDA440	†4.10
ZN414	†1.45

DIODES

Type	Price (£)
AA113	0.17
AA119	0.13
AAZ13	0.30
AY102	1.85
BA100	0.24
BA102	0.25
BA104	0.19
BA110	0.80
BA111	0.70
BA112	0.85
BA115	0.15
BA121	0.85
BA129	0.39
BA145	0.19
BA148	0.19
BA154	0.19
BA155	0.19
BA156	0.15
BA157	0.25
BA158	0.28
BA201	0.13
BAX13	0.08
BAX16	0.10
BAY72	0.18
BB104B	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.40
BY100	0.35
BY103	0.35
BY118	1.10
BY126	0.16
BY127	0.18
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.83
BY182	1.14
BY199	0.29

Type	Price (£)
BY206	0.31
BY238	0.25
BYX10	0.31
FSY11A	0.58
FSY41A	0.51
ITT44	0.08
ITT210	0.63
ITT827	0.80
ITT921	0.12
ITT922	0.12
ITT923	0.18
ITT1075	0.15
ITT2001	0.12
ITT2002	0.13
ITT2003	0.25
OA10	0.37
OA47	0.15
OA81	0.17
OA90	0.10
OA91	0.12
OA200	0.10
OA202	0.13
S2M1	0.38
S6M1	0.49
TV20	2.25
IN914	0.07
IN916	0.09
IN1184	1.10
IN1185	1.30
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4007	0.14
IN4148	0.06
IN4448	0.10
IN5400	0.15
IN5401	0.17
IS44	0.07
IS920	0.09
IS921	0.12

ZENER DIODES

400mW plastic 3.0-33V	21p each
1/1.3W plastic 3.3-180V	20p each
1.5W flange 4.7-75V	99p each
2.5W plastic 7.5-75V	87p each
20W stud 7.5-75V	92p each
75W stud 7.5-75V	£6.88 each

VDR'S ETC.

Type	Price (£)
E295ZZ	
/01	†0.21
/02	†0.21
E298CD	
/A258	†0.20
E298ED	
/A258	†0.18
/A260	†0.18
/A262	†0.18
/A265	†0.18
/P268	†0.18
E298ZZ	
/05	†0.20
/06	†0.18
E299DD/P116 –	
• P354 all	†0.17
E299DH	
/P230	†0.72
2322 554	
02221	†0.59
VA1015	†0.78
VA1026	†0.64
VA1033/34/38/39/40/53 all	†0.17
VA1055s/56s/66s/67s/ all	†0.21
VA1077	†0.27
VA1096/97/98 all	†0.19
VA1104	†0.44
VA8650	†1.40
2322, 662, 98003	†1.20

VALVES

Type	Price (£)
DY86/87	†0.54
DY802	†0.54
ECC82	†0.54
EF80	†0.54
EF183	†0.70
EF184	†0.70
EH90	†0.94
EL34	†1.08
PCC84	†0.65
PCC85	†0.79
PCC89	†0.74
PCC189	†0.94
PCF80	†0.65
PCF86	†0.74
PCF200	†1.16
PCF801	†0.74
PCF802	†0.79
PCL82	†0.65
PCL83	†0.74
PCL84	†0.65
PCL86	†0.74
PCL805/85	†0.74
PD500	3.75
PFL200	†0.94
PL36	†1.08
PL81	†0.94
PL84	†0.79
PL504	†1.05
PL508	†1.33
PL509	†3.10
PL802	†3.25
PY81/800	†0.58
PY500A	†1.45

RESISTORS

Carbon Film (5%)† ea

¼W 5.6 Ω-330K Ω (E12)	3p
⅓W 10 Ω-10M Ω (E24)	3p
1W 10 Ω-10M Ω (E12)	5p
2W 10 Ω-10M Ω (E6)	9p

Wirewound (5%)

2½W 0.22 Ω-270 Ω	18p
4W 1.0 Ω-10k Ω	22p
7W 1.0 Ω-22k Ω	24p
11W 1.0 Ω-22k Ω	28p
17W 1.0 Ω-22k Ω	33p

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TELEVISION

Industrial Indigestion

The UK's TV industry is in a sorry state, and the electronics industry's Little Neddy has now appointed independent consultants to study it – the TV industry will be co-operating in this study, and will be partly financing it, public funds making up the total. The basic problem is lack of profitability – in fact operating overall at a loss.

The study will make comparisons with foreign setmakers, and is expected to lead to rationalisation, i.e. someone, somewhere closing down. It's a sad situation just five years after the famous boom when it was impossible to produce enough sets, and plants of one sort or another – from complete set assembly lines to small plants doing subassembly work – were being hastily set up all over the place.

We don't think it melodramatic to call the position tragic. After all, a great deal of the basic TV development work over the years has been undertaken in the UK. There has been extensive investment, often at the most difficult times, i.e. when sales have been low, in order to keep up with technological requirements. There is no doubt about the engineering achievements of the UK TV industry. And belated though nevertheless genuine efforts have been made to develop export markets. What went wrong?

There's a sad inevitability about some aspects of the story. Take for instance the 405-line system. This meant that for many years manufacturers elsewhere had no interest whatsoever in the UK market. Then with the start of u.h.f. services everything changed. There was a further short period of isolation from full international competition – during the dual-standard era, while the u.h.f. services were being extended to cover the bulk of the population. Then came the Japanese/continental invasion and the famous 1972-3 boom.

On the economic side there had been the policy of stop/go (remember? – it's been stuck at stop for rather a long time now). The idea was that the government of the day tried to keep the economy running smoothly by controlling consumer demand. If production bottlenecks arose and inflationary tendencies started to accelerate, taxes were increased, particularly on consumer products, in order to damp down demand. Conversely, if the economy was slack purchase tax was chopped and credit made easier to obtain. It seems to be generally accepted nowadays that the system worked atrociously: no government could ever monitor the real economy with sufficient accuracy to get the timing of its economic measures anywhere near right, and the system made it impossible for firms to plan their activities and investment sensibly.

Then came the era of consumerism. The only thing that mattered was that the consumer got a good bargain with every conceivable safeguard. Nothing inherently wrong with that. But it just so happens that as a nation we are rather better at distribution than at production. The discount warehouses sprang up, then the high street discounters, and in fact the consumer has had a bargain indeed. If the UK setmaker couldn't compete, your aggressive retailer could always get his supplies from elsewhere – helped by highly efficient UK agents! The net result: production without profit.

The industry study is going to have its work cut out to offer anything much by way of a solution to this dilemma. It's not as if the situation is unique to consumer electronics – or to the UK. The once mighty US consumer electronics industry has been ailing badly – most recently GE, one of the pioneers of TV in the USA, sold off its TV plant to Hitachi – while the Norwegian government has just baled out Tandberg at a cost of several millions. There is massive over capacity in other industries as well: steel, cars and shipbuilding spring immediately to mind. The fact is that the international economy is suffering from accute indigestion.

Looking back, the stop/go policies of the fifties and sixties left UK producers ill prepared for the conditions of the seventies. In TV terms, u.h.f. exposed the UK market to international competition, which was exploited by aggressive merchandising. The public have got their sets cheaply, but no one has made much profit out of it all. The ultimate loss comes in employment.

Trade protection is being widely canvassed as a solution. We may well have to resort to it in some measure. The industry study is going to have to think in international terms if it's going to be able to offer anything worth while from a long-term point of view. Perhaps solutions can lie only in a degree of international trade co-operation.

COVER PHOTOGRAPH

Our cover photograph shows the busy end of Garry Smith's lattice aerial mast. The arrays are as follows: top, a Wolsey Colour King wideband u.h.f. aerial fitted with a Labgear two-stage masthead amplifier; next, four feet below the u.h.f. array, a Jaybeam ABM11 wideband Band III aerial fitted with a Labgear CM6030 amplifier; and at bottom, immediately above the Stolle rotator, a home-constructed wideband Band I array incorporating a Band II dipole, both dipoles being fitted with Labgear CM6030 wideband masthead amplifiers. Photograph taken by Keith Hamer.

Teletopics

OBA OR ITV-2?

The Annan Committee on the future of broadcasting in the UK deliberated for a long time before producing its report and recommendations last spring. One of the main recommendations was that a new organisation, the Open Broadcasting Authority, should be set up to run the fourth TV service. The idea was to encourage a fresh approach to programming and to give greater scope to those outside the present broadcasting establishment to produce material for TV. You may think that this sounds rather nebulous: but similar organisations operate successfully in other countries, the usual example quoted being the Netherlands.

The Government has now announced that it is shortly to publish a White Paper outlining its proposals. Having deliberated rather more briefly that Annan, the main point – if the many leaks are to be believed – seems to be that the OBA suggestion will be thrown out and the fourth service handed over to ITV. But not immediately: the decision is likely to be deferred for "at least three years", due to the cost and the low national priority. Well yes, we can see that: the present organisations appear to be stretched to the limits to find material to fill the hours available, and the economic situation is taking an inordinate time to improve. Surely however if there is to be such a deferment this would provide the time required to carefully plan and set up a new organisation with new objectives? It looks though as if the more convenient solution will be adopted instead: there's probably enough potential advertising to finance TV-4, which can thus be simply handed over to the IBA to farm out.

But isn't the public entitled to the chance of being able to choose to see something which could offer the prospect of a genuine alternative to the present all too often dreary fare? We're not against advertising, but a second purely commercial network means yet another programme designed to have majority appeal. What's wanted is something that aims to have minority appeal – not total lack of appeal, that's something else again!

RECENT CHASSIS

We had an opportunity recently to examine the Rediffusion Mk. III colour chassis – the one with the RCA PIL tube. It's an interesting chassis and, service engineers be warned, is quite unlike any other chassis produced by a UK setmaker. For one thing, it uses a thyristor line output stage which is fed from a regulated h.t. line – unlike the usual continental practice of effecting width/e.h.t. regulation within such a line output stage. The field timebase is that rather complicated design, originally devised by RCA, we've become familiar with in the Thorn 9000, Rank Z718 and Decca 100 chassis. There's a sync separator/line oscillator chip we'd not come across before – the TDA9400. Most of the signal side consists of conventional discrete transistor circuitry, though the RGB output stages are of the class AB type (see *Television* November 1976, page 43). The ident stage consists of an *RC* oscillator, while beam limiting is effected by means of a f.e.t. in the luminance channel. These sets appear mainly under the Doric brand name.

Tandberg have now released further details of their new range of colour sets – fitted with the CTV3 chassis which we mentioned briefly in January. Reducing the power dissipation has been one of the main aims, and a consumption of 110W has been achieved. An interesting feature is the "colour noise limiter" which provides improved picture quality under adverse signal conditions. Briefly, an a.c.c. circuit can hold the chrominance signal steady even when the a.g.c. circuit is no longer able to stabilise the r.f./i.f. conditions. The consequence is imbalance between the chrominance and luminance signals, and a noisy picture with excessive saturation. The colour noise limiter consists of a peak detector which measures the noise on the bursts and produces an output which is added to the a.c.c. potential. Under normal conditions this added bias is cancelled by the a.c.c. action, but above a certain threshold the peak detector output takes over to reduce the gain in the chrominance channel. Another feature is the two-position contour control, which is again intended to give an improved picture under adverse reception conditions. This is done by adjusting the video bandwidth. The models in the range are the TV164, TV165, TV166 and TV156, the latter incorporating ultrasonic remote control.

Thorn have introduced the 4200 chassis, a version of the 4000 chassis with provision for fitting a 12-channel ultrasonic remote control unit and also a unit which gives a clock and channel display on the screen.

The latest Belgian Barco sets do just about everything possible to date. In addition to digital tuning by voltage synthesis, time and channel on the screen, telephone button cutting sound and the display of a second channel's picture in the corner of the screen (as featured in one or two German sets), there's programme jumping, with eight-second flashes of a second programme at regular 22-second intervals. The innards of TV sets are becoming complex indeed.

Two 12in. mains/battery portables, Models 190 and 191, have been added to the Pye range. They are UK produced and have been designed for easy servicing – all components are mounted on a single printed board which can be slid out with the set still working.

TELETEXT RECEIVERS

Thorn have released details of their Teletext receiver – the 9650 chassis, developed from the recently announced 9600 chassis – and ITT have started to market their Model TX791 teletext colour receiver. Meanwhile Rank, who were first to introduce a colour set (Model BC6333) equipped to receive the teletext transmissions, have introduced a test panel to aid fault diagnosis. Plug it in in place of the Tifax decoder panel and indication is given, by means of a l.e.d. display, as to whether the fault is in the Tifax unit or the interfacing panel.

CLEANING AVOIDS EHT ARCING

Dirt and dampness are a common cause of persistent arcing or tracking around the e.h.t. connector of colour tubes, and it's good practice to clean around the e.h.t. connector

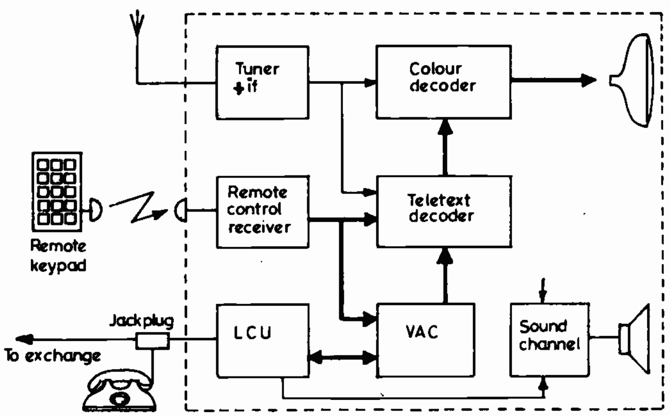

Fig. 1: Block diagram of a TV receiver incorporating a teletext decoder and Viewdata facilities.

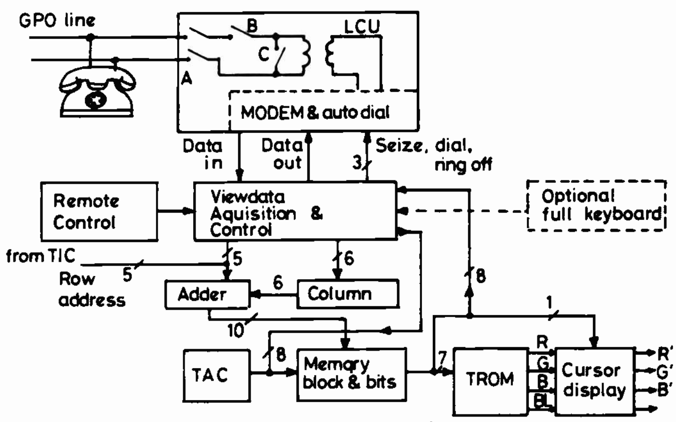

Fig. 2: Data highways and interconnections between the teletext and Viewdata sections of the receiver.

whenever a set is serviced. Thorn have been investigating the effectiveness of cleaning and sealing agents for tubes used under adverse conditions, and are now offering the trade two specially formulated aerosol sprays as a cleaning and sealing kit (part number 00X6—062, trade price £1.65 plus VAT). Thorn point out that the use of this kit should reduce cases of tube failure due to e.h.t. flashovers.

RELAY STATION OPENINGS

Llanberis (Gwynedd) BBC Wales channel 22, ITV (HTV Wales) channel 25, BBC-2 channel 28. Receiving aerial group A.
Upavon (Wiltshire) ITV (HTV West) channel 23, BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.
Ynys Owen (Mid-Glamorgan) BBC Wales channel 55, ITV (HTV Wales) channel 59, BBC-2 channel 62. Receiving aerial group C/D.

All these transmissions are vertically polarised.

MICRO MONITOR

Sinclair's Microvision 2in. TV set is to be made available in other forms – as a portable monitor for studio use, as a camera viewfinder and for video recorder playback.

REPROCESSED CRTs FROM MULLARD

A range of reprocessed colour tubes – the Colourex range – has been introduced by Mullard for the replacement market. The range includes 18-26in. 90° types and 22 and 26in. 110° types, also 22 and 26in. 20AX tubes. Replacements are supplied only on receipt of an old tube with sound glassware. The reprocessed tubes are fitted with a new gun and rimband, and undergo the same testing procedures as the Mullard Colourscreen range – they also have a similar guarantee.

VIEWDATA

The results of Mullard's research and investment in developing the components necessary for Viewdata use were recently shown to the trade press. Mullard emphasise the importance of an integrated system, their "package" consisting of a line coupling unit (LCU), a Viewdata acquistion/control unit (VAC), a teletext decoder and a remote control unit. The arrangement is shown in Fig. 1, while Fig. 2 shows the data paths and Viewdata/teletext interconnections adopted. The telephone line is connected to the LCU via a jack socket. The LCU provides the interfacing with the receiver, and consists of a 1200/75 band modem, line isolation, loudspeaker output, autodialler and protection. The VAC provides interfacing between the LCU and the teletext decoder. Its functions are to handle the data received from the Viewdata computer, feeding this to the teletext display circuitry, and to transmit requests for new information. In effect, the Viewdata and teletext decoders share a common display system. The Mullard teletext decoder has been arranged to enable the Viewdata facility to be added without any modification to the teletext i.c.s.

ESSEX ELECTRONICS EXHIBITION

The Department of Electrical Engineering Science at the University of Essex, Colchester, is organising the first Essex Electronics Exhibition which is to be held on April 18-19th. In addition to the exhibition there will be a programme of seminars, and the Department will be showing its research and teaching activities. Admission will be by free ticket from the University (Wivenhoe Park, Colchester) or from exhibitors.

TV LICENCE INCREASE

An increase in the TV licence fee later this year seems certain – whilst the IBA has been able to compensate for the effects of inflation through its agreements with the programme companies, the BBC has suffered the full effects of inflation on both its engineering and programme sides. The only question is the scale of the increase: the BBC wants it to be large enough to be able to maintain the same level for several years.

WORTH NOTING

Two items of interest have been introduced by Adam Imports Ltd., Unit 2A, Ripon Road Industrial Estate, Harrogate, North Yorkshire. The first is a combiner unit which accepts the aerial input and the output from a TV games centre and provides a common feed to the TV set's aerial input socket. There is a selector switch, and the unit is designed to avoid radiation of the game via the aerial. The idea is to avoid damage through constant plug changing of course, and should also prove of interest to those with multiple aerial installations for reception from alternative transmitters.

The second item is something new to us, a battery operated racing car game. Three moving dots of light represent the cars: there is the player's car and two others and the object is to complete four laps in the shortest time whilst avoiding the other cars. An LED display counts up to 99 seconds, after which the time runs out. We don't like to speculate on the sound effects, which are apparently built in.

Beware the Ides of March

Les Lawry-Johns

THE first time I saw that ITT CVC9 I had a funny feeling. I didn't know then that it was going to get me as hopping mad as a mad march hare, similarly to the one we had some time ago which gave faultless performance on our bench but always showed hum bars when returned to the customer.

I know what you're thinking: check the bridge rectifier in the l.t. supply; change the regulator AD161 (or whatever); and check the 33V stabiliser D11 down the bottom on the tuner supply.

We did. We did more in fact, much more. All electrolytics in the l.t. supply circuit substituted, yet another AD161 tried (they're not all suitable even when new), yet still perfect at our place, hum bar at the customer's pad. We eventually got acceptable results by adding an extra, large electrolytic on the l.t. line somewhere on the regulator where there isn't one, and then rushed away like the coward we are and tried to forget it.

Don't get me wrong, we are second to none in our admiration of the CVC5-9 series, but there have been those occasional instances. ... And now this one. It appeared to be simple at first. The fusible 56Ω resistor R380 in the h.t. feed to the line output stage had sprung open, denoting an overload in the line output stage. This chassis has a 630mA delay fuse in series with this supply, the resistor springing open rather than the fuse failing if there is a prolonged but not severe overload. The earlier CVC5 had a 400mA fuse in this line: it used to pop off regularly, but that's another story.

Well, we thought. Not a sudden surge of current like a capacitor shorting or a short in the PY500 efficiency diode. No, there were no shorts to be found. So we resoldered R380 and, with the screening off the line output stage, switched on and waited. Our neon glowed a few inches away from the stage and the e.h.t. rustled up. Kermit appeared on the screen and sung a sad song. No overload. We then left it happily working while we got on with a car radio which worked perfectly on a negative supply and positive earth but not with a negative earth as we required after replacing a shorted sound output stage. It should have worked both ways as diodes are used in the supply line to ensure this. Sure enough, one diode was open-circuit, presumably cooked by the original overload. Locate and replace the diode and it worked both ways. Good.

Where's Kermit gone? Nothing on the CVC9 screen, and the PL509 line output valve overheating with only 15V drive on its control grid (should have been more like 70V). Two things to consider. Either the PL509 was drawing grid current, or there was lack of drive from the PCF802. Change the PL509. Lovely picture but not Kermit. Never mind.

We then watched the drive voltage at the control grid gradually falling bit by bit until the new valve was glowing red and unhappy. Switch off, refit the original valve and unsolder the screen grid supply resistor R421 (which again is a spring-open type, so this was quite easy). With this open, the line output stage is inoperative and tests can be made in a leisurely manner. The h.t. goes up a bit with the reduced load and this does alter things a trifle, but full line drive was not to be expected since the anode (pin 6) of the PCF802 line oscillator valve gets some of its supply from the normal h.t. line via R402 to get it started and then more from the boost line via R403 (see Fig. 1) when the line output stage comes into operation. We could not expect full line drive therefore as the h.t. at pin 6 remained at a little below 100V. It didn't fall however, and everything seemed to be in order in the line oscillator stage.

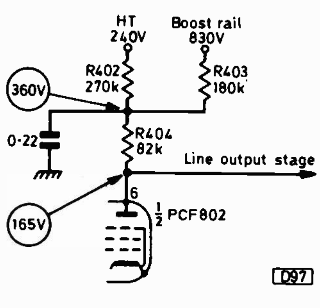

Fig. 1: Supplies to the anode of the PCF802 line oscillator stage in the ITT series CVC5-9 chassis. The main supply is via R403: the feed via R402 is a start up supply.

As we had already replaced the PCF802 earlier in the proceedings this was out, as were the line oscillator capacitors which we still viewed with suspicion as the result of earlier experience. Join up the screen grid feed resistor R421. Up comes the line drive and the picture for a while, and then of course it all sort of tapered off.

And then it hit me like a hammer on the head. The line drive was dropping to a figure just below what it is before the line output stage comes into operation. Where's R403? Follow pin 6 print across to R404, follow on to R403. There it is. Look on the component side. Buried beneath a transformer of course. Remove the tranny and there it is. Nice colours though. Unhook one end, about 300kΩ instead of 180kΩ, doubtless going up further under load. Replace with a 220kΩ 2W type (nearest we had). Refit the tranny, switch on, and test for a long enough period whilst we dressed up the grey scale and convergence.

Double Trouble

When the estate car drew up outside I recognised it and the driver, but not the dog in the rear guarding the Ferguson 3713 colour set. It was Mr. Doubleday bringing in his TV set as is his wont. A nice man Mr. Doubleday, but he has one distressing habit. He always repeats the last word of each statement he makes.

In he came carrying the Thorn 8500.

"Hallo Mr. Doubleday," I greeted him. "Nice dog you've got there, what is it?"

"It's a German pointer, pointer," he said. It was clearly going to be an interesting few minutes.

"What's up with the old set this time?" I enquired, for the want of something to say.

"It won't go, go," he replied. "Even when I push in the little red button it only hums and goes click, click."

"Oh dear," I said, trying hard not to say an extra dear.

Now Mr. Doubleday is no fool, he knows his onions. "There's probably a short, short," he confided.

"I agree, agree", I blurted out, and was immediately sorry. He didn't even notice.

"I'll be back about five, five. The reception is still no good where we are you know know", he rushed on. "See you then then."

He lives just outside the Medway towns, not far from the Bluebell Hill transmitting aerial but lower down the hill. It would appear that the mighty signal serves everyone except those in its shadow. Incidentally, there's a pub at the top of

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CA3023	1.78	LM386N	0.80	MC1305P	1.85	SN76033N	2.55	TAA621	2.15
CA3036	0.97	LM387N	1.05	MC1306P	1.00	SN76110N	1.46	TAA661A	1.32
CA3041	1.49	LM388N	1.00	MC1310P	1.91	SN76115N	1.87	TAA661B	1.32
CA3042	1.49	LM389N	1.00	MC1312P	1.98	SN76116N	2.06	TAA700	3.91
CA3043	2.01	LM555CH	0.48	MC1327P	1.54	SN76131N	1.30	TAA930A	1.00
CA3044	1.84	LM565CN	1.30	MC1350P	0.75	SN76226N	1.94	TAA930B	1.05
CA3046	0.89	LM701C	2.80	MC1351P	1.20	SN76227N	1.51	TAD100	1.95
CA3048	2.23	LM702A	2.80	MC1352P	0.97	SN76228N	1.76	TBA120	0.85
CA3052	1.82	LM702C	0.75	MC1357P	1.45	SN76530N	0.91	TBA231	1.20
CA3064	1.84	LM703LN	1.05	MC1414L	1.20	SN76532N	1.50	TBA400	1.50
CA3065	1.74	LM709	0.65	MC1430P	2.20	SN76533N	1.30	TBA500	2.21
CA3066	3.02	LM709-8	0.45	MC1431P	3.00	SN76544N	1.44	TBA500Q	2.30
CA3067	3.13	LM709-14	0.45	MC1433G	3.00	SN76545N	2.09	TBA510	2.21
CA3068	3.46	LM711CN	0.55	MC1435G	1.80	SN76546N	1.44	TBA510Q	2.30
CA3070	2.49	LM726	5.36	MC1437L	1.80	SN76550-2	0.41	TBA520	2.21
CA3071	2.31	LM733CN	1.45	MC1438R	7.46	SN76552-2	0.65	TBA520Q	2.30
CA3072	2.37	LM741C	0.65	MC1439G	1.45	SN76570N	2.08	TBA530	1.98
CA3075	1.88	LM741C-8	0.40	MC1455G	1.55	SN76620AN	1.10	TBA530Q	2.07
CA3076	1.93	LM741C-14	0.50	MC1456G	2.20	SN76650N	1.10	TBA540	2.21
CA3086	0.51	LM747CN	0.90	MC1495L	4.70	SN76660N	0.80	TBA550	3.13
CA3088F	1.59	LM748-8	0.50	MC1496G	1.10	SN76666N	0.92	TBA560CQ	3.22
CA3089E	2.52	LM748-14	0.50	MC1529G	6.50	SL414A	2.35	TBA570	1.29
CA3090Q	3.80	LM1303N	1.47	MC1530G	6.50	SL415	2.50	TBA641B	2.50
LM301AH	0.67	LM1304N	1.85	MC1531G	6.50	SL610C	2.35	TBA700	1.52
LM301-8	0.44	LM1305N	1.85	MC1553G	6.50	SL611C	2.35	TBA720AQ	2.30
LM308H	1.82	LM1307N	1.10	MC1545L	5.75	SL612C	2.35	TBA750	1.98
LM308N	1.17	LM1351N	1.20	MC1545L	6.75	SL620C	3.50	TBA800	1.20
LM370N	3.00	LM1310N	1.91	MC1550G	0.80	SL621C	3.50	TBA820	1.03
LM371H	2.25	LM1458N	0.91	MC1552G	6.40	SL623C	5.75	TBA920	2.90
LM372N	2.15	LM1496N	0.91	MC1553G	6.40	SL630C	2.35	TBA940	1.82
LM373N	2.25	LM1800N	1.76	MC1590G	3.75	SL640C	4.00	TCA160B	1.81
LM374N	2.25	LM1808N	1.92	SAS560	2.50	SL641C	4.00	TCA280A	1.30
LM377N	1.75	LM1820N	1.10	SAS570	2.50	SL701C	2.00	TCA290A	3.13
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the hill called the Upper Bell and one at the bottom called, would you believe it, the Lower Bell. There's more irrelevant information to follow, so don't go away.

Now to the set. Switching on produced nothing so the cut out was out. Pressing the button produced a hum and then a click as the cut out cut out (this sort of thing gets you after a while). Having been fooled in the past, we checked the current through the cut out. 4A. This was a brief check, and the anti-surge fuse didn't have time to blow. With that relatively small overload, clearly the mains filter capacitor and the rectifiers could not be at fault so suspicion fell upon the line output transistor.

The collector of the transistor is connected to the top of the line output transformer via a brown lead and a series choke. Unhooking this is a matter of seconds. With this off the set came on with the tube heaters glowing, so either the transistor was at fault or there was a short associated with the circuit.

Withdraw the chassis partly and lower the right side panel to gain access to the line output stage's working parts. With the brown lead disconnected, the collector of the line output transistor is isolated except for the heatsink which is fairly hefty but insulated by its chassis pegs. Checks proved that there was a leak from the collector to the emitter. There's the usual tuning capacitor (C406) present, but this is rarely at fault and wasn't on this occasion. Other checks showed no fault so we fitted a nice new transistor, using a 2SC643A to replace the original BU105/02.

All clear. Reconnect the brown lead and make sure that the focus plug hasn't been pulled off in the struggle. Switch on, slight buzz and up comes the e.h.t. Nice. Connect aerial and select bottom button to tune to London (leaving top three alone as they are tuned to Bluebell Hill but our aerials do not look that way). Not a bad picture.

Switch off and refit the chassis fully in. Insert screws and replace rear cover, at the same time switching on again to see that all is well. It wasn't. Buzz and click and we were back to square one.

Check again. New line output transistor not new any more. Slide out chassis. No shorts, no cause. Oh well. Fit another transistor, recheck and try again with the chassis still partly out. Lovely. Leave for some time, no trouble.

Carefully slide chassis in. At the moment it was fully in there was a sharp click and another line output transistor bit the dust. Not much fun. Close inspection showed that as the chassis was pushed fully into the cabinet the e.h.t. cable doubled back and touched the input to the rectifier, whereupon the insulation failed at that point and bang went the line output transistor. There was nothing wrong with the rectifier, only the cable near the e.h.t. clip end. This was shortened and the clip refitted, thus killing two birds as it were since the defective bit was out and the cable no longer doubled back. Another new transistor (must order some more) and all was at last well.

Some Quickies

Life then settled down to the dull routine of run of the mill jobs. A lady brought in a Murphy V1400 which is a 14in. portable made in Japan.

"No sound" she said. There was no sound until we put it on its face to remove the cover. Then the sound came back. Tilt the set up and off went the sound. This proved to be nothing more than a slightly defective volume control (knob at the front, thus pressure restored sound), and this responded to cleaning.

What she had omitted to mention however was that ITV on channel 23 couldn't be tuned in though the higher channels could. As it happens, with this type of tuner the top can be easily taken off, or rather the side as the side was at the top . . . you see. This revealed the single slab stator and the thinner rotor plates on either side in each section. The rotors were not fouling, so we cleaned off the grease on the spindle in each section and on came the ITV, now easily tuned.

Next was a nice white Waltham portable, only a week or so old. Would we help? Blown fuse, shorted diode in bridge. Replace diode, replace fuse, worked for a short time, fuse blew. Another diode shorted, would you believe it? Put another one in and another fuse, only to find that the primary winding of the mains transformer was now defective with shorted turns. Consult with customer about implementing warranty.

Thorn 1500 with intermittent vision and sound signals. Guess at faulty BF197 transistor in final i.f. stage. Guess right for a change.

Two hours, then it went ping

Finally a Philips G20T325 (320 solid-state monochrome chassis). No results due to the h.t. line resistor R4465 having sprung open (feed to the line output stage). Check possibilities, no fault. Solder up resistor, picture and sound o.k. H.T. a trifle high: reset R5630 for 158V HT1 line. Then the mains fuse shatters.

Why? Check around, find that the bridge rectifier is shorted on one leg, negative as usual. Remove faulty bridge and carefully fit another *of the wrong type* (they say that confession is good for the soul). Despite the fact that there were plenty of BY179s around, I had carefully selected a BY164 (42V, 120V VIRM) and put it slap across the 240V mains input. Incredibly it held and functioned.

I woke up in the early hours of the morning, suddenly fully aware of what I'd done.

"What's the matter now" asked my always sympathetic spouse. "Is the wind worrying you?"

"I haven't got the wind" I snapped, and then realised that there was a force nine gale outside. "Was that slim Philips black and white set collected?"

"Yes, nice fellow too."

"He won't be nice when he brings his set back: I put the wrong rectifier in and it won't last a dog watch." I slipped back into a troubled sleep, with green bridge rectifiers dangling before me instead of black ones.

Sure enough he came back and I explained my error. He said he was glad it wasn't the set, as he was beginning to think there was one of those gremlins loose inside.

Opening up the set I was amazed to find the fuse intact. "How long did it last?" "About two hours and then it went ping." This meant that the spring of the line output stage h.t. supply resistor R4465 had sprung open again. Not the rectifier at all: back to the original illusive intermittent fault.

I hurriedly removed the BY164 and substituted the correct BY179. Resoldering R4465 and then switching on produced normal results. To me this meant either that the h.t. rectifier thyristor was leaking after a period, or that the line output transistor was acting up. Despite the earlier drain on our resources of these latter items we still had a few left of the correct type – the 2SC643A will replace the BU105, BU204, BU205 and BU206 (not the BU108, BU208 and BDX32 however). So we fitted a new line output transistor and left a voltmeter connected to the HT1 line to see whether it crept up over a period. It didn't, so we concluded that the BU205 had been at fault all along and that the failure of the BY179 had been only a red herring.

Video Adapted Receivers

David K. Matthewson, B.Sc.

A large proportion of the capital expenditure of anyone involved with closed-circuit television on whatever scale is likely to be spent on video monitors. Even in a small studio with a monitor for each of say three camera channels, a studio out and a videotape recorder monitor the cost will be at least £600, and that's using relatively cheap, non-professional monitors. Since they are so expensive, it's fortunate that for many applications proper broadcast standard monitors are not required. Even our local "professionals" use a well known Japanese colour TV/monitor for many non-critical applications.

Quite a wide range of monitors is available, either with or without audio facilities and with either colour or monochrome tubes. Those at the top end of the range are usually purpose built, but many of the cheaper ones are based on successful domestic TV chassis. These latter ones also provide a 1V 75Ω off-air video signal as well as an off-air audio output. Examples of this type of video adapted receiver (VAR) are the Sony colour Model CVM-1810UB and the Sony monochrome Model CVM-90UB. Both are based on domestic designs but have an additional printed panel containing input and output buffer amplifiers, and can be switched to either off-air or video input as required.

Sony Monochrome VAR

The circuit of the extra board used in Model CVM-90UB is shown in Fig. 1. It's comparatively straightforward, and bearing this in mind it should be possible to modify other sets to act as VARs with quite a considerable saving in cost.

Choosing a Set for Modification

Various factors have to be considered before choosing a set for modification. The most important is safety, and to this end only sets which have a fully isolated mains transformer (and thus an isolated chassis) should be used. Sets with a half-live chassis are suitable for use only in conjunction with a properly designed u.h.f. modulator – no attempt should ever be made to interface such sets directly with the video or sound stages. The second point is that the timebases should be sufficiently flexible to be able to cope with the sync signals provided by cheap videotape recorders and cameras in addition to the high-quality broadcast signals. Finally, there should be convenient points at which to link up to the added video/audio in-out board. It's best to take the composite video signal from the output of the first video amplifier, and the audio from a point after the sound detector but before the output stage. It's a good idea therefore to study the service manuals of a number of sets before making a final choice.

Practical Adaptation

The set I chose recently was a Sharp Model 12P-30H monochrome portable. This is a battery/mains u.h.f. only set which should be available at less than £60. The mains transformer makes the set safe, and the resulting VAR displays a stable picture from a wide range of sources, including helical-scan videotape recorders and off-air broadcast signals.

Fig. 2 shows where the modifications were made, Fig. 3 the added circuits in block diagram form, and Figs. 4-6 the circuit details.

The added circuitry is quite conventional and is designed to give and accept a 1V peak-to-peak composite video signal at 75Ω. The 6MHz trap is required because the off-air video signal is extracted at a point before the intercarrier sound filtering, so that the intercarrier sound signal is still present. In this particular set it is not necessary to amplify the off-air audio output, though Fig. 1 shows how this can be done.

The video and audio input and output sockets are PL259 types and can be mounted at the back of the set along with a 75Ω termination switch. A switch mounted on the amplifier board changes between off-air and video input – the board can be arranged so that this switch projects through the front of the cabinet. The switch changes both sound and vision.

No problems should be encountered in constructing and installing the amplifier board as neither the components nor the layout are at all critical. Alignment of the 6MHz trap is best done with an oscilloscope, though it can be done "by eye" if one is not available.

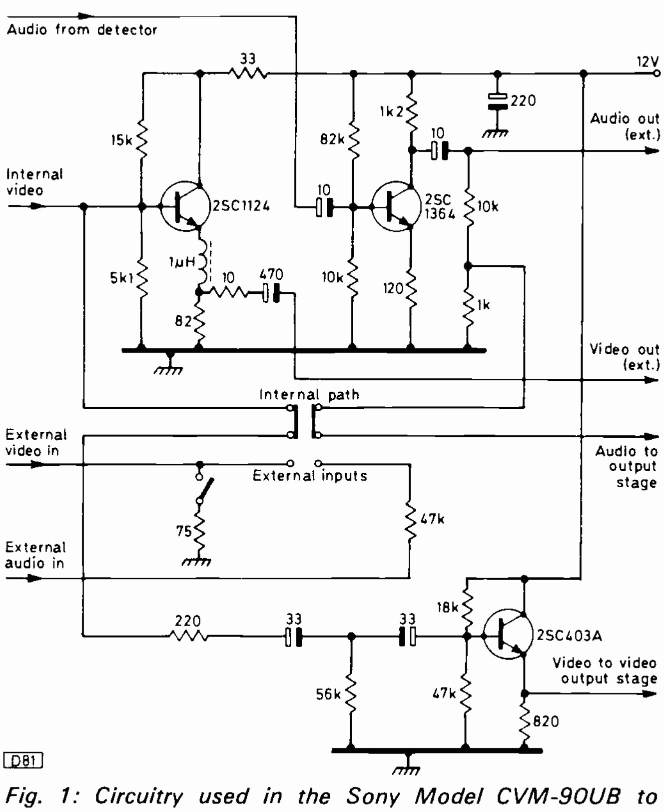


Fig. 1: Circuitry used in the Sony Model CVM-90UB to provide external video and audio inputs and outputs. The amplifiers are mounted on a separate panel.

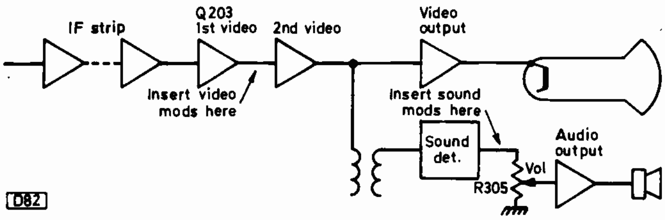


Fig. 2: Block diagram showing where modifications were made to the Sharp monochrome portable Model 12P-30H.

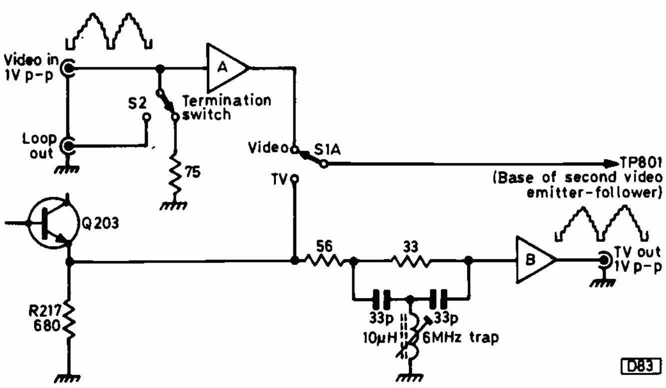
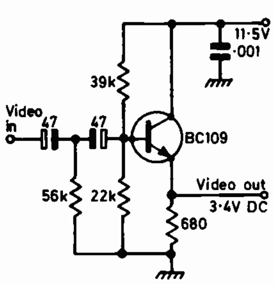


Fig. 3: Block diagram showing the arrangement of the video input and output amplifiers (A and B respectively). In the unmodified form the emitter of the first video amplifier Q203 is directly linked to TP801.



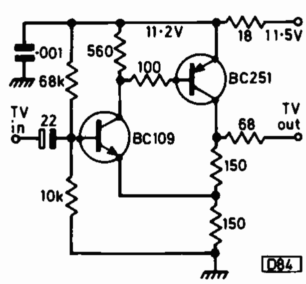
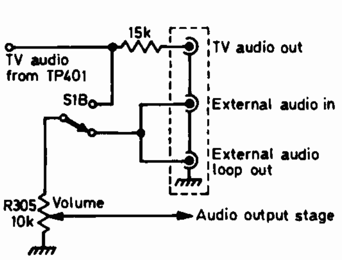


Fig. 4 (left): Circuit of the external video input amplifier A: the output goes to the TV/video switch S1A.

Fig. 5 (right): Circuit of the off-air video output amplifier B: the output signal is fed to the TV output socket.



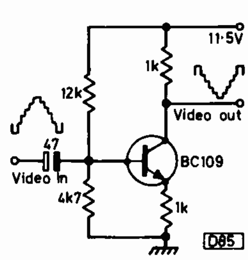


Fig. 6 (left): Modifications for external audio input and off-air audio output. The sockets are mounted on the back of the set: 3·5mm mini-jacks are suitable.

Fig. 7 (right): Suggested circuit for an inverting stage to precede the main amplifier should the polarity of the signal otherwise be opposite to what is required.

The method of adaptation described here can be applied to other sets, though in some cases the off-air video output and video input signals may require inversion in order to get signals of the correct polarity. A suitable inverting amplifier circuit is shown in Fig. 7.

Finally, remember that any such modifications to a set will invalidate the manufacturer's guarantee. ■

Set Renovations

Steven Knowles

MOST engineers involved in the servicing side of television will at some time or another have come into possession of a receiver for which the owner has no further use and which would seem to be ideal for renovating and reselling as a "reconditioned set". Some engineers do this on a regular basis, others only occasionally. Whichever the case, the procedure is the same. The set is taken in, thoroughly examined, all faults removed (and this includes any potential faults or weaknesses that may be spotted in the process) and then finally sold, whereupon it begins a new life in a new home.

Choice of Set

Obviously not all sets are suitable for reconditioning. Some will be just too old, some more will be of a type that was none too reliable even when new, whilst others, even though they may be of quite recent vintage, may be disqualified due to the way previous repair work has been carried out. The condition of printed panels is a vital consideration here: how many burn-ups have taken place in the past, and in what manner have they been repaired?

Different engineers have different priorities when deciding whether or not a set is a suitable candidate for reconditioning. Some use the age of the set as the deciding factor; others recondition only certain makes and chassis; some consider only single-standard sets, refusing to bother with any of the earlier "dual" models; whilst others take each receiver on its own merits.

It's my own opinion that the last method is by far the best. The problem with using age as the deciding factor is that age is no guide to condition (or at least only very generally). For example in my area, within a very short distance of one another, there are two receivers fitted with the Thorn 1500 chassis. Both were installed new in 1972. One has received only five service calls to date since then. The other has been a real "1500 nightmare", producing all the possible ailments of weak sync, lack of contrast, intermittent field jitter (my god!), and the open-circuit dropper section which short-circuits the video and i.f. transistors. There we have it then: two sets of the same type and of the same age – and totally different. To take it a step further, which of these two sets would be the better candidate for reconditioning? Yes, I agree with you! But this sort of situation will not arise very often since the engineer doing the overhaul will in many cases not have met the set before and consequently will know nothing of its servicing history.

Dual-standard sets call for a different line of thought (no, I wasn't trying to be funny). The problem is that these sets were designed as a compromise between two different systems of operation. A dual-standard set working on 625 lines can hardly be expected to give results as good as a single-standard set designed for that purpose although, remarkably, some of them do. The point here is that the vast majority of sets that are bought after reconditioning are bought as "second sets" i.e., for a bedroom or a dining room. The customer will very likely have an outside aerial array for his set, but he is unlikely to have two. Unless the customer decides to do it properly therefore, arranging for another aerial to be installed on the mast to feed the second set, or, alternatively, if in a good signal area he arranges for a "split" on the existing installation, an indoor or set top aerial will be required. Gain will then need to be good, and results are likely to be much better if the set in question has a transistorised i.f. strip and/or tuner. Also, if an indoor aerial has to be used it is advisable that the set is used on one standard only, i.e. u.h.f. Using both standards means two aerials which can be quite unsightly as well as unnecessary.

Another problem comes in here. A large percentage of dual-standard sets were fitted with rotary u.h.f. tuners, and whilst this presents no problems to the more technically minded customers it's surprising how many people, used to the more simple push-button or touch sensitive systems of today, can get into a right old tizz-wozz when it comes to tuning in stations in a manner similar to an ordinary radio set – surprising, but there it is!

The foregoing remarks also apply to dual-standard colour sets. Again discrimination is required as to what is and what is not suitable for reconditioning. Many people seem to think that a colour set is suitable for reconditioning just because it *is* a colour set! A lot of early ones were real electrical jungles and, whilst it may be possible to simplify them by removing the v.h.f. sections (system switching etc.) and wiring up for one mode of operation only, the time taken to do this may make the whole thing uneconomic. Anyway, we're talking about overhauling sets, not rebuilding or redesigning them.

If dealing with only one particular make of chassis, spares can often be used from the earlier ones which are beyond overhaul to repair newer ones. To take the Thorn range for example. The 800 series, which started way back in 1961, was soon superseded by the 850 (dual-standard and convertible versions). Following this came the 900 and 950 chassis, then the 1400 which was the last all-valve dual standard set from Thorn. The 1500 single-standard hybrid chassis followed that at the end of the sixties, and is only now being phased out. Parts can often be interchanged between a series of chassis like these. For example, I recently used a set of deflection coils from an early "scrap" 900 chassis to replace a faulty set in a more modern 1500 chassis: many more similar swops can often be made.

Panel Repairs

Now let's look at the overhauling business itself. We have already mentioned the importance of the condition of printed panels and the way in which any previous repairs have been dealt with. It often happens that a valve's h.t. feed or bias resistor overheats and burns out due to an interelectrode short in the valve, or to a short in an associated decoupling capacitor. If the offending resistor was mounted touching the board, a burn mark will be apparent when the resistor is removed. Even though a replacement component may be stood off from the board by fitting it on lengthened leads, conduction can still take place across the scorched area. If only the surface of the board is affected, the carbonised area can be removed by scraping gently with a penknife or similar instrument. If the scorch extends through the thickness of the panel however then this portion will have to be removed. The resulting hole (providing it's small) can be dealt with as follows. "Key" the edges of the hole or roughen with sandpaper or a small nail file. Place a piece of masking tape over the hole on the component side. Turn the board upside down. Mix up a suitable quantity of Araldite and use it to fill the recess. Araldite is not only extremely strong when dry, it's also an excellent electrical insulator. When the mix has gone completely hard, remove the masking tape and replace the component. Note that this method is suitable only for repairing small areas. Large gaps or holes should not be dealt with in this manner.

Renovation

The mains dropper is another important consideration in those sets that have one – and most receivers will have at least one open-circuit section which has been bridged (usually more). There may even be two resistors wired in series if the open-circuit section is of a particularly high value. The replacement resistors themselves are usually of different types, ranging from the ordinary wire-ended component to the more reliable RS sections. It's often the case that the replacements have been soldered directly to the dropper tags – the resulting heat from the dropper nearly always melts the solder and the component is left "hanging" from the tags.

When overhauling sets that have droppers my own guidelines are as follows. If only one section has been bridged (providing the resistor is of a suitable type, has the correct wattage rating and resistance value and has been properly connected) I let it pass. If more than one section has been bridged I replace the complete dropper. Mains droppers are relatively inexpensive items and if the original looks at all ropey it's well worth while replacing it (in terms of future reliability). One last point worth remembering: if an open-circuit section which has been bridged should temporarily heal itself (and this can happen) then the total resistance across that section will be halved, i.e. the two resistors are in parallel, leading to severe overrunning (depending on the value concerned).

Still concentrating on the mains input circuit, two other points worth checking are the on/off switch and the mains filter capacitor. If one pole of the on/off switch has been linked across (due to an open-circuit) it should be replaced. The filter capacitor should also be checked (if only to make sure it's there!). When it goes short-circuit some engineers simply snip it out instead of replacing it. The purpose of this capacitor (as its name implies) is to bypass mains interference – accordingly it should always be replaced. If the capacitor is found to be missing, an $0{\cdot}1\mu F$ one rated at 1,000V d.c. is a suitable replacement.

Mention was made earlier of "potential faults or weaknesses". For example, the field scan amplitude may be perfectly acceptable, but how has the preset height control been set in order to achieve this? If it's found to be set at maximum or near maximum, it's silly to let the set go out in this condition for it will undoubtedly be back within a short while. The trouble (assuming the linearity is all right) is nearly always due to change in value of a resistor in the boost feed to the field charging circuit (and once a resistor value change starts it usually continues).

The same applies to the field linearity. Once again this may be perfectly acceptable, but how have the linearity preset controls been adjusted to bring this about? If one or both of the presets are found to be hard against the end stop a fault condition is present and should be corrected. Check the valve and its biasing components.

Whilst on the subject of presets, it's always worth checking the operation of the preset "user" controls (usually rear mounted). These are generally connected straight into the printed circuit board and rough handling by the previous owner may have caused a fractured joint leading to intermittent operation. If rocking any of these controls causes an undue amount of disturbance to the circuit concerned, there is possibly a fracture. If it cannot be seen by the naked eye, run a soldering iron over all suspect joints in the immediate area of the control.

The Tube

We have left mention of the state of the tube until the end as there is not much that can be done for a receiver which has a faulty tube. If the chassis is otherwise good, it may be worth while fitting a reconditioned tube. Alternatively the chassis can be put to one side until such time as another set (not necessarily of the same make or type) is received with a good tube though otherwise useless, a swop then being made.

The only other possibility (which is not to be recommended when reconditioning for resale) is the use of a c.r.t. rejuvenator. The disadvantage is that the length of time rejuventation lasts cannot be predicted. There is little point in selling a set with a beautifully clear picture only to have the customer return in a couple of months' time with the complaint "the picture's gone all dim and weak". He's not going to take it very kindly when you tell him that the tube's gone and needs to be replaced. On a so-called "reconditioned" set? – it's really not on!

Exterior Appearance

Now to consider exterior appearance. There is nothing worse than seeing for sale a set whose outside control knobs are full of dirt in the milled edges. It's a simple matter to remove the knobs and clean the edges with an old toothbrush or similar, or, if you are of a lazy disposition (like myself), to put them in a bowl with some hot water (not too hot) and household soap powder and leave them for about half an hour, after which most of the dirt will have fallen out. Be careful if the knobs have any numbers or lettering on them though as this may also be removed!

Customer Relations

Finally, customer relations. If you have not met the customer before, nor had any dealings with him, he may well be suspicious and may tend to regard any transaction that takes places between you and him as being a bit of a gamble (on his part). Tact is called for here, and much can be done to assure him (or her) that you are not a crook of the highest order trying to unload a "rogue" television set! A guarantee of some sort should always be given, and when the customer asks (as he surely will) what happens when something goes wrong outside the guarantee period much can be done to dispel his fears if you indicate that you are prepared to service the set should any troubles develop.

The engineer may also on occasion be asked by one of his customers to examine a set that a third person has for sale.

The approach may be something like "a chap I know has a television he wants to sell, it's not very old and I was thinking of getting it for the boy's room. Would you be prepared to look at it for me?" This sort of thing should not be sneered at. It's a chargeable item, and can be looked upon as similar to a prospective car buyer calling in the AA for an examination. The customer is not an expert: you are, and your time must be paid for.

To sum up, selling reconditioned sets can be a very profitable side to the business. If one is prepared to do it properly, there should be very few comebacks on reconditioned sets.

Renovating the Pye 67 Chassis

John Law

THE Pye 67 chassis was, as its number suggests, the Pye-Ekco contribution to the 1967 crop of television receivers. It's also known as the 267, and is a hybrid, dual-standard monochrome chassis. The same basic circuitry with very little modification was also used in the subsequent 368 chassis. The 67 proved to be a popular and reliable design and was widely used by the rental companies. Models fitted with it include the **Dynatron** TV95-TV100, the **Pye** 48, 49, 55, 58, 59, 60 and 61, the **Ekco** T500, TC501, TC502 and T510-T515, the **Invicta** 7043, 7044, 7197, 7301, 7348 and 7349 and the **Ferranti** TC1157-TC1165. Bulk sellers of ex-rental receivers have offered these sets at around £5, at which price they are a good buy and worth the expense of renovation.

The chassis can be lowered to a horizontal position after removing two self-tapping screws at the top. The line output transformer is in a cage on the right-hand side of the main panel, the mains dropper is at the top centre, while the i.f. strip consists of a small printed panel on the left-hand side. The valves, timebase components and the timebase system switch occupy the main panel. Access for servicing is good. The system switch is operated through a bowden cable from the station selector knob on the front of the cabinet, the i.f. section of the switch being mounted on the small i.f. panel.

A system switch will deteriorate due to contact corrosion, the accumulation of dirt and grease, or failure of the contacts and slider to mate. Regular switch cleaning will prevent failure, which can cause no e.h.t., an intermittent raster or loss of signal. Carry out cleaning with a small paint brush and methylated spirits. When dry, coat each contact with Servisol: leave for a few minutes for the corrosion to soften, then clean off again with spirit. Finally, give the switch another coat of Servisol.

The mating of individual contacts can be checked visually. To adjust, loosen the nut and bolt securing the i.f. switch slider to the right-angle bracket operating the timebase slider, move the slider contacts into position to mate, then tighten the nut and bolt to prevent further slip. Check several times in both positions. The i.f. section of the switch is less exposed, but a touch of Servisol now and then keeps the contacts in good condition.

Miniature preset potentiometers are a prime cause of trouble in older sets. Chemical changes occur in the composition of the track, while dirt and grease on the surface cause intermittent connection. Due to the lightweight construction, the slider is easily damaged, especially when an unsuitable screwdriver is used (this happens all too often). Presets which carry h.t. current are prone to burn out.

In the Pye 67 chassis R105 and R108 control the field linearity, R110 the height, and R157 the height equalisation on the two standards. Many complaints of field jitter, loss of height or poor linearity can be traced to one or more of these presets. It makes sense, therefore, to replace the lot: the cost will be around £1 plus an hour's work, which is a sound investment.

The preset contrast controls are current carrying: although they are not troublesome it's probably worthwhile replacing them at the same time in order to avoid the occasional burn spot causing intermittent results.

The audio circuit uses the well-known PCL82 triode-pentode valve. The most common fault here is heater-cathode leakage, as a result of which there is excessive current and the 560Ω pentode cathode bias resistor R92 is over-run. The symptom of course will be sound distortion. If you replace the valve, check R92 for discolouration or burning: if in doubt replace it. Discolouration indicates that the value has changed, and the new valve will soon be ruined if run under the wrong bias conditions.

Another cause of distortion is leakage in C79 (0·05μF) the coupling capacitor between the triode anode and the pentode control grid. The triode's anode load resistor R86 (100kΩ) can go open-circuit, removing the sound signal. A dried out volume control will be noisy when operated: it may clean up with a touch of Servisol, but if it's too far gone a replacement will be required. As usual, the volume control and the mains on/off switch are combined. Be very careful to replace it with an identical component: there are two variations in switch layout, and if the wrong type is wired in it may go up in a puff of smoke when switched on. It's best to draw out the wiring, with the lead colours, before the old control is removed.

Power Supplies

The power supply uses the familiar two rectifier arrangement – one (D12) providing the h.t. and the other (D11) feeding the heaters with a pulsed d.c. supply (negative-going in this case). The heater chain is terminated by a resistive network, the voltage developed across this being used, after filtering, to supply the transistors in the tuner and the i.f. strip. The l.t. supply is −18V, the npn transistors being operated with their collectors returned to chassis.

A common fault is no results, with a blackened mains fuse. The usual cause is the mains filter capacitor C64a (0·02μF). Both the fuse and the capacitor are on the mains side of the on/off switch and are thus in circuit whenever the set is connected to a live socket. In consequence the capacitor can blow the fuse when the set is not switched on. Note that the fault may not show up when a resistance check is made. Wiring the circuit in this way ensures that the fault does not burn out the on-off switch, though in the subsequent 368 chassis the capacitor is on the receiver side of the on/off switch. C64a must be rated at 1kV d.c. working.

A less common cause of a blown mains fuse is a short-circuit h.t. rectifier.

Valve heater failure is not common with modern valves but may nevertheless be experienced. The most likely suspects are the PL504 (line output) and the PY800 (boost diode) valves and these should be checked first in the event of no glow from the c.r.t. or any of the valves.

Similarly the c.r.t. heater seldom goes open-circuit nowadays. The cathode gets poisoned however, by absorbing impurities from the glass. The result is a grey picture with a loss of highlights. The use of a c.r.t. booster can work wonders. Several suitable circuits have appeared in *Television,* for example in the August 1973 and May 1974 issues.

If the mains fuse has blown due to the h.t. rectifier going short-circuit, check the h.t. reservoir capacitor C66 since the a.c. may have damaged it. Replacement of the reservoir/smoothing electrolytic can is recommended

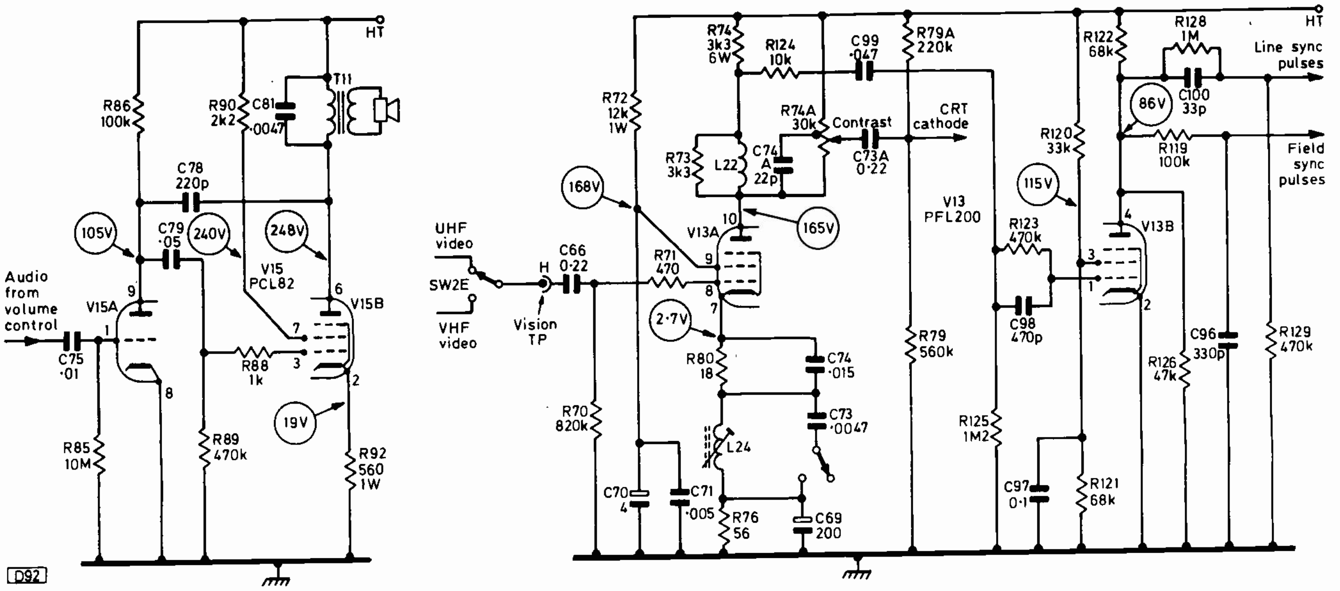


Fig. 1: The audio (left) and video/sync circuits (right).

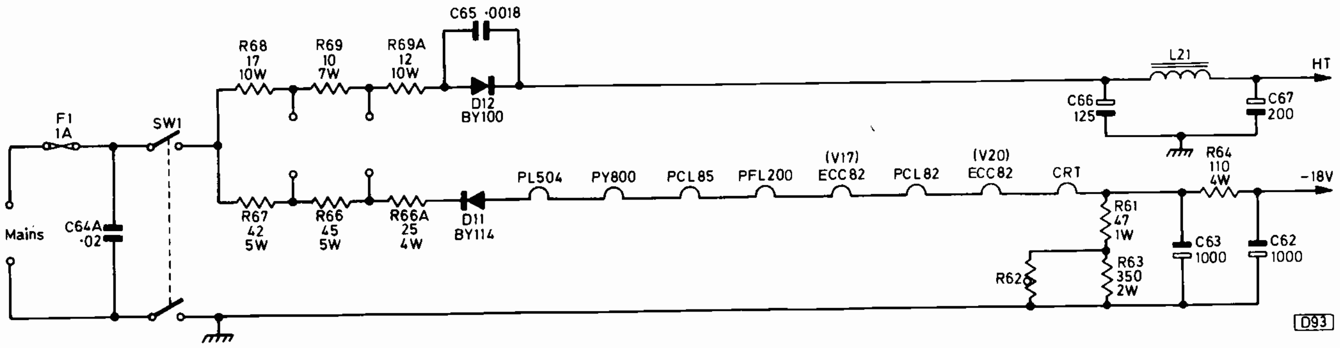


Fig. 2: The power supply circuits.

anyway if the set has been in use for some years.

If the heater circuit rectifier goes short-circuit there will be no d.c. supply for the transistors and thus no signals. The heaters will at the same time be over-run, glowing brighter than normally to indicate the source of the trouble. An ohmmeter across a short-circuit diode will show zero ohms in both directions instead of around 1kΩ in one direction and over 100kΩ in the other direction.

Unlike most sets of this vintage, the mains dropper resistor is not a common source of trouble in these sets.

Signal Circuits

The transistor i.f. panel used in the 67 and 368 chassis has proved to be very reliable. System switch slip can be readily seen to be due to the switch lever securing nut and bolt being loose.

The final transistor on the video side is a phase-splitter which is used to feed the same polarity signal to the video output pentode on both systems. A PFL200 on the main panel acts as video output valve and sync separator. This valve had a bad reputation when these sets were initially made but it has been subsequently improved. A picture with poor definition and shading can still be due to this valve however. If a replacement does not clear the fault, check the value of the video section screen grid feed resistor R72 (12kΩ 1W), the anode load resistor R74 (3·3kΩ 6W) and the continuity of the peaking coil L22 (its damping resistor R73 will allow h.t. to reach the anode when L22 is open-circuit). The two electrolytics in this circuit – the 200μF cathode decoupler C69 and the 4μF screen grid decoupler C70 are also suspect. These components can also be responsible for poor contrast and a tendency to weak field sync.

On the sync separator side the valve and the two resistors forming a potential divider to supply its screen grid can all be responsible for weak sync. The upper resistor R120 (33kΩ) in particular has a tendency to increase in value, thus lowering the screen grid voltage. The anode load resistor R122 (68kΩ) has been known to go open-circuit, thus cutting the valve off.

Timebase Circuits

The timebases are slightly more elaborate than usual. For example, one normally finds a PCL85 acting as combined field oscillator/output valve in valved and hybrid monochrome sets. In these chassis the pentode section of a PCL85 provides the field output, with an ECC82 (V17) acting as a cross-coupled multivibrator field oscillator. The triode section of the PCL85 acts as a phase-splitter driving the flywheel line sync discriminator circuit – so the PCL85 can be responsible for weak or no line sync. A second ECC82 (V20) acts as line blocking oscillator and d.c. amplifier to amplify the flywheel sync control voltage.

The field sync pulses are integrated by R119/C96 and then fed to the field oscillator via the interlace diode D18. Poor field sync is often due to defective contacts within the diode: a judicious clamp with a pair of fine-nosed pliers can give it a new lease of life, or at least tide you over until a replacement is obtained.

The ECC82 field oscillator valve can also be responsible

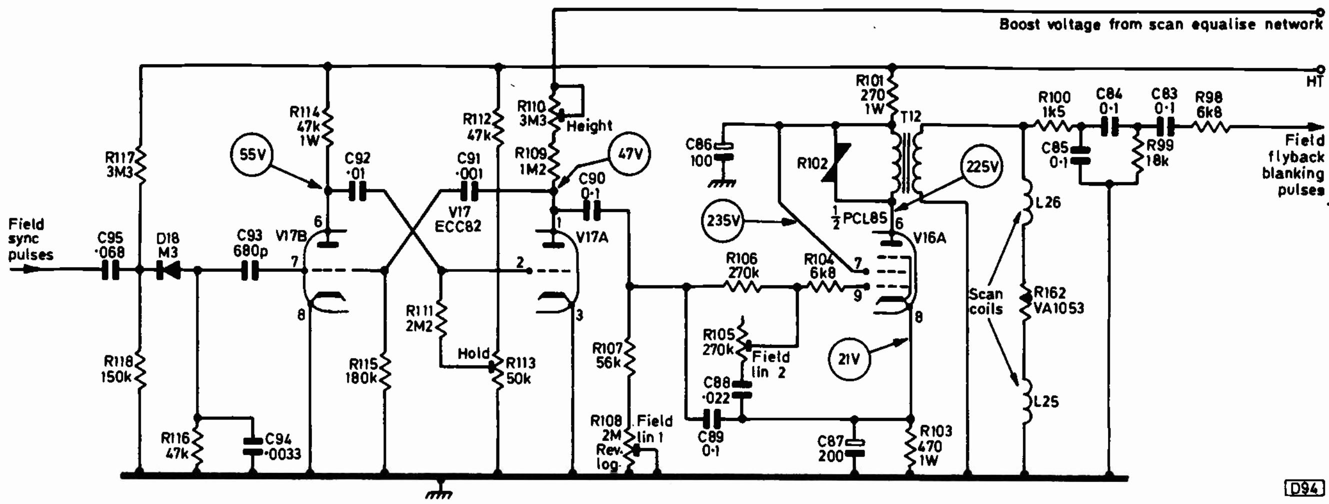


Fig. 3: The field timebase circuit.

for weak field sync. Apart from trying a new valve, suspect the high value (2·2MΩ) resistor R111 in series with the slider of the hold control. If its value changes with time the control has to be moved nearer to the end of its track until it no longer locks the field. The hold control R113 is connected in series with R112 across the h.t. line: very occasionally the control develops burn spots on its track, resulting in an erratic or collapsed field when the knob is rotated. Other causes of weak field sync have already been mentioned – R120, C69, C70.

The coupling capacitor C90 between the field oscillator and the field output stage is also the field charging capacitor, generating (with C89) the field frequency sawtooth waveform which drives the output pentode. It's charged from the boost rail via R109, R110, R157 and R156. A common fault on this chassis is lack of height due to R109 (1·2MΩ) rising in value, giving a small picture beyond the range of the height control. Using a 1W replacement usually provides a permanent cure. R156 can also increase in value to cause this fault. The small presets as a source of field faults have already been mentioned.

Complete field collapse – a single white line across the centre of the screen – can be tricky to deal with since the fault may be in either the oscillator or the output circuit. R114 going open-circuit will stop the oscillator working, as will defective cross-coupling capacitors (C91 and C92). The operation of the pentode section can be checked by gently prodding its control grid with a metal prod or needle. This should open out the scan a little if the pentode is working. If there is no response, check the voltages. There should be 225V at the anode (pin 6), 235V at the screen grid (pin 7) and 21V at the cathode (pin 8). If these voltages are present the valve should be operating. If there is still no field scan check the connections from the field output transformer to the scan coils: be careful to switch the set off since there are high pulse voltages on the coils and the transformer. A stray wire can burn out the transformer in an instant. The miniature v.d.r. R162 mounted on the scan coil assembly between the coils can be temporarily shorted across to enable the continuity of the coils to be checked. If there is no anode voltage check R101 and C86, the h.t. feed components: C86 can go short-circuit while R101 can be damaged by a defective valve. A charging circuit fault which can cause field collapse but may not be immediately obvious is when C116 goes short-circuit, thus removing the supply to the charging circuit.

Poor field linearity – a small picture with the bottom half compressed – can be caused by a defective PCL85 or its cathode bias components R103 and C87. When replacing the valve, inspect the bias resistor: if it is discoloured or burnt looking the valve has probably developed a heater-cathode leak. The resultant increased current flowing through the resistor changes its value. If the value increases, the voltage across it will rise and may exceed the working voltage of the decoupler C87 which will then be damaged. If R103 is clean, with its value colours unblemished, the cause of the lack of linearity probably lies in failure of C87 alone, and a replacement should restore a full raster. A much less common cause of lack of linearity is when C86 dries up, causing negative feedback at the screen grid.

Line Timebase Faults

A common line timebase fault is loss of line hold. The first suspect has already been mentioned – the PCL85 valve. If replacement fails to restore lock check the flywheel sync discriminator diodes D19A/B: if in doubt, fit replacements. Another possibility is the reference signal integrating resistor R147 (150kΩ) which can change value. Weak line sync can be caused by the ECC82 (V20) and the resistors in the timing circuit – R140 and the two hold controls R143/4.

If the line oscillator is working, a clear whistle will be audible on 405 lines. Should the oscillator stop, watch out for overheating in the line output stage. To avoid this while the oscillator stage is being checked disconnect one end of the line output pentode's screen grid feed resistor R149. Replacing V20 may well restore oscillation: check by measuring the voltage at the control grid of the PL504 line output valve (should be around –50V). If the voltage here is positive, check the coupling capacitor C111 which may be leaky or short circuit. If there is no voltage at the anode of V20B, the primary winding of the blocking oscillator transformer T13 is probably open-circuit, though the charging capacitor C110 has been known to go short-circuit. Check the pin voltages around V20 and the value of the components connected to any pin which has a wrong voltage on it.

Once negative drive has been restored at the control grid of the PL504, resolder R149 and switch on. The PL504 and the PY800 boost diode can overheat due to failure in the valves themselves. If the oscillator is working and there's no sign of overheating but still no e.h.t. R149 may be open-circuit. If there is overheating first change the PL504 and PY800. If the overheating persists, remove the top cap of the DY802 e.h.t. rectifier valve. If this clears the red glow,

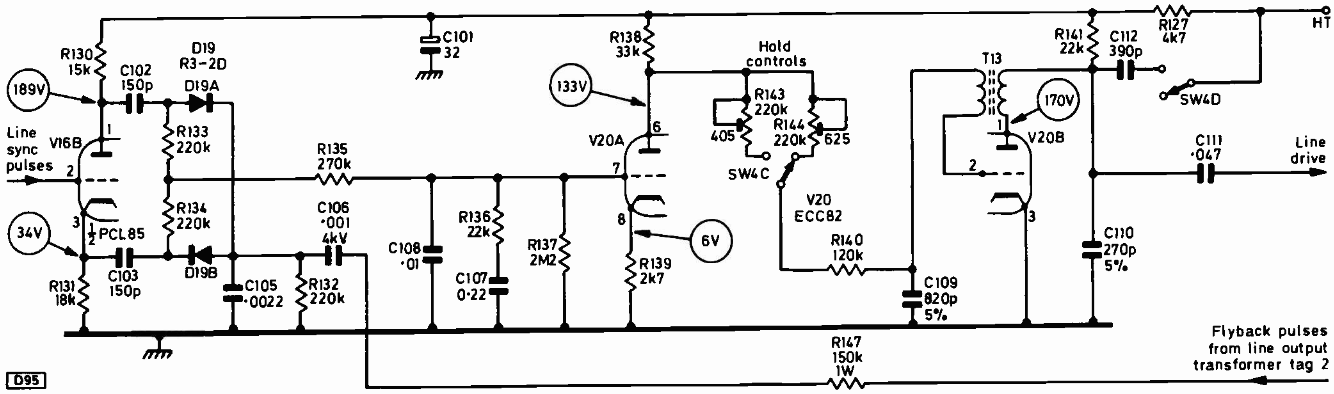


Fig. 4: The flywheel line sync and line oscillator circuits.

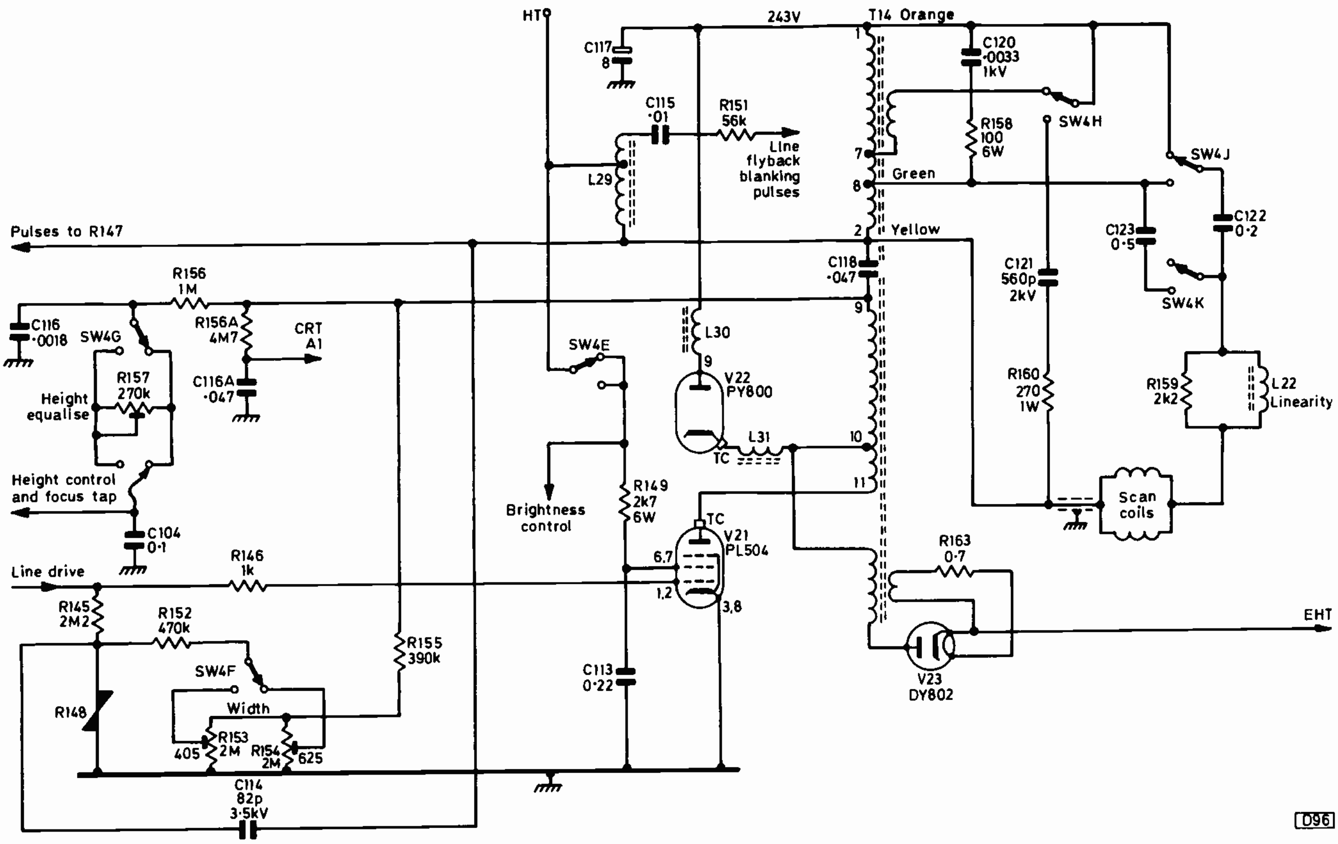


Fig. 5: The line output stage.

the DY802 is faulty. If there is no improvement however remove the PY800's top cap. If this restores signs of life, the boost capacitor C118 is probably short-circuit. Replace it with an $0\cdot 1\mu F$ capacitor rated at 1kV working. If removing the PY800's top cap doesn't remove the glow, the line output transformer probably has shorting turns. As mentioned at the beginning, the system switch is another possible cause of no e.h.t.

A narrow picture or intermittent width may be valve trouble, but the values of R152 and R155 should be checked. The width control potentiometers occasionally develop burn spots, but this is easily located. If R156A increases in value the c.r.t. first anode voltage is reduced and the result is a blurred picture.

A ballooning picture when the brightness control is increased is generally due to a soft DY802 e.h.t. rectifier. The scan-correction capacitors, C122 on its own on 625 lines, C122 plus C123 on 405 lines, can be responsible for non-linear scanning when short-circuit.

Arcing around the line output transformer occurs if the width controls are set too high. Keep the setting as low as possible compatible with the picture filling the screen. This keeps the e.h.t. voltage down.

Striations, i.e. a raster with alternate light and dark bands mainly on the left-hand side, occur when the line linearity coil's damping resistor R159 increases in value.

An awkward fault was line frequency changes accompanied by streaks across the picture. The cause was poor contact between the line oscillator valve pins and the socket.

The 368 Chassis

In 1968 the chassis was restyled as the 368 chassis. At first glance the chassis are identical, with the same tuner and i.f. panel. There were changes in the line output circuit however and in the positions of the PL504 and the PY800 valves. The height equalisation control was omitted, and a solenoid was added to give electrical system switch changeover. ■

LONG-DISTANCE TELEVISION

ROGER BUNNEY

THE year 1977 will be recalled for its quite extraordinary long-distance Sporadic E reception. Jordan ch. E3 was received in the UK on a number of occasions, and there has been much multiple-hop reception from the Middle East. Other notable reception in the UK includes Nigeria – received three times in a single week – and Gwelo, Rhodesia ch. E2. There was excellent tropospheric reception, with u.h.f. signals received from the USSR, Finland, Poland and Czechoslovakia during October – some transmitters were received at a distance of over 1,000 miles. What can we look forward to in 1978? There is a chance of slightly impoved Sporadic E conditions – a prediction based on the current active winter conditions and reports from our Australian friends on reception in the Southern hemisphere – and perhaps next autumn we may get improved F2 conditions. As regards satellites, the replacement OTS satellite should be providing the first 12GHz TV signals for Europe, while in Japan the BSE broadcast satellite should start operating on chs. A (11.975MHz) and B (12.075GHz) during February.

From a personal viewpoint I would like to thank readers for their interest and support during the year. We are always pleased to hear from enthusiasts, and to receive news and comments on reception conditions.

December Reception

There was little of real excitement during December. There were improved Sporadic E conditions on several days, Clive Athowe (East Anglia) reporting reception of YLE (Finland) chs. E2/3/4, SR (Sweden) chs. E2/3/4, NRK (Norway) ch. E2 and TSS (USSR) ch. R1 on the 2nd, and TSS R1/2, TVP (Poland) R1/2 and MTV (Hungary) R1 on the 11th, while Brian Fitch reported strong USSR communications signals near ch. R2 on the 17th and 18th, confirmed in part by James Burton-Stewart (Buckingham) who logged TSS ch. R1 on the 18th during the afternoon.

There was a mid-month improvement in tropospheric conditions, with various French and W. German signals on the 15th and 16th – two new French u.h.f. stations were logged here at Romsey. These conditions continued until the 20th when changed weather arrived. There were good signal pings here in Band I from the Geminids meteor shower during the 12th-14th, and Garry Smith (Derby) logged several good MS signal pings in Band III during this period. While monitoring F2 conditions I logged North Atlantic signals at up to 34MHz on the 5th.

MS Reception Experiment

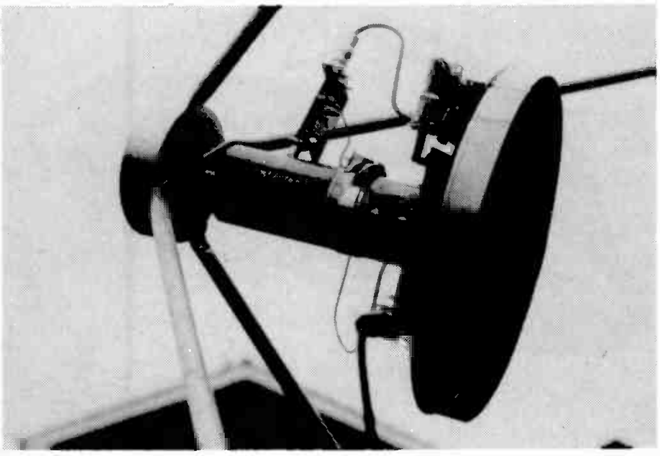
As an experiment, on the 29th I ran three receivers simultaneously on ch. E4 but fed from different aerials, a double-three at 55ft. and a single four-element aerial at 29ft, both arrays pointing to the NE, and a two-element aerial at 33ft. pointing due east, all these arrays being wideband Band I types. It was noticed that strong signal pings from Swedish ch. E4 stations arrived via all the arrays simultaneously, and at similar strengths despite height variations of 36ft. The 55ft array picked up interfering signals from Sutton Coldfield on ch. B4, while the lower arrays tended to pick up electrical interference from nearby sources – traffic etc. The conclusion reached is that height is not important for successful MS reception provided one clears the immediate obstructions and that there is a low level of interference locally.

Dish Systems

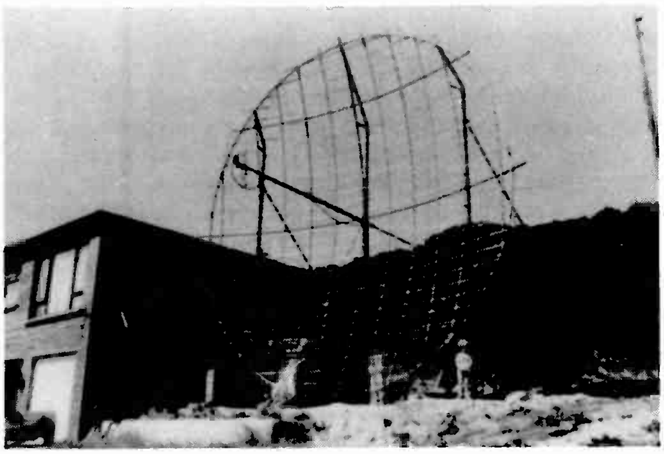
Following the interest in dish aerials started two years ago when the ATS-6 satellite was received in the UK several enthusiasts have continued research into dish arrays. Notable in this field is Steve Birkill, and one of this month's photographs shows a close-up of a 4GHz feed and integral head amplifier used in conjunction with an 8ft. diameter dish. Incidently, in the August 1976 column we listed possible gains for dish arrays: Steve points out that at best such a system will be 66% efficient, and any figures thus calculated should take this efficiency figure into account.

A well known figure in Southern Ireland, Dan Joe Kelleher (Macroom), has constructed a 25ft. dish system for the reception of signals from South Wales at u.h.f. (group B). Compared with a stacked multiple director system the output from the dish is vastly superior, the latter providing good quality colour signals when only a noisy monochrome signal is present from the Yagi stack. The dish has a base adjustment of 20° and a focal adjustment ranging from 8-18 feet, the pickup head being a Wolsey Colour King. Withstanding gales of 90m.p.h., the structure tends to dominate the nearby house (see photograph) but the performance and results are noteworthy – we hope that Mr. Kelleher will send details of the construction for a short article in the near future.

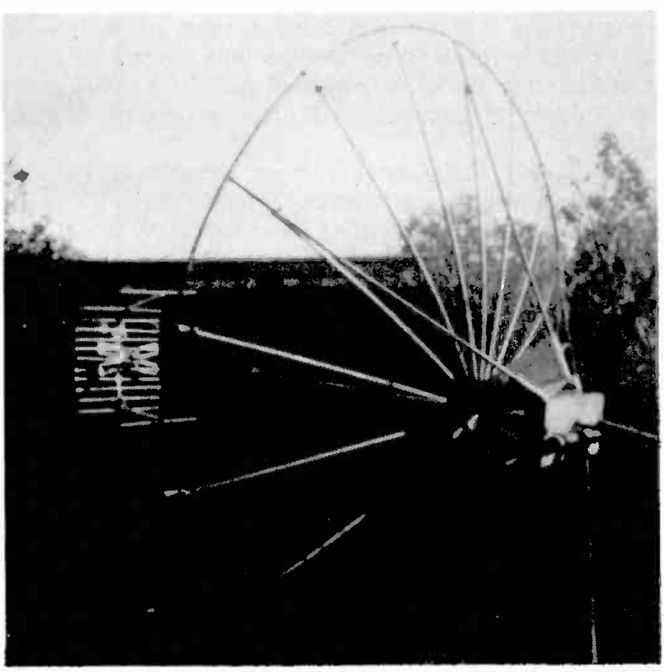
C. Wilson at Potters Bar has been constructing and testing a 3 metre diameter dish. The outer rim and the six rear support spokes (see photograph) are made from copper plumbing pipe soldered with T-joints, the front parabolic spokes from hardwood held in place with Jubilee clips and the dish itself of wire netting. The signal head is a modified short-backfire design, the reflector overhang being increased (giving an extra 3dB gain at the l.f. end!). The aerial is used mainly for comparison checks with experimental arrays. Some success has been had with u.h.f. signals reflected from aircraft however. M. Gray, another



Close up view of Steve Birkill's 4GHz head unit.



Dan Joe Kelleher's impressive 25ft. dish array.



Rear view of C. Wilson's 3 metre dish, which uses a short backfire aerial as the head assembly.

TV-DX enthusiast, has been assisting C. Wilson in the dish project.

Windmill Interference

An interesting report appeared in *Broadcast Engineering* recently. The University of Michigan has established that substantial interference to TV reception can be caused by large windmills (of the types used for power generation). The large blades produce multipath reception which varies with the blades' size, their rotational speed and the direction of the wind. The rotation produces a modulating waveform which approximates sync-like pulses that occur on every half revolution. The problem gets worse with increasing frequency, particularly at u.h.f., adverse effects being noted at up to two miles!

News Items

Holland: Good news from Ryn Muntjewerff: the Lopik ch. E4 station is to have a new transmitter with an increased e.r.p. of 125kW, although for our Dutch friends Ryn comments that "it will for us be a funeral!"
West Germany: The ZDF chain is in the early stages of a five year expansion, with a new studio complex under construction. There is talk of a fourth TV chain which may be operated by private companies.
France: The Ariege TV relay has been completely removed (the 40m. mast and transmitter) by persons unknown! One wonders if it's now operational in Italy as a "free TV station"? Brian Fitch tells us that a pirate radio station has successfully challenged at law the French state monopoly of radio/TV. Although it seems that further legal action will be forthcoming, the "breakthrough" could well herald an explosion of broadcasting not unlike that in Italy.
Liberia: It's hoped that ELTV-Monrovia will be operating in colour during 1978, following the installation of new equipment at the recently completed transmission and production centre.
Swaziland: W. Homann (Transvaal) tells us that this country will commence TV on System B/G in February 1978.
South West Africa: There is thought of starting a TV service financed by business sources, the service to be independent of the State.
Tunisia: The Fubk test card is now being used by the RTT, the ident being "RTT" on the left-hand side and the equivalent in Arabic script on the right-hand side.

From our Correspondents....

Our Australian friends report excellent Sporadic E conditions! Anthony Mann has seen various Malaysian stations at his Western Australian home, with Network 1 on test card G and Network 3 using the PM5544. New Zealand has also been received. Signals from the north include Korea and Chinese harmonics, apparently coupled with F2 activity.

Bob Copeman (Sydney) reports daily TV reception from Hawaii, with some F2 activity and a 35·22MHz paging station. Apparently u.h.f. TV is to be used for both public community and ethnic programming. All community f.m. test transmissions ceased from December 31st. A further 56 TV relay transmitters are to be built this year in the remote areas of Queensland and Western Australia.

N. Cartwright (Ipswich) has installed an Antiference XG21W array with Labgear 6040 amplifier mounted on a 37ft. mast. The latter is rotated by loosening the U-bolts at the bottom. He hopes to increase the height shortly by sliding a 1½in. o.d. mast up the inside of the existing 2in. o.d. scaffold pole. Signals have already been received from France, Holland and Belgium.

Doug Everitt (Enid, Oklahoma, USA) has written describing his system and the signals received there. Of

The FTE wideband active aerial.

particular interest was his account of the TV receivers currently available. The "Star System television" is a random-access tuning receiver line where one enters a two digit number corresponding to any of the 82 channels in use (on the American continent) on a keyboard or a remote unit. There are also mute and channel-number recall buttons. The main advantage is that the system gives access to all channels, an obvious advantage in areas where there are more than a dozen channels (e.g. New York). Doug uses a Finco 7ft. (2·12m) dish for u.h.f. DXing and has achieved considerable success, with signals from upwards of 1,000 miles.

Aerials: News and Developments

With the completion of the UK u.h.f. network nearing and most people now using u.h.f. only sets the aerial market here has become mainly a replacement one. The fringe areas left are sparsely populated, so most people get by with a relatively simple aerial. The main concern of aerial manufacturers therefore becomes getting the maximum performance at minimum cost. Not an exactly exciting scene!

Fortunately there are interesting developments to be found elsewhere. A recent technical report in the US IEEE *Transactions on Broadcasting* described many aerial and amplifier developments. For example, the Winegard Company (Burlington, Iowa) has introduced a new type of array with an extremely interesting gain/bandwidth performance. If you study the gain of a representative wideband UK aerial, be it of the multiple or flat director variety, you will find that it rises gradually over the bandwidth, peaking at or just below the highest frequency covered. For example, the wideband Antiference XG21W covers channels E21-69, with a gradually rising gain from 13·5dB at ch. 21 to just under 19dB at ch. 52. Examining the aerial itself, it will be found that most of the director assemblies are cut to the h.f. end of the band, with those close to the dipole gradually increasing in size to resonate at the l.f. end of the spectrum. The problem for the designer therefore is to decide at which point within the spectrum greatest gain is required while maintaining the bandwidth. The group A version of the XG21 has a ch. 21 gain of 19dB, which shows the result obtained from a relatively narrowband aerial with optimised director dimensions. The Winegard wideband array resolves the problem of maintaining high gain at both the top and bottom ends of the spectrum by using a new director design which they call a tri-linear director: it consists of three flat in-line elements connected by polythene insulating material, giving a combined director which is resonant over much of the bandwidth. At the l.f. end it acts as a 16in. capacitively-loaded half-wave element, while at the h.f. end it performs as three individual half-wave collinear elements. The result is an array with an excellent gain/bandwidth characteristic, with the l.f. end having a much higher gain than that given by the conventional approach. The complete array has a series of these tri-linear directors which are all of similar dimensions.

Winegard has also been concerned with the problem of low-noise amplification. Balanced ribbon feeder is generally used in the US, so that a balun (a small matching transformer) which introduces a slight loss is required at the input to any amplifier used and to the set. To improve matters, Winegard has introduced a form of push-pull input amplifier in which the two sides of the balanced feeder are connected to the bases BFR91 amplifier stages. The outputs drive the matching transformer, which feeds the output stage (an MT5108). The amplifier's output is taken via 75Ω coaxial feeder. The extremely good noise figure is as low as 1dB at ch. A25, rising to 6·8dB at ch. A83 (890MHz), the average figure being 3·3dB. Gain varies from 19dB l.f. to 16·8dB h.f. Although the balanced feeder problem doesn't arise in the UK, I feel that the twin-stage amplifier might be useful for matching two aerials without the problem of bandwidth limiting that a conventional phasing harness introduces.

My thanks to Bernard Kirk, a DX-TV enthusiast now resident in W. Germany, for a considerable amount of information on W. German aerials and equipment – there's quite a vast range available there. Multiple director u.h.f. arrays are commonly used, though there's a large number of conventional Yagis with wideband coverage to ch. E60. Most aerial manufacturers use different channel groupings to ours, favouring 21-37, 21-48 and 21-60.

Fuba and FTE Maximal have introduced compact wideband (v.h.f./u.h.f.) aerials of the type described not long since by Pat Hawker (see *Television*, December 1976) – they have the appearance of flat discs. One Fuba version has a wideband two-element Band III array and a wideband 15-element u.h.f. array, with a built-in amplifier and gains of 13dB at v.h.f. and 14dB at u.h.f. From the information given in the catalogue, the FTE unit has an impressive performance indeed, with outputs at 0·15-18MHz, 47-68MHz and 87·5-104MHz at a gain of 20dB, and 174-230MHz and 470-790MHz at 30dB. (The editor was somewhat surprised recently to come across a W. German coach with one of these aerials mounted atop parked in his local high street: the interior was arranged as a lounge, with a colour receiver – it appeared to be a Sony one – mounted behind the driver. What an excellent way to see the world!)

The WISI catalogue featured a range of signal strength units for indoor use – in effect, a specialised TV receiver with, in addition to the c.r.t. display, frequency measurement in the MW and SW bands, in Bands I/II/III and at u.h.f., either by preset push-button or fully tuneable. There is also digital readout as dB relative to μV – in addition to the meter.

Service Notebook

G. R. Wilding

Hazards of Servicing in the Home

One of the hazards of TV servicing in the home is when fresh faults develop in a set you're working on, especially if the resultant symptoms are more serious than the original ones. In most cases this happens with elderly receivers, often due simply to chassis removal – wire-wound dropper resistors may break, or the line output transformer insulation fail for example. As you will inevitably be considered to be responsible in some way, the best thing is to put the fault right with the minimum expense as part of the job. The worst example I've come across was of a set which had intermittent sound. It was collected and taken to the workshop for soak testing. On return it was switched on and the tube heater went open-circuit. Try and explain to the owner your innocence about that!

We were recently called to look at a set fitted with the Pye 169 monochrome chassis. For about ten minutes after switching on all the verticals quivered. Thereafter the set worked perfectly. A new PCF802 line oscillator valve completely cured the trouble, but just before we replaced the back we noticed a spark on the c.r.t. base connector where C85, which decouples the c.r.t. heater (see Fig. 1), is connected to pin 5. Inspection showed that its leadout wire

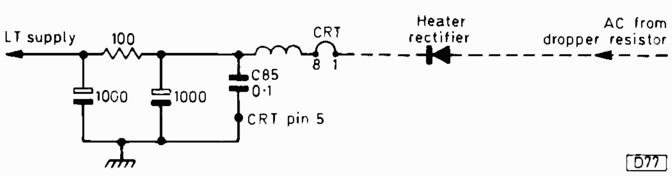


Fig. 1: Pye 169 chassis: a short-circuit in C85 removed the signals and the raster.

was not soldered to the print. We resoldered it, but on switching the set on again there was neither sound nor raster, though all the valves were glowing. On switching off however an unmodulated raster appeared for a few seconds. Consternation in the household!

In these hybrid sets the l.t. supply for the transistor circuits is obtained from the earthy end of the heater chain – and the c.r.t. heater is the last one in the chain. You guessed it of course, when checked with an ohmmeter the capacitor we'd just resoldered turned out to be short-circuit, thus removing the l.t. supplies to the signal circuits. The video output transistor, though fed from an h.t. line, was cut off due to the absence of its base bias, which comes from the l.t. supply. In consequence it was cut off, biasing the c.r.t. off until the set was switched off.

Contrasting Faults

An ITT colour receiver fitted with the CVC5 hybrid chassis produced neither raster nor sound. On switching on however a field pulse buzz could be heard, clearly indicating that the h.t. supply was present. Now since the sound and raster had gone simultaneously and the only supply obtained from the line output transformer on these sets is the boost supply, the cause of the trouble was almost certainly absence of the l.t. supply, since this supplies the sound and vision i.f. strips and the emitter-followers which drive the RGB output transistors. With no supply, the emitter-followers would fail to provide any forward bias to the RGB output transistors, leaving them cut-off with their collectors at the h.t. voltage. Since the c.r.t. cathodes would also be at h.t. potential therefore, the c.r.t. would be cut off and the loss of the l.t. voltage would account for the absence of both the sound and the raster. The l.t. bridge rectifier in these sets feeds a series regulator circuit which provides stabilised lines at 20V and 18·8V. As expected these were absent, due to the 0·5A fuse feeding the bridge rectifier being open-circuit. This had blown due to one of the diodes in the bridge going short-circuit, and on replacing the bridge and the fuse normal results were restored.

In contrast, a Pye hybrid colour receiver presented almost the reverse symptoms, sound plus a defocused, peak brightness raster with only faintly discernible modulation – in the form of ill-defined colour blobs. The brightness control had no effect. Unlike the ITT hybrid chassis, this one uses colour-difference tube drive, with the brightness control acting on the control grid of the PL802 luminance output pentode which drives the c.r.t. cathodes. We have known PL802s go really soft, with a purple glow, thus bringing the anode voltage down to a very low level to give the bright raster symptom. This one was running cool however, as were the nearby wirewound resistors. Only one resistor on the CDA panel, which in addition to the PL802 houses the three PCL84 colour-difference output valves, was getting hot – unduly so. This was R389 (3·3kΩ), which feeds the screen grids of the PCL84s. H.T. was arriving at the CDA panel from the line timebase/power supply panel, so the only conclusion could be that somewhere on the CDA panel there was a break in the h.t. supply print as a result of which the PL802's anode voltage was virtually zero, removing the c.r.t. bias and causing the excessive c.r.t. currents.

On unplugging and removing the CDA panel, a dark spot was seen at a point in the print leading to the PL802. Testing with an ohmmeter revealed an open-circuit here, and on bridging the spot with a jump lead a normal picture was restored.

The cause of the hot R389 was that the PCL84 anodes were also without h.t., the screen grids, fed by this resistor, taking the entire current.

In both cases a little thought about the arrangement of the circuit, along with the minimum number of simple tests, pinpointed the cause of the faults.

Loss of Line Sync

"Picture all lines" was the complaint with a monochrome Philips set fitted with the 210 chassis, and on inspection it was found that the line hold control could not be adjusted to obtain the correct frequency. In this and similar Philips chassis there are two ECC82 valves in the line generator circuit, one connected as a multivibrator while the other acts as line sync pulse amplifier and flywheel sync phase comparator. The d.c. conditions of both valves have a direct bearing on the frequency range of the hold control, so change of value of any of several resistors in the area was the most likely cause of the trouble – valve ageing will also shift the line hold control position of course, but usually not to the extent evident here.

When confronted with several possibly defective resistors we always – to save time and effort – first check those of high value and with a constant current drain, since these are the ones most likely to change value after some years' use. The prime suspect in this case was R2164, 470kΩ, which returns the control grid of one of the ECC82 line oscillator triodes to the h.t. rail. It turned out to be nearly 1·5MΩ, and on replacing it line hold could be obtained with the control at nearly midpoint.

The raster then became increasingly distorted by a curved indentation which slowly travelled up the left-hand edge of the screen however, but on switching the set off the picture returned to normal – though of reduced size – till the h.t. and the e.h.t. finally collapsed. The explanation was heater-cathode leakage in the ECC82 line oscillator valve – this was removed of course on switching off!

Grundig 1500GB

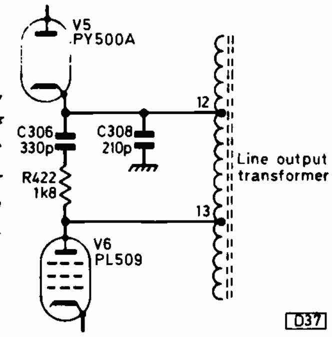
The fault on this hybrid colour receiver was sound but no picture, due to the 630mA fuse in the h.t. feed to the line output stage being open-circuit. A resistance check revealed an almost complete short-circuit between the cathode of the PY500A boost diode and chassis. The valve itself was in order, as was the PL509 line output valve, so we next disconnected the 440pF, 7kV tuning capacitor which is connected from this point to chassis. The short persisted however, as it did after disconnecting the pulse feed to the tripler and isolating the boost capacitor C637 and the scan-correction capacitor C638. It then seemed that the line output transformer primary winding was shorting to the core or to an earthed winding, the latter turning out to be the case. It's noteworthy that the transformer can be replaced without unsoldering a single lead: it's simply plugged in, secured, and the leads to the valves and the tripler clipped on, all of which takes about two minutes.

Lack of Width

Our first move when confronted with power supply defects or lack of width – especially in colour receivers – is to make a careful visual check. Thus when an ITT set fitted with the CVC8 chassis came our way bearing a tag which said that the picture had suddenly decreased by almost two inches at each side we first removed the e.h.t. cover and looked for any signs of components affected by excessive heat etc. There were no visible signs of trouble however, so after ensuring that the vulnerable 0·47μF, 1kV boost capacitor was o.k. and that the 210pF, 8kV harmonic tuning capacitor hadn't developed a leak the only thing to do was to switch on and await developments. A low-emission PL509 line output valve was discounted since the fault had appeared suddenly, and anyway if it was so weak it would have taken an abnormally long time to give even this output, and would have caused excessive ballooning on advancing the brightness control.

Within about a minute of the picture appearing, the wirewound 1·8kΩ resistor R422 (see Fig. 2) mounted on the edge of the line output transformer began to glow. This resistor forms part of a damping network, in conjunction with the 330pF, 6kV resistor C306, which turned out to be short-circuit. On replacing both components the screen still wasn't filled completely, and it was found that both the factory and the dealer width controls were at almost maximum setting. The cause was an increase in the value of R411 (560kΩ) which is one of the resistors in the feed between the boost rail and the width controls. Replacement gave correct width with both controls at normal settings.

Fig. 2: Width reduced by almost 2in. on each side of the screen was due to C306 in the line output transformer primary winding's damping network having gone short-circuit. ITT CVC8 chassis.



Focus Faults

The trouble with an ITT colour set fitted with the CVC5 chassis was complete loss of focus. Moving the focus control had very little effect, only slightly improving the definition when at the high-voltage end of the v.d.r. This suggested that the high-value resistor (4·7MΩ) between the v.d.r. and the supply tap on the e.h.t. tripler had gone very high in value, but tests showed ample voltage at each end of this resistor. The next move was to check the voltage at the focus electrode on the c.r.t. base – pin 9. There was negligible voltage here, although normal voltage was present at the lead from the focus control. There's a series resistor, R276 2·2MΩ, in the supply path on the c.r.t. base panel (tube side) and this was found to be virtually open-circuit. Replacement and readjustment restored first class definition.

A few days later we came across another set with the CVC5 chassis, this time with varying focus. Once again R276 was responsible. Since it's so easy to check this resistor, it pays first to make sure that it's all right when faced with focus troubles on this chassis. But remember that the voltage here is around 5kV.

Lack of Colour

The owner of a Decca colour set fitted with the 30 series hybrid chassis complained that the colour strength had gradually decreased over a few weeks to a low level. As the contrast was excellent the fault was clearly in the chrominance channel, so our first move was to check whether the colour-killer transistor TR208 was being fully turned on to forward bias the base of the second chrominance amplifier transistor TR206. This can be done by linking the collector and emitter of TR208 – test points are provided – or by checking to see whether the voltages are correct. The d.c. conditions around TR208, TR206 and the first chrominance amplifier transistor TR205 all turned out to be correct however. Lack of gain could be due to excessive negative feedback in either of the chrominance amplifier stages of course, and it was noticed that the emitter of the second chrominance amplifier is decoupled by a 33μF electrolytic capacitor (C224). This was an obvious suspect, and on removing it for test it turned out to be virtually open-circuit. A replacement restored normal saturation.

Practical TV Aerial Masts

Keith Hamer and Garry Smith

THE authors have been active long-distance television enthusiasts for many years, during which we've experimented with a number of ideas for erecting reliable aerial masts. As anyone who is contemplating the purchase of a mast will know, professional types are prohibitively expensive. Thus for someone with only a moderately sized wallet an alternative approach must be found. Two types of mast will be described, the scaffold pole variety and the more professional looking lattice. Sections of lattice mast are expensive, but can occasionally be picked up second hand when a relay company is dismantling a structure. For example, in our area the u.h.f. transmissions were piped around a large housing estate at v.h.f., being reconverted at each receiver by an up-converter. The idea was not very successful and was subsequently abandoned.

Many of the accessories mentioned in this article were manufactured by Jaybeam Ltd., and we've found them to be sturdy and reliable over the years. The original mast consisted mainly of aluminium poles bought from this company: it was in use for over four years without any sign of deterioration. While on this point, it's advisable periodically to check any installation for wear and tear. There is quite a lot of weight involved with aerial masts, and their collapse can be damaging indeed. This point is underlined by the effects of the high winds a few weeks back.

Foundations

As with any form of building, it's vitally important to have a firm foundation for a mast installation. For the methods suggested here a hole measuring about three cubic feet should be excavated. Dig carefully though – there may well be water pipes or drainage systems present! Once the hole has been completed, check around the immediate vicinity with a probe for any pipes which may be a further few inches down from the bottom of the hole. This is in preparation for later activities involving pole positioning. The hole will eventually be filled with concrete, and to give extra strength it's suggested that broken bricks are added.

Wooden Supports

The original mast we used took the form shown in Fig. 1. The two wooden posts act in a similar manner to flag pole supports and consist of a pair of ten foot beams with holes drilled at the top and bottom. These take 1¼in. aluminium poles which are ultimately clamped to the mast. The supports must be thoroughly treated with wood preservative in order to minimise the possibility of decay.

The beams should be about a foot apart. Ensure that the two sets of 1¼in. holes are directly opposite each other: it's essential that correct alignment is observed, otherwise it will be difficult later on to obtain a true vertical attitude.

Before the hole is filled with concrete and bricks check with a plumb line and spirit level to ensure that the wooden uprights will be perfectly vertical once the concrete has set. This stage must not be overlooked, as normally the clamps are not adjustable to allow for any such errors. If the beams are not in a vertical plane, or if the 1¼in. drilled holes are not correctly aligned, the completed mast will lean at an alarming angle and, unfortunately, there is very little that can be done about this except for taking out a very good insurance policy!

The concrete should be allowed to set really hard before the installation is touched, but if possible it's a good idea occasionally to check that the supports have not moved from their vertical state. If they have, there should still be time to put this right.

To avoid movement of the beams whilst the concrete is setting they can be shored up with props. It may also be possible carefully to position some of the bricks between the sides of the hole and the surface of the beams.

The Cheap Way!

The following arrangement was used successfully for several years and is basically the same as the method previously described. Two 2in. diameter aluminium scaffold poles are hammered directly into the ground to a depth of approximately three feet, leaving about 1½ feet protruding. The basic idea is shown in Fig. 2. With this method concrete is not necessary but the two poles should still be perpendicular, though remembering the principle of the lever the error will not be as great as would be the case with the first suggestion using beams.

The only trouble with this approach is that unless plans of the intricate water works system underground are to hand somebody at the local water authority may have to be called out in case of unforeseen circumstances!

Scaffold Pole Mast

The original type of scaffold pole mast we used consisted of two 10ft. sections of aluminium pole which had an outside diameter of 2in. The poles were connected via a 15in. metal jointing sleeve, thus giving a total length of 20ft. An aerial rotator of West German origin was attached to the end of the mast, and to be on the safe side an alignment bearing was incorporated. The various accessories to the basic mast will be dealt with later, and all the Jaybeam reference numbers will be quoted. Similar hardware is available from other companies but has not been tried by the authors.

The general shape of the mast is shown in Fig. 3. The aerials have been omitted, but this particular mast design carried one 46-element u.h.f. group B array, one 10-element Band III array, a two-element Band II (TV) array which was fixed to the 2in. pole, and a four-element Band I aerial which, like the Band III and u.h.f. arrays, was fully rotatable through 360°.

The aluminium pole was used for it's lightness, though a steel section would have been satisfactory. It should be remembered however that although the individual components do not weigh very much, once the mast has been assembled on the ground and is ready for hoisting the

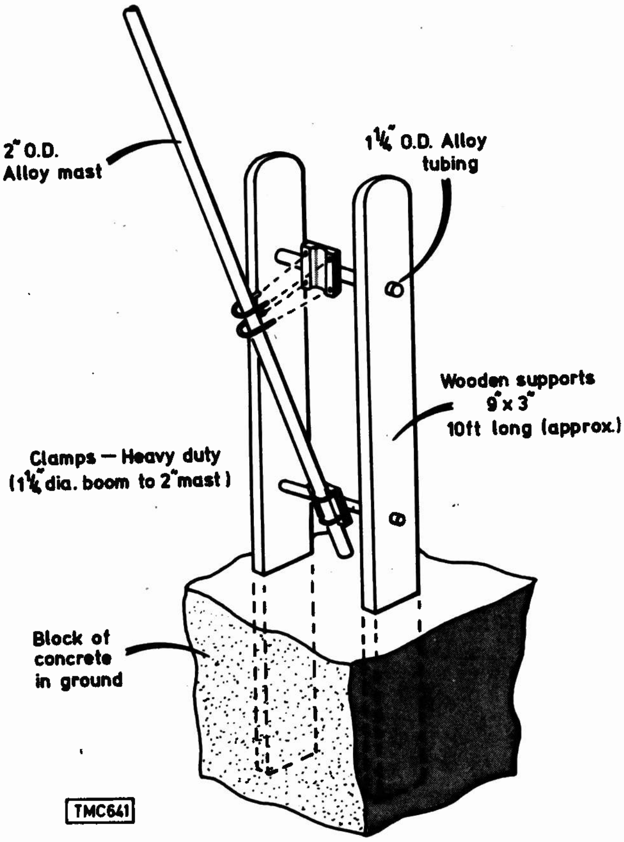


Fig. 1: Basic form of the original mast, showing the two wooden supports which are spaced about a foot apart. By using the heavy duty clamps, the 2in. scaffold pole can always be removed at a later date and replaced with a more substantial lattice mast, the wooden supports being retained for this purpose.

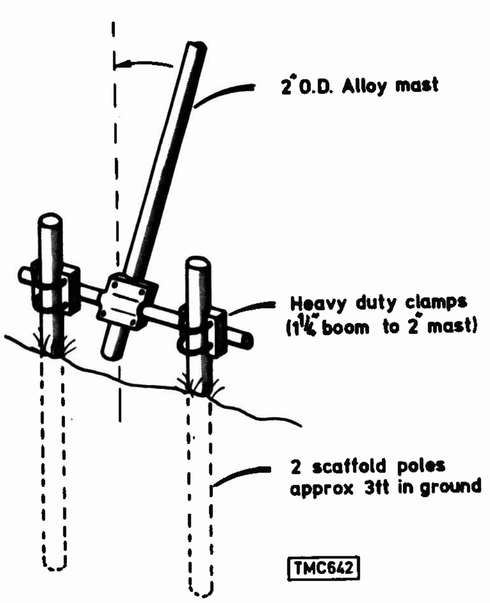


Fig. 2: The cheap way. Two alloy poles are hammered into the ground, saving on concrete, wood and effort. Be careful not to damage any underground pipes or drainage systems. The mast is supported by the guy wires. As with the wooden supports, the uprights should be truly vertical – otherwise the finished mast will lean at an awkward angle.

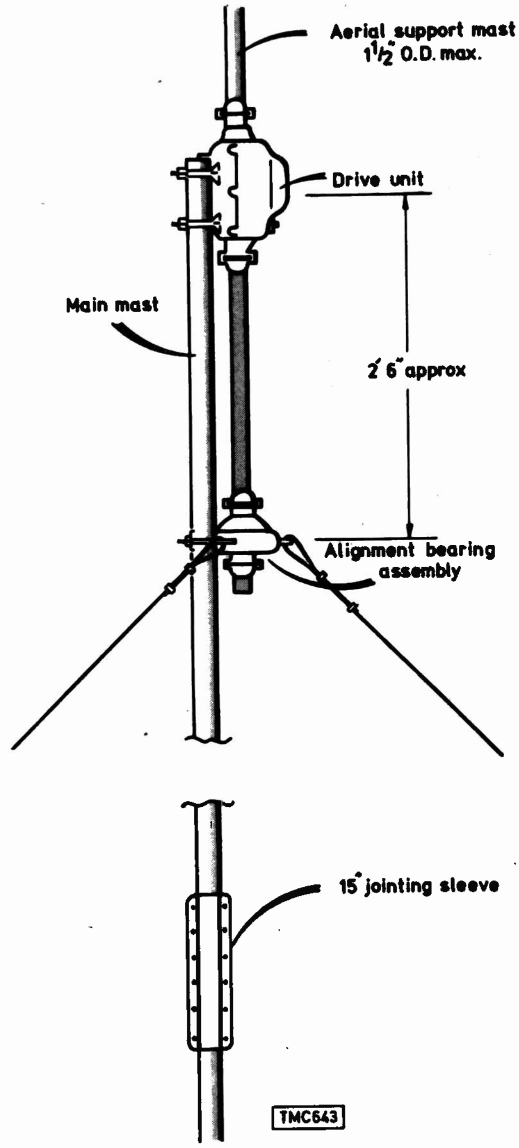


Fig. 3: The scaffold mast, showing the alignment bearing assembly which is recommended to remove stress from the rotator.

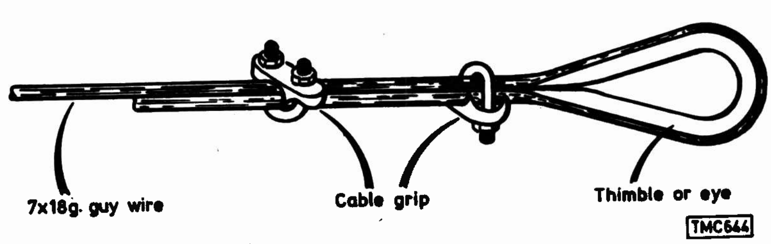


Fig. 4: Method of looping guy wire round an eye or thimble. The two cable grips are secured in the fashion shown in order to minimise rain water collection and thus help prevent corrosion. As a further help the grips should be greased.

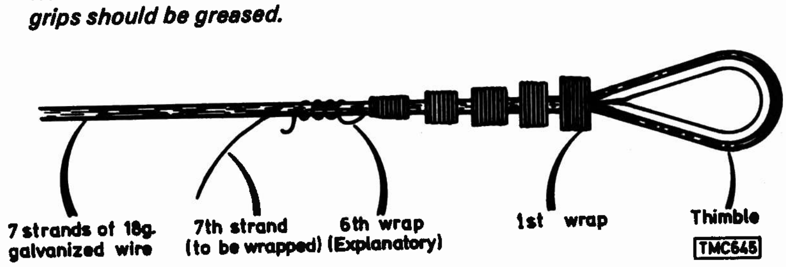
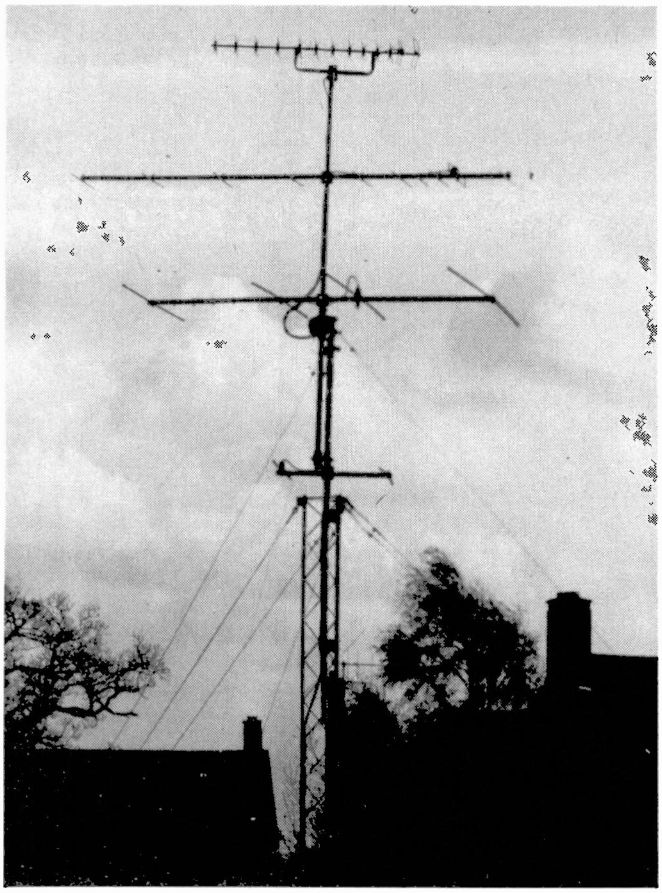


Fig. 5: The individual guy wire strands can be twisted as shown here as an alternative to using cable grips. The method shown in Fig. 4 is to be preferred however.



Keith Hamer's lattice mast.

true mass of the structure will soon be all too apparent.

A mast of this type will bend as it is being lifted, the amount depending on whether an aerial rotator is employed, the number and size of the arrays, and whether an alignment bearing is attached. The type of pole above the rotator, that is the aerial-carrying pole, will also influence the amount of sag. For the type of rotator used on the original mast, this pole was 1¼in. in diameter and made of steel. This made for a more robust construction, but alas it rusted rather more quickly than would an aluminium type. Rust is something of a problem with steel scaffolding, whereas only the shine wears off aluminium (at least in this area).

When the mast is finally ready to go up it's an advantage to have an army of helpers on hand. It's possible to have too many cooks spoiling the proverbial if they have little or no idea of what to do however! It's always wise to brief such potential havoc-makers as to exactly how they can help. Once the mast begins to flop about in mid-air, it's sometimes difficult not to have a change of heart and call the whole thing off.

With the free end of the pole attached to the lower set of clamps on the support system and the clamps tightened up, it should be possible to raise the mast to the vertical position. Somebody with a long clothes-line prop comes in handy here, to help support the desperately sagging monster at the aerial end.

Always make sure that every nut and bolt has been tightened before erecting a mast, otherwise Newton's Law will be brought home the hard way. It should be remembered however that over-tightening can cause stress and metal fatigue and ultimately a weakened structure.

If a 30ft. mast (i.e. from ground level to the top aerial) is to be used, the wooden support method first described should make the operation easier because once the mast is vertical the upper clamps can be tightened and, hopefully, the people assisting can let go in readiness for attaching the guy wires to strategically placed stakes.

If the cheap and cheerful method is adopted then once the mast is vertical there is very little to keep it in that state. It's a good idea therefore to predetermine the exact length of each guy line by using the ever useful theory of Pythagoras. If the guys are cut to the correct length, this will stop a lot of nail biting and save precious time.

With the cheap method there are no foundations so it may prove wise to place a flat metal plate between the bottom of the mast and the ground – to prevent the whole lot slowly slipping into a hole under it's own weight!

Before the mast is erected, all nuts, bolts and screwthreads etc. should be greased, otherwise they will become corroded and impossible to loosen at a later date should modifications be envisaged. A plastic covering should also be placed over the top of the scaffold pole and the aerial-carrying pole, to prevent water in the form of acidic rain running down the inside and thus creating a rust hazard. Support poles at ground level should be similarly protected, with a trace of grease on the clamps. In short, anything which is likely to be adjusted later and prone to rust should be greased.

Guy Wire

The type of guy wire used can vary. The variety we used consists of seven strands of twisted 18 gauge wire. This is quite strong and is easily manageable. The wire is galvanized and does not rust, so an eye-sore to neighbours isn't created (whether or not some neighbours would call the whole installation one big eye-sore is another question).

To loop guy wire a device commonly known as an "eye", or perhaps more correctly as a ¼in. thimble, should be used (see Fig. 4) so as not to put any undue stress on the stays. The loop is secured with two ¼in. cable grips. A method colloquially known as the "Post Office Wrap" could be used instead of grips as it's capable of achieving a surprisingly strong bond: Fig. 5 shows the basic way in which to make the wrap. It may be wise to use both wraps and grips as the latter are relatively cheap and the wraps take only a few minutes to perform.

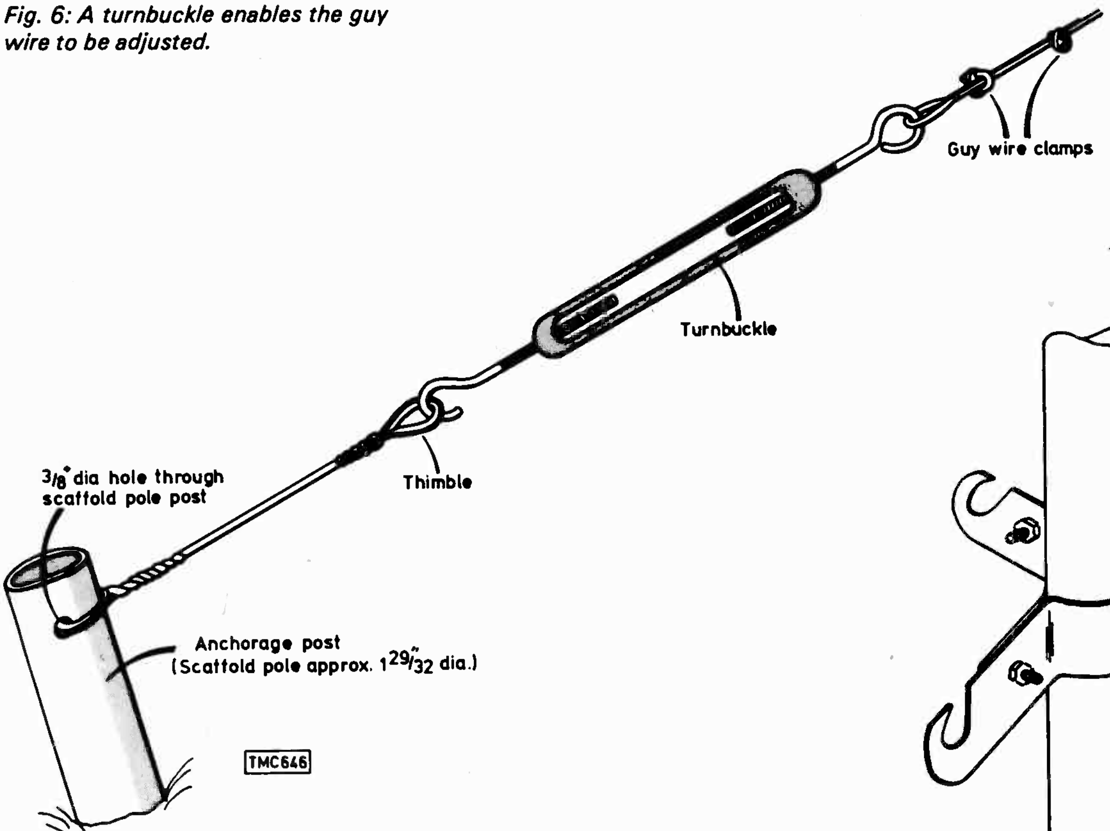
One semi-professional mast used here employed nylon guy ropes which for most of the time were perfectly all right. On one occasion however there were, to use radio banter, warnings of gales in Wight, Dover, South East Iceland and Derby, and unfortunately the nylon was stretched with great ease causing the entire mast to move along the ground. Fortunately the wind subsided in time, and the nylon was hurriedly replaced with strands of 18g wire.

Careful selection of good quality guy wire is essential, especially if the "cheap" approach is adopted since the wire is then the only support.

Another factor to be borne in mind with the scaffold pole mast is that two people are required to pull on two of the sets of stays whilst everyone else is attempting to push the object to a vertical position. Two assistants will help to minimize both swaying and sagging, but if poor quality guy wire is used it may just snap, inflicting serious injuries. This problem is overcome by a rather novel idea when erecting a lattice type mast – more about that later.

If possible, four guy lines should be used to keep the mast from swaying in any direction, and these should be attached to firm anchor points. If there is limited space three lines will suffice. It is a good idea to have a second set about half way up, particularly with the "cheap" method, in case one of the lines to the top of the mast should break.

Fig. 6: A turnbuckle enables the guy wire to be adjusted.



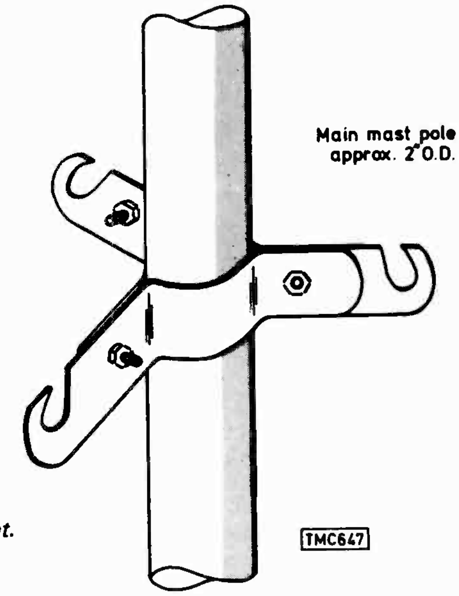


Fig. 7 (right): Non-rotating hook for guy wire attachment.

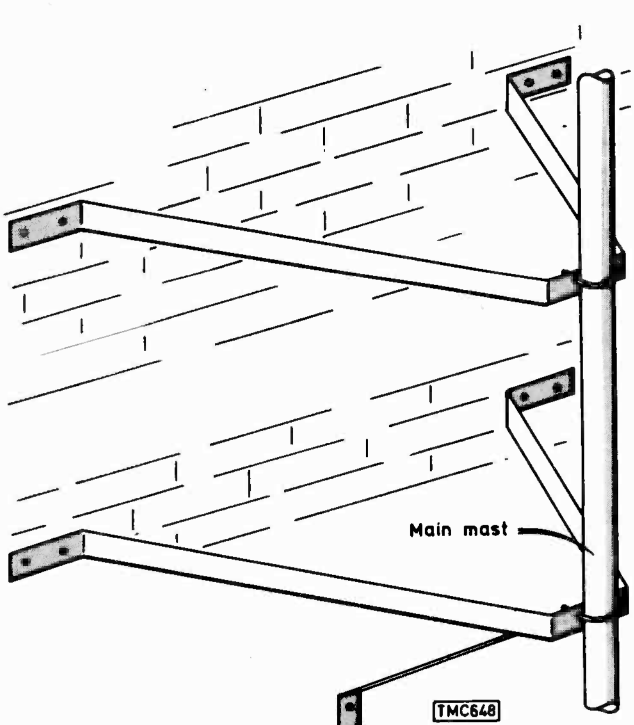


Fig. 8: A 2in. diameter mast can be supported by means of heavy duty wall brackets – they should be farther apart than shown here. If the mast is to be rotated by hand, loosen and well grease the clamps.

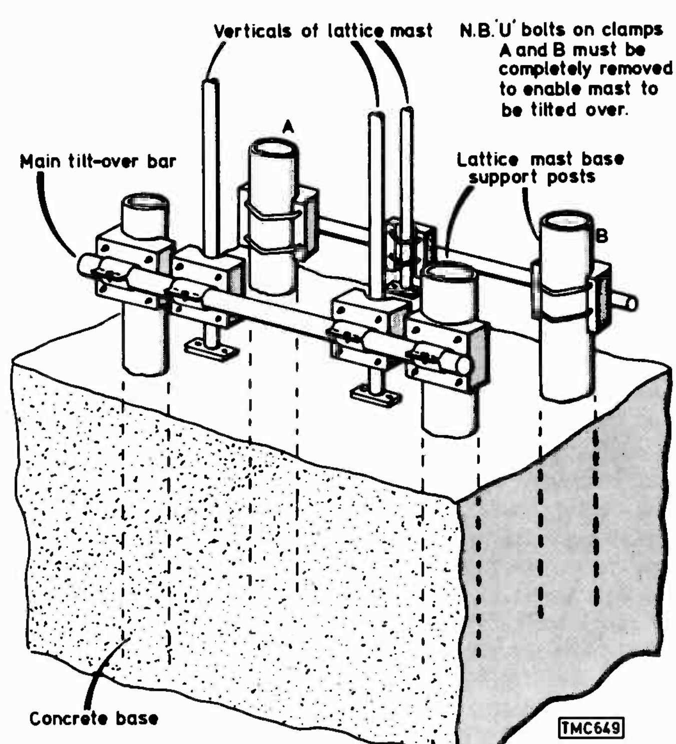


Fig. 9: Lattice tower tilt assembly, showing the clamping arrangement.

The anchorage points are made from aluminium poles hammered into the ground at an angle facing away from the mast. The 2in. diameter poles will make strong connection points if knocked into the ground to a depth of about three feet. It's useful to drill two $\frac{1}{8}$in. holes in each pole before positioning them in the ground as an aid to making good anchorage points: the wire can then be passed through the holes and then wrapped around the pole several times.

To provide some kind of adjustment for a guy line a device known as a turnbuckle can be used. If advantage is to be made of these useful items, remember that they must be almost completely unscrewed initially otherwise there is no room to make adjustments. The basic method of operation is shown in Fig. 6, which also gives details of the guy wire posts.

As previously mentioned it's wise to grease the screw threads otherwise it will be impossible to make any further adjustments because of corrosion.

The type of turnbuckle used here is 4½in. in length when set for minimum adjustment. They are relatively inexpensive for the degree of useful adjustment afforded.

Guy Wire Hook

A non-rotating guy wire hook of the type shown in Fig. 7 can be easily clamped to the 2in. scaffold pole mast and is a simple way of attaching the guy wire. The hook can be clamped about mid-way along the pole for securing the lower set of stays. If the upper set is to be attached to the aerial-carrying pole, a rotatable hook is available, but if an aerial rotator is to be employed, the wire can often be secured to the motor housing depending on the type used. Rotators manufactured by Stolle incorporate special lugs for this purpose.

Securing the Cable

Good quality coaxial cable must be used, and if the installation is to be used for DX-TV the coaxial cable must be of the low-loss type.

The cable can be secured to the mast simply by wrapping adhesive tape around the pole. Flexible plastic grips could also be used.

Due to varying weather conditions, adhesive tape may unwrap itself. To avoid this possibility, rot-proof twine should be tied around the mast thus keeping the tape in place.

The same procedure is necessary for securing the cable between the rotator (if fitted) and the control box. Do not tie the twine too tightly as this may in time damage the various cables.

Rotating the Aerials

To make full use of a mast installation, particularly if it is to be used for DXing, it is strongly recommended that some type of aerial rotating system is adopted. This can be achieved either mechanically or by employing a professionally constructed electronic rotator. The former is all right in good weather, but in winter it can be a dreadful bind having to leave a warm house or shack just to turn the aerials a few degrees. If a mechanical system is to be used however it may be possible to site the scaffold pole near a window so that easy access is obtained to the mast and only the fingers suffer from frost-bite! Provided the structure of the house or shack is sound, heavy duty stand-off brackets can be fixed to a nearby window as shown in Fig. 8. Place a metal base under the scaffold pole and leave the clamps on the wall bracket slightly loose to allow the pole to be easily rotated. If the pole is of steel and several arrays are attached, it may require a rather energetic person to do the rotating, but this activity is good for building muscles.

Being able to view the screen and rotate the mast simultaneously is a great advantage of course, as this avoids rotating the aerials beyond the required direction. At one time the authors had to go outside to rotate the system, only to find upon return that the aerials had gone just too far. Fortunately those days have long since gone.

There are several types of array rotators on the market, but the one described here is made by a West German firm. The drive unit is shown in Fig. 3 and this is connected to a control unit via a five-core cable. The control unit allows for array adjustment through 360°, and can be installed next to the receiver so that the best possible signal can be obtained at a glance. The only drawback with a professional rotator is its high cost. Typical prices range from £80 upwards, but cheaper types may occasionally be found – it's worth bearing in mind the number and size of the arrays to be used however.

Some installations may require only an occasional adjustment in direction, whilst others may take quite a hammering. If the latter is the case, a good sturdy rotator is essential. An alignment bearing is also suggested, as shown in Fig. 3. If heavy aerials are used it may be a good idea to have another bearing above the rotator if this is possible. When tightening the nuts on the rotator and alignment bearing any specific sequence indicated by the manufacturers should be followed so that undue stress does not occur.

It's suggested that only about seven feet of array support mast is above the drive unit. This is ample for carrying aerials for Bands I to V.

Lightning Protection

Some if not all rotators provide facilities for ensuring against lightning strikes. The manufacturer's specification should be consulted, but it's likely that the mast will already be sufficiently earthed anyway. For readers of this article outside the United Kingdom, special regulations concerning lightning protection may have to be observed.

Lattice Masts

Lattice masts look professional but do make a hole in the pocket – a gigantic hole! Fortunately the authors were able to obtain eight 10ft sections for £5 per section, but bargains like this are few and far between. It can be worthwhile looking at a copy of the publication *Radio Communication*, in which surplus lattice masts are sometimes advertised. If there is a communal television mast in the vicinity it may be worth keeping an eye on it in case it's dismantled. The relay company can then be approached and a bargain may be on the cards.

One big advantage of a lattice mast is that it can be climbed. This considerably eases final adjustments, and additional fixed aerials (that is, non-rotatable) can always be attached at a later date. This is not very easy with a two inch scaffold pole.

For a 20ft lattice mast plus another 15ft or so for aerials, the foundations and clamping arrangement shown in Fig. 9 are suggested. Use is again made of the heavy-duty clamps. A number of these will be required and details are given in Table 1.

Before the lattice work is erected it is a good idea to give it a coat of protective paint to prevent it from rusting. A large mast in the garden is bad enough for some neighbours, but a mass of rusty metal may be too much altogether!

As with a scaffold pole mast, the guy lines should be cut to length. All the same accessories can be used. The foundations must be of concrete, due to the enormous weight of the lattice sections alone, and this rules out the "cheap" method of merely knocking support poles straight into the ground.

The site chosen for the mast is up to the individual, but it

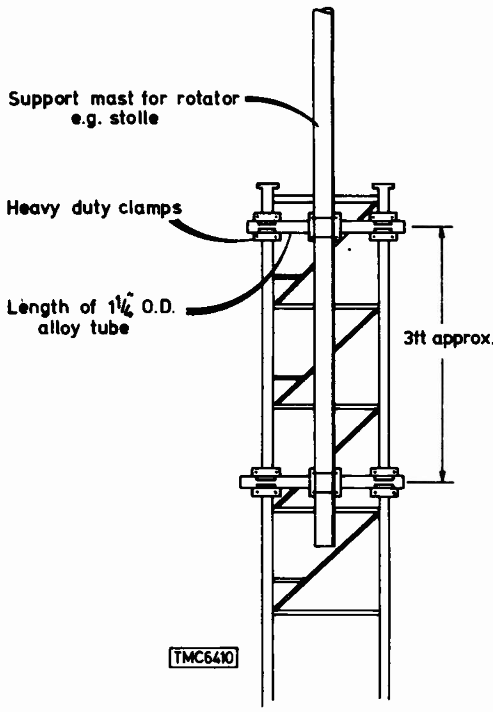


Fig. 10 (left): Method of fixing a 2in. diameter alloy mast to the top of the lattice tower. The mast is clamped on the inside of the tower: for clarity, only one side of the tower is shown above.

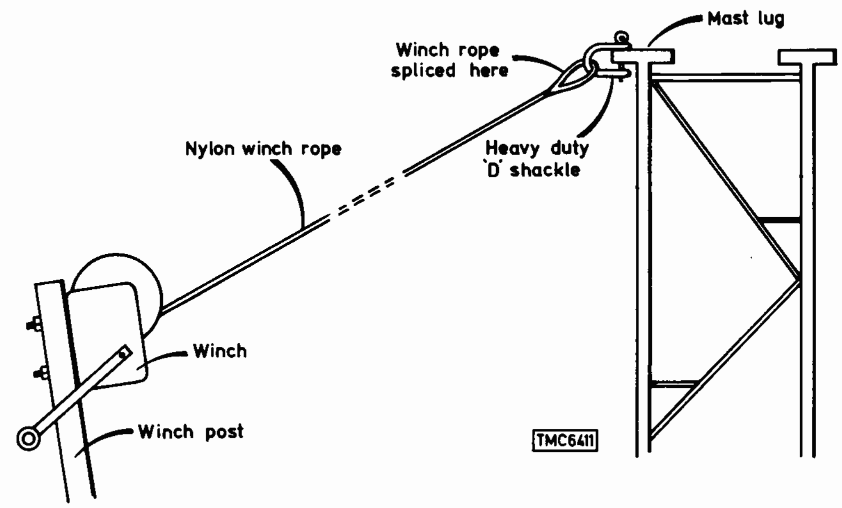


Fig. 11: Using a winch to raise and lower a lattice mast.

should be as close as possible to the receivers so as to reduce the coaxial cable run. This is not always possible but it should be remembered that even when the best quality cable is used losses will occur, particularly at u.h.f., even if masthead amplifiers are used. It may be considered worth losing a little signal strength in favour of siting the mast far enough away from property in the event of collapse, but unless the owner lives in the middle of a desert or East Anglia a 30-40ft mast is almost certain to hit something so it may be better to live dangerously and gain a few more dBs.

If a 20ft lattice mast is obtained, extra array height can be achieved by adopting the method shown in Fig. 10. Six more heavy-duty clamps are swallowed up, and since this article was initially prepared the cost of such accessories has shot up to just over £1 per clamp plus of course the ever-present burden of Vatman. Still, by the time you have forked out for a lattice mast a few extra pounds spent here and there won't really seem to matter too much. Having the luxury of a mast is most definitely expensive but well worthwhile.

Using a Winch

When the lattice mast and the associated conglomeration of accessories has been laid along the length of the garden it soon becomes apparent that great difficulty will be experienced in lifting it to a vertical position. If an army of volunteers is available, all well and good, otherwise a different procedure will be required.

The answer is to use a winch, and fortunately these are not very expensive. The main problem may be in finding somewhere to buy one, and in this respect the authors were fortunate in that there is a local yacht chandler in business. A suitable type is one that can take 1000 lbs strain. The winch is surprisingly small and costs around £14. Suitable rope for hoisting the mast is relatively cheap. The type we used can take weights of up to one ton. Nylon rope was used in favour of metal cable as a safety precaution in the event of the rope snapping. Metal cable would inflict very serious injury, whereas with nylon rope the only people in any danger are those supporting the lattice work. Whilst on the subject of safety, it may be wise for all concerned to wear some form of protective head-gear, just in case anything does decide to plummet to the ground!

A firm anchorage point for the winch is necessary, and it's suggested that an aluminium scaffold pole is knocked into the ground to a depth of about three feet. The winch can then be bolted to the pole. This is quite sufficient.

Most lattice masts have lugs to which the rope can be attached via a sturdy "eye" and shackle arrangement. The two latter items were also obtained from the yacht chandler.

Without a winch system it could take seven or eight people to erect such a mast, but using this labour-saving device only three are necessary. There does not seem to be any great need for brute force either – the winch does all the work. Even turning the winch handle requires little effort and the other two people are used to do only the initial lifting.

The general winch arrangement is shown in Fig. 11, which also shows the method of attaching the nylon rope to the lattice mast lugs. The D shackle is a heavy-duty type for safety reasons.

Once the mast has been erected and firmly secured with the heavy-duty clamps, the rope can be removed and stored for use at a later date should the mast have to be lowered. If the rope is left attached it may well deteriorate and become weakened. The winch can also be unbolted from the anchorage point and stored in a safe place rather than being left out to rust.

If it's inconvenient to use the winch in the manner described, it can alternatively be attached to a metal pole at an upstairs window. Provided the mast is to be positioned directly opposite the window, and that the latter can be easily opened, no difficulties should arise. The angle of leverage is better using this method and the idea is depicted in Fig. 12. A strong pole should be used, and it's a good idea to protect any favourite wall coverings with a cloth where the pole comes into contact with the wall.

Not all gardens will be long enough to enable the mast to be laid out before it's winched up. Some types of lattice mast can be built up section by section: this is all right if vertigo does not cause problems, because by the time the lattice has been completed the constructor will be some 30-odd feet or more up in the ether!

Where's the Fire?

Whilst passing through the Staffordshire countryside the authors were amazed to see a fire engine in someones' garden with the ladder fully extended. At the top was a large collection of aerials! This seemed a very novel idea, and ideal for when lightning is about as the ladder is easily retractable. The only problem of course is the initial procurement of the fire tender. . . . The aerial height achieved was good, and of course the inbuilt ladder facilitated easy adjustment to the arrays.

Planning Permission

The regulations for obtaining planning permission for such a structure vary from county to county. It's suggested that a letter is written to the local officer in charge of planning to ascertain whether permission is necessary. Details of the height, location and purpose should be given in the letter.

If the mast (either of the scaffold pole or lattice type) can be detached from the foundations, as in the case of all ideas given in this article, make this clear as the mast may then not be regarded as a permanent structure by the planning office – but this cannot be guaranteed.

If permission is necessary the planning office may well send some forms to be filled in – there are forms for everything in local government! The completed forms are then considered by the appropriate body, and notification will be received in due course. The result may not be favourable, so it would be wise not to purchase any building materials until the project is approved.

Depending upon the type of neighbours, it may be advantageous to approach them and inform them about the new object which will soon be glinting in the noon-day sun. If special insurance has been taken out for the mast, mention this in passing as it will tend to console them a little. Also try to impress upon them that the aerial system will in no way disturb their radio or television reception. Unfortunately the nearest amateur mast tends to draw the blame for any receiver faults or interference, even if it's the dropper section that's gone open-circuit.

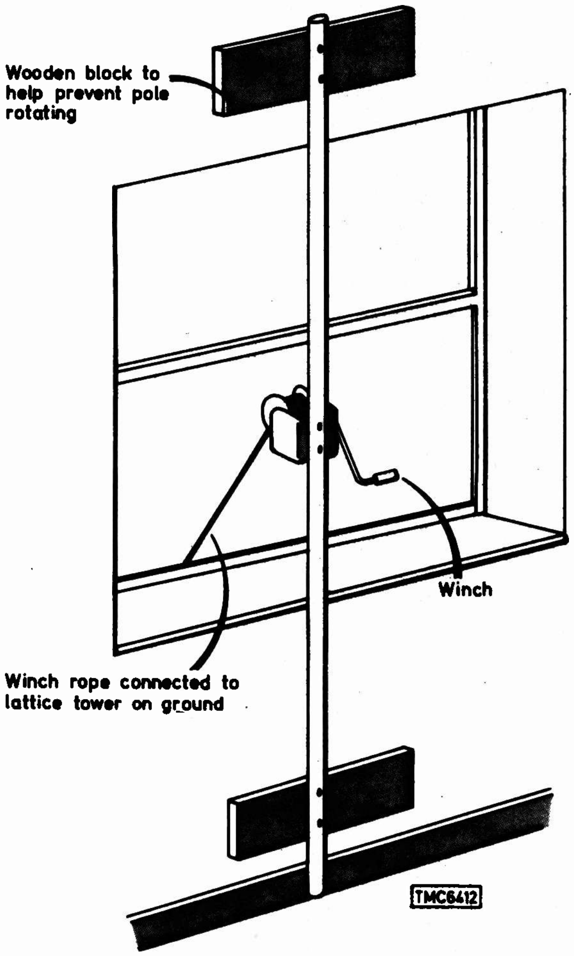


Fig. 12: Raising and lowering the mast by means of a winch attached to a pole on the inside of an upstairs window.

Table 1: Materials and accessories

2in. o.d. alloy mast (10ft)	type A10
1¼in. boom to 1-2in. heavy-duty clamps	type JBL29/2
15in. jointing sleeve	type JBL59/15
Aerial rotator (Stolle type)	–
Alignment bearing for rotator	–
Three hook guy wire clamp (non rotating)	type JBL58
24in. stand-off wall bracket (heavy duty)	type W24HD

The type numbers quoted are all Jaybeam ones, and the above items are all available from Jaybeam Ltd. The aerial rotator and alignment bearing are also available from Antiference Ltd. The following items are available from suppliers such as ships' chandlers: cable grips (¼in.); thimbles or eyes; 7 × 18 gauge guy wire; 1000lb winch; nylon rope (one ton stress); ¼in turnbuckles.

Aerials and Amplifiers

The type of aerials and amplifiers etc. to be used in conjunction with the mast installation will depend on the individual, but as a guide it's suggested that Roger Bunney's excellent series called "How to DX" (*Television*, beginning May 1977) is consulted.

Aerials can be expensive, but for DX work good ones are essential. After the expense of installing a mast, it would be a pity to attempt saving a few pounds on cheap aerials and amplifiers.

In Case of Difficulty

If for any reason problems are encountered in obtaining the items listed in Table 1 it's suggested that Derwent Electronics are contacted at 7, Epping Close, Derby DE3 4HR. They will try their best to order the required items, and most Labgear aerial preamplifiers are in stock. A stamped-addressed envelope should be enclosed with any enquiries.

Conclusion

For serious DX work it will be necessary at some time or other to invest in a mast, whether of the scaffold pole type or the much more expensive lattice variety. Even if the object of the exercise is only to receive programmes from a different region, for example within the United Kingdom, some form of mast is recommended.

Although more expensive, a lattice mast does allow the addition of arrays and amplifiers at the masthead. Despite the very much increased weight, a lattice type is a lot easier to erect than a scaffold pole as it doesn't sag. The problem of weight is overcome if a winch is used. The assistance offered by such a device cannot be over emphasised! ■

LETTERS

RANK A823 CHASSIS FAULTS

Following your recent letters on the Rank A823 chassis, I'd like to add the following couple of faults. On several occasions I've found field flyback lines present, with the voltage at 4TPl on the c.r.t. base panel about −25V to −35V instead of −85V. Under these conditions the field flyback blanking and beam limiting circuits can't operate. The reason is 6R8 (820kΩ) in series with the input to the tripler going open-circuit. This component is mounted on the line output transformer overwinding and is not easy to change. In every case a normal size picture has been present, presumably due to the parallel capacitor 6C8 continuing to provide a pulse input to the tripler.

I've also found that when dealing with large numbers of these sets some appear to have a low-emission c.r.t. when what has happend is that one of the line output transistors has failed. This would give the usual large picture condition, but some resourceful person has turned down the set e.h.t. potentiometer and adjusted the height control to give a "normal" picture! The clue here is that the c.r.t. first anode supply across 6C13 is only about 500V. – **John Adams,** *Oxford.*

SPARKING AND ARCING

The following report on a series of sets we were called to see has a common theme – and is worth noting!

The first set was a Bush colour receiver. Sparking was the complaint, and on examination we found severe arcing around the c.r.t. final anode cap. The tripler was clicking as well. It was noticed that the living room where the set was installed was warm and also humid. After repairing the set the customer mentioned that he was out at work all day. So the room would then be cold. This may not mean anything much by itself, but does when the subsequent sets are taken into account.

The second set was a KB colour receiver with no e.h.t. The tripler was found to have failed and was replaced, restoring the e.h.t. Examination of the old tripler showed signs of arcing. The customer was in all day, and the room was very warm and humid.

Call number three was to another Bush colour set, and again the problem was arcing. The c.r.t. earthing springs were making poor contact and seemed to have a coating over them. The final anode cap showed signs of arcing. The customer was out all day and the room was warm and humid.

I wondered whether there could be a common cause of these problems. The form of heating used was the only common factor of relevance – a portable Calor gas heater. So I borrowed one to try in the workshop. There was plenty of warmth, but the atmosphere was very humid, resulting in general arcing on all the sets when first switched on in the morning. I asked the friend from whom I had borrowed the heater and who used it in his garage what his garage tools were like – grey and coated he said.

A few months ago you published some comments on a KB set that kept blowing triplers. I'd trace that customer and check the type of heating used. I hope these experiences will assist others in dealing with this sort of problem: when faced with set arcing, I now take a look at the fire. – **K. T. Wilkins,** *Merrivale TV Services, Warley, West Midlands.*

THE WALTHAM W125

Not so long since you published an article on servicing the Waltham W125 24in. monochrome receiver. A point that wasn't mentioned was that if the heater rectifier D404 or its parallel 0·0033μF protection capacitor C413 goes short-circuit there is no protection whatever for the valve and tube heaters. The only visible effect is increased brightness and contrast – for a time! Unfortunately C413 does go short-circuit. It's easy to provide protection however, à la Bush. Add a diode across C414 (the heater line decoupler) – with its cathode to chassis of course. – **A. F. Bennett,** *Walsall, West Midlands.*

BIOLOGICAL FAULT

I was called to see a Pye colour set fitted with the 697 chassis, the complaint being smoke from the rear of the set. On removing the timebase panel I found – as so often – that the c.r.t. first anode supply decoupling capacitor C224 was short-circuit, its associated 100kΩ smoothing resistor R227 cooking up in consequence. On replacing these components, refitting the panel and switching on the picture appeared, but in magenta, i.e. no green. So I collapsed the field to set up the first anode controls: red and blue could be adjusted normally, but when the green control was advanced the red and blue lines faded out while when the green was turned down again red and blue returned. On lifting the convergence panel (on which the first anode controls are mounted) a caterpillar was found across the tags of the green control ... Removing this gave correct adjustments and a good picture. – **K. E. Fellingham, Tech. (CEI), AMSERT,** *Bury St. Edmunds.*

Miller's Miscellany

Chas E. Miller

Getting the Drift

A few weeks ago I bought a hybrid Pye colour set which had suffered the not unusual line output transformer burn up. When the transformer was replaced the set gave a good picture, but after being on for a minute or two it tuned itself from BBC-1 down to ATV, then to BBC-2 – without being touched. Clearly this was a fault on the voltage supply to the electronic tuner, confirmed by a quick check with the AVO: the voltage had dropped sharply from its correct value.

Tracing the source of supply was more difficult than might be expected. The chassis was in production for a number of years, and finding the version which used the electronic tuner involved wading through several volumes of the well-known servicing books. Eventually I discovered that the tuner voltage is derived from a resistor (R389) which decouples the h.t. feed to the screen grids of the three PCL84s on the colour-difference amplifier panel: one of these valves was developing an internal short as it warmed up, thus pulling down the voltage and causing the tuner drift. The culprit was found by easing each out of its socket in turn, with the set on and the AVO connected, until the voltage returned to normal. A new valve solved the problem, but while about it I carried out the maker's recommended modification by changing the value of R389 from the original 3·9kΩ to 3·3kΩ.

Another Odd One

A dual-standard 19in. Bush receiver came in with the complaint that the picture and sound were intermittent. As might be expected, the set worked well enough while it sat on the bench with its back off, but started to give trouble as soon as the latter was replaced. It was a very tap-worthy fault, which could evidently be produced almost by breathing on the set. It was finally traced to bad earthing of the i.f. printed panel to the steel frame. This appears to rely on the print being held in contact by a number of self-tapping screws, and it seemed curious that all these should have failed at once. Tightening them didn't provide a trustworthy cure, so an earth strap was soldered between this panel and the earth part of the timebase panel. I've never had to do this before, although I've had several instances of field collapse due to print cracks on the timebase board near the scan coil plug and around the PCL805 holder.

Translations

One of the major German setmakers supplies a booklet containing translations into English of the terms used in continental service manuals. I had a dabble as soon as a copy came into my hands, but the first three words I looked up weren't mentioned. I gave this up but it set me thinking that a translation of some very widely used phrases used by customers could be of help to inexperienced TV service engineers. As follows.

Comment: "It's never been right since you brought it back".
Meaning: "We don't want to pay the bill".
"We were recommended to you".
"No one else will touch it".
"We've had no trouble at all before this".
"The last engineer practically lived in the house".
"It's been nothing but trouble".
"A fuse blew two years ago".
"It went off as soon as you turned the corner in your van".
"We don't want to pay your bill".
"Our neighbour hasn't got an outside aerial and he gets a *perfect* picture".
"He's got more snow than there is in Alaska".
"There's no need for you to rush, we're not telly addicts".
"I'll be on the phone before you even get back to your workshop".
"There'll be someone in all day to let you in".
"Provided you call between 5.45 and 6 p.m.".
"Can we try it for a day or two?"
"We don't want to pay the bill".

There must be many more of course. I'd be grateful for suggestions to add to the list. At the same time, thanks to readers who have written to me. I get round to answering all letters personally, but it takes a little time!

How the Yanks Did It

A friend recently presented me with a copy of the RCA Colour Television Pict-O-Guide, published in 1957 by the Radio Corporation of America, which largely developed what became the NTSC colour system. Because the book is aimed at the service engineer rather than the highly technical student it's essentially practical, the necessary discussion of the theory behind the system being managed in ordinary day-to-day language. The author explains that he does not expect the serviceman to be versed in colorimetry and mathematics. There are dozens of photographs taken directly from the screen of an RCA colour receiver to illustrate purity and convergence adjustments and various fault conditions. In fact the text shows remarkably little difference from the British manufacturer's service manuals of a decade and a half later! (We had to learn from somewhere! – *Editor.*) One feature we missed (thankfully) over here was the provision of extra purity magnets around the rim of the picture tube. Six in number, these had to be screwed in and out to counteract the effects of external magnetic fields which might cause edge impurity. There were no built-in degaussing coils then. The entire static and dynamic convergence sequence is explained in much greater detail than I've ever seen in British manuals, which makes it rather disappointing to find that a crosshatch display (again an actual photograph) described as showing satisfactory convergence is rather inclined to "medal ribbons" on the left hand side. To be fair however these probably wouldn't have been too noticeable at normal viewing distances.

Perhaps the most surprising thing in this book for me was the circuit of what we would call the decoder. Even allowing for the absence of a PAL switch, it's staggeringly simple.

Just five valves are employed, three triode-pentodes and two double triodes. It's a graphic reminder that one valve can often do the work of several transistors – with far fewer peripheral components. The single chroma amplifier drives the control grids of the B–Y and G–Y detector valves (two 12AT7s or ECC81s), whose sections are arranged in two pairs. The output from the reference oscillator is injected into the groups of cathodes via a small r.f. transformer. Appearing at the anodes are +B–Y, –B–Y, –G–Y and +G–Y signals. The –B–Y and –G–Y are combined to give R–Y, and the triodes provide enough amplification to allow the c.r.t. grids to be driven directly. It tempts me to hook up a PAL-modified version, using an ECC82 as a bistable of course . . .

Business as Usual

Your correspondent was married on September 24th last. At 8 p.m. on the 23rd he was engaged in a desperate defensive battle with a recalcitrant customer who wanted his set looking at there and then and was not inclined to take "no" for an answer. I managed to get rid of him at last, but I couldn't avoid a nasty feeling that he might be waiting for me outside the church . . .

Removing Ghosts

Nick Lyons

U.H.F. reception in my area has been good since the start of transmissions here. Until recently, that is. Somebody somewhere has built something, though I'm damned if I can find out what it is or where. The results are alas evident enough: a negative ghost about a third of a line in width from the correct picture and of quite enormous amplitude. In some parts of the town it's bad enough to make some sets using previously adequate aerials lose sync. My own set suffered, and considering that I was using an MBM30 aerial with 20km line of sight to Emley Moor you can appreciate the problem.

What we needed was a method of using existing aerial stocks to solve the problem and avoid the necessity for large, narrow beam aerials. To assess the magnitude of the problem, we tried several types of standard Yagi and multidirector arrays, but had no success. Log-periodic aerials were tried: they eliminated most of the ghosting, but in some awkward signal areas provided insufficient gain.

Since stacking aerials reduces the beam width, i.e. gives a sharper polar response, it was decided to try this approach to the problem and, remembering Roger Bunney's account of phasing together two stacked dipoles (see *Long Distance Television*, March 1977), I decided to make up the suggested harness. As shown in Fig. 1, this consists of a quarter-wave length of 50Ω feeder connected between the 75Ω downlead and the 75Ω parallel connected aerial feeders. The two aerials to be used were simple ten-element types with single folded dipoles, but to make matters worse the installation was in the loft. Since the start of the ghosting, the existing 18-element aerial in the loft produced only two channels, the third being almost impossible to lock. No amount of aerial realignment would cure this.

After adjusting the two horizontally stacked aerials for about a quarter of an hour however not only could all three channels be locked but the ghosting was only slightly visible on any of them.

The mechanical arrangements are shown in Fig. 2. The U-bracket from the 18-element aerial was used to mount the two aerials – any piece of rod can be used of course and should be arranged so that the centre to centre spacing of the aerials is around a wavelength. Both aerials should be parallel to each other, with the elements of both in line. This means that both must be of the same type and size, while the aerial feeder lengths must be exactly the same (about a metre is convenient).

Although Roger Bunney said the system is an essentially narrow band one, the term narrow band has to be taken in context. At u.h.f. the percentage change in stub length over the frequency band of a channel group is of the order of ±8%. If we assume that with such a small change the impedance varies in a roughly similar manner, then the impedance seen by each aerial and the set should be in the range 65-85Ω. All things considered therefore the system has sufficiently wide bandwidth in a reasonable signal area.

Since the original installation was rigged up we've used 18-element arrays in the same configuration for the more troublesome or weaker signal areas with bad ghosting. The results have been excellent.

The lengths of 50Ω feeder required for each of the aerial channel groups, taking into account the velocity factor, are as follows: group A 0·134m; group B 0·107m; group C/D 0·092m. ■

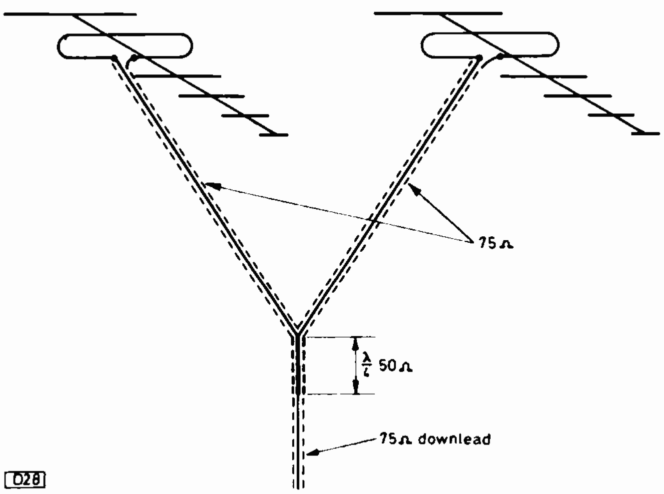


Fig. 1: Method of phasing two stacked aerials.

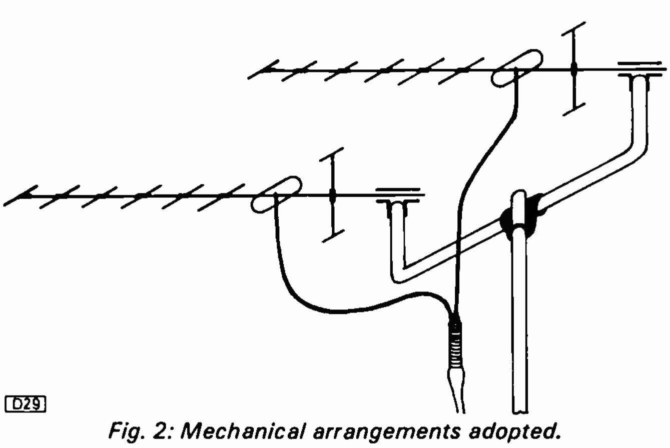


Fig. 2: Mechanical arrangements adopted.

On-Screen Clock

Part 2

E. A. Parr, B.Sc., C.Eng., MIEE

Connection to modern cathode-driven colour receivers was dealt with in Part 1 in some detail. For direct coupled amplifiers few if any external components will be required. For a.c. coupled amplifiers the three clamp transistors and their associated components can be mounted on a small stripboard. If the brute force method is used, the high-voltage transistors and the other components should again be mounted on stripboard.

Many older colour TV sets use colour-difference signals (R–Y etc.) to drive the c.r.t. grids, with the cathodes driven by the Y (luminance) signal. Similar principals to those above apply here except that four switches are necessary, three for the colour-difference signals and one for the luminance signal. Four switches are provided on the PCB.

Use with Monochrome Sets

Finally, monochrome sets. These are relatively simple. Only one switch is required for the video (say F) and one each for the time and background. Outputs K and L are then linked. A good point to pick up the video signal is at the input to the video output stage. The video to the switches should be a.c. coupled at the input and output as shown in Fig. 8. The time and background can then be set to the required black/white levels. Care should be taken not to make the black too black as this might upset the sync separator. Clamping the video is not normally necessary. The level of the time display does vary with picture content, but this is far less noticeable on a monochrome picture.

The line and field sync signals in a monochrome set are extracted in the same manner outlined for colour sets. In general, monochrome sets have simpler timebases, so suitable points should be easier to identify.

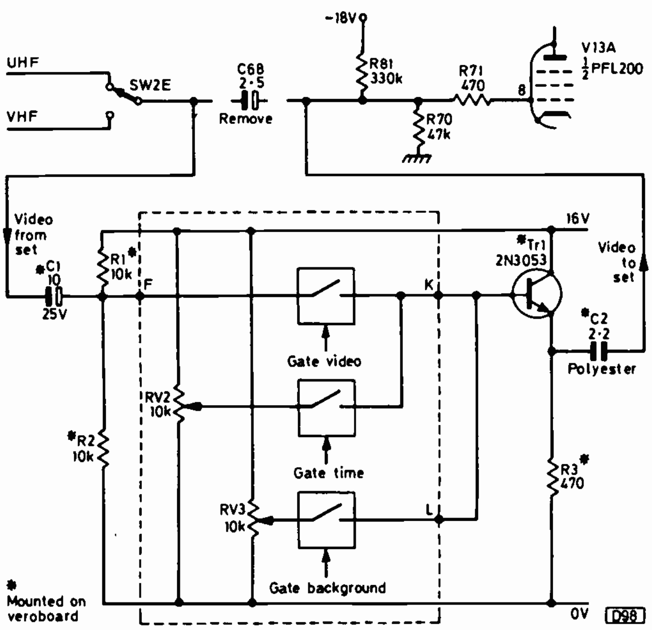


Fig. 8: Typical interconnections with a monochrome set, in this case the Pye 368 dual-standard chassis.

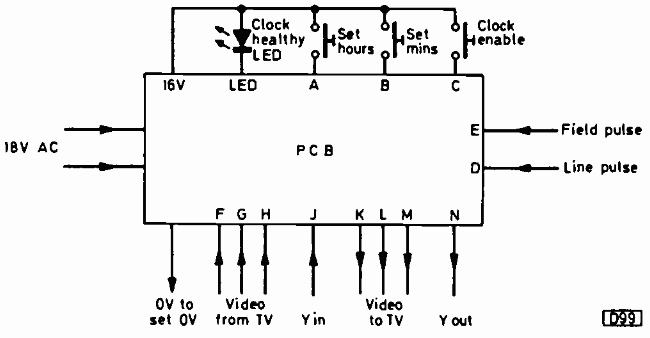


Fig. 9: Summary of board interconnections.

Testing

Before turning on for the first time, make sure that the wire link connecting the power supply to the circuit is out. Turn on and adjust RV6 to give 16-17V at the link. Turn off, insert the wire link and turn on.

The first thing to check is that the TV signal still gets through with the display disabled. If it does all is working well with the 4016 chips. At the same time the "clock healthy" LED should be permanently on. Press either set time button and the LED should start to flash, showing that the clock is running. If all is well so far, enable the display. Hopefully you should get a display which can be adjusted for colour by RV2 – RV4. A scope helps for getting the correct levels on these three trimpots, but it can be done by trial and error.

The oscillator trimpot RV1 controls the 1·1MHz oscillator. Its effect is to adjust the display's horizontal position and width. There is no control over the vertical position or height.

It is only fair to point out that little fault-finding can be done without an oscilloscope. If a scope is available, check the following points in case of trouble:

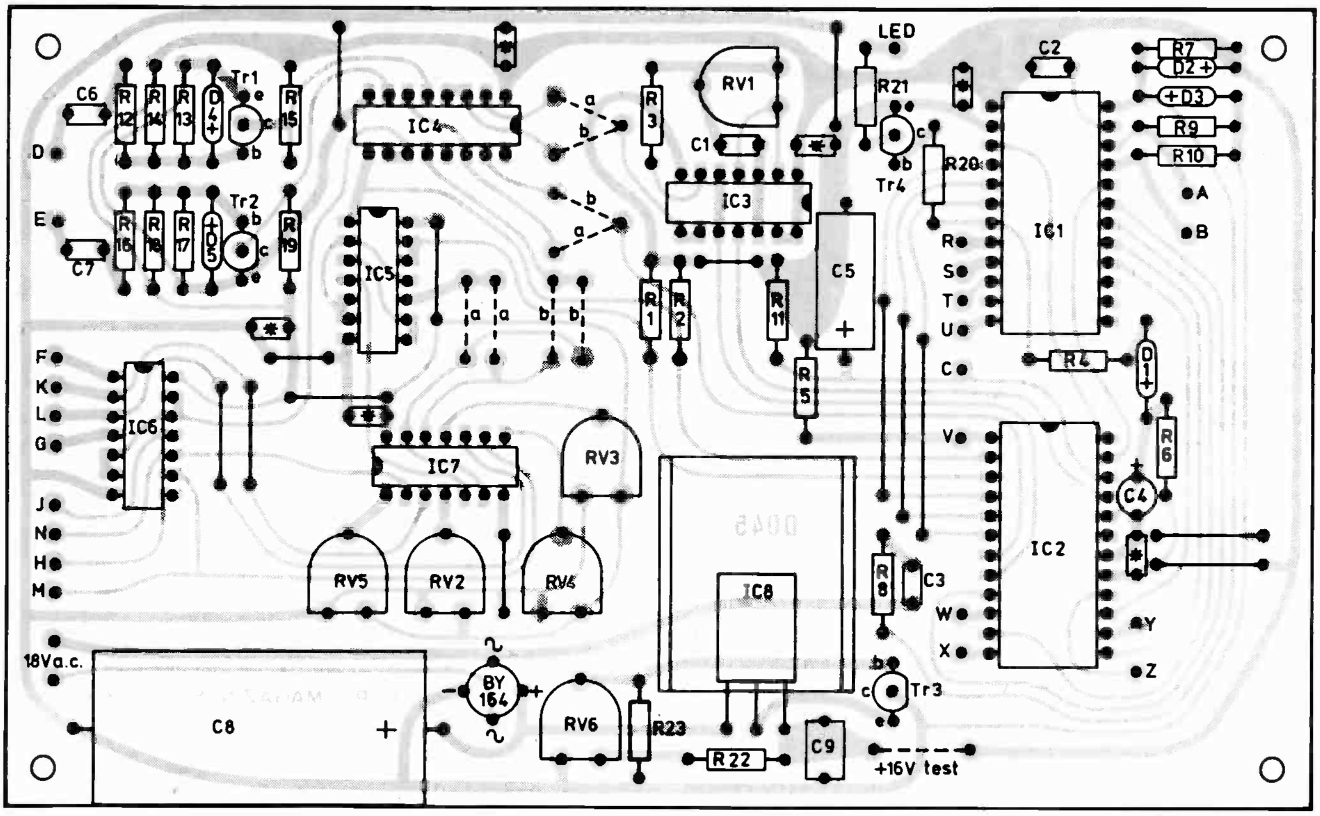
(1) Are the syncs present and of the correct polarity?
(2) Is the 1·1MHz oscillator running (IC3 pin 11)?
(3) Is the digital clock running? Check for multiplex signals MX1-MX4, the strobe and data.
(4) Are nice clean signals being produced at IC2 output pins 2 and 3?
(5) Are the gate signals present?
(6) Is video present at the 4016 switches?
(7) Are the d.c. levels on RV2-RV4 in the video range?

Despite all that, the prototype worked first time.

Board Layout

In order to simplify the board layout, some of the gates in IC4 and IC5 and the switches in IC7 have been transposed and do not therefore correspond to the circuits shown last month. This does not affect circuit operation.

COMPONENTS LIST
– see page 266 –



[✱] Denotes decoupling capacitors (10n)

TMC661

Fig. 10: Board layout.

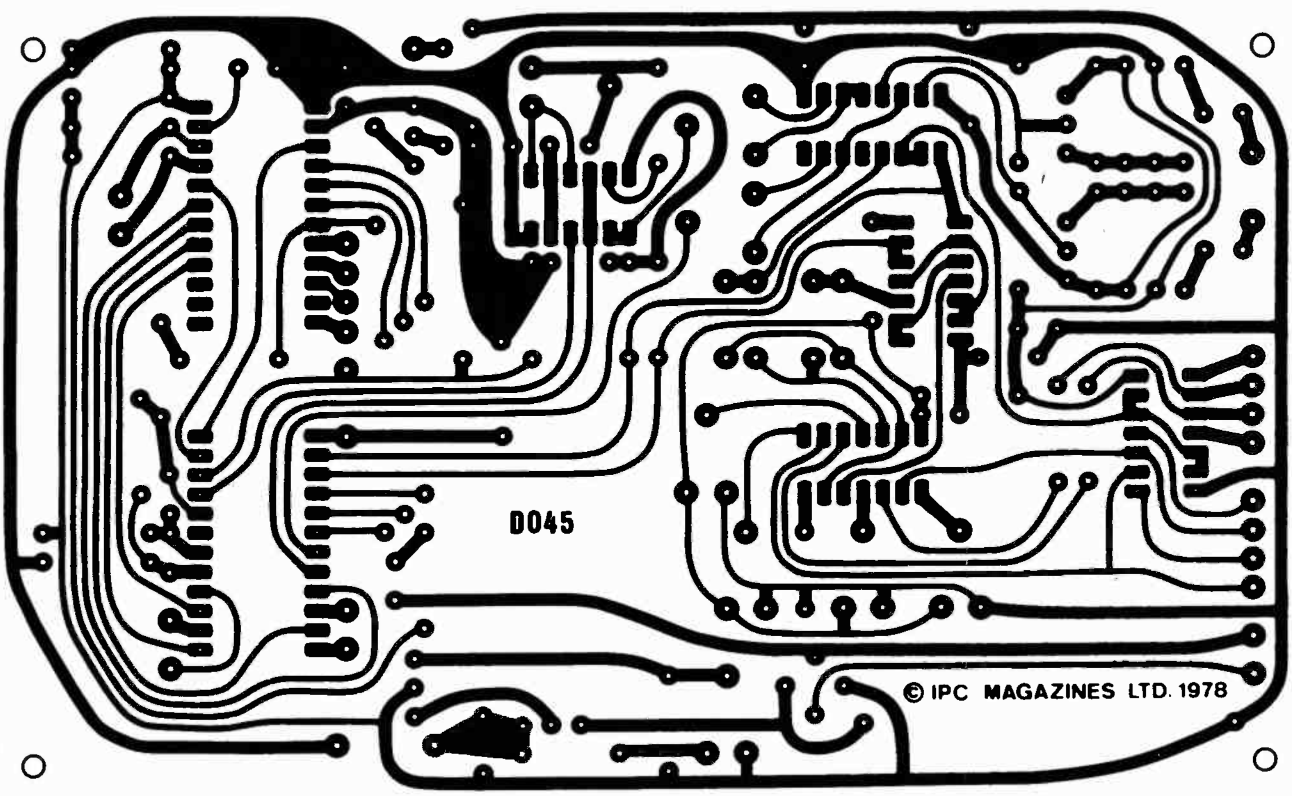


Fig. 11: Board pattern.

Note that C4 is a tantalum bead capacitor: a 35V type is suitable.

Other Devices

The chip chosen (AY-5-8320) puts the display to the right of centre of the screen. Alternative chips are the AY-5-8322 and AY-5-8324. These are pin and electrically compatible. The 22 puts the display slightly below the screen centre, while the 24 puts the display at the bottom centre of the screen. These two devices can be used on the PCB without modifications. For readers outside the UK, the 8320 and 8322 chips will work with 525-line TV systems. ■

Servicing Saba Colour Receivers

Models 6715, 6716, 6735 and 6745 (Chassis H)

Part 2

P. C. Murchison

HAVING looked last month at the power supply section of the receiver and the common faults there we will move on to the next most likely trouble spot, the thyristor line output stage. The circuit is shown in Fig. 4.

Line Output Stage Operation

First a word about its operation. Four active devices are used to provide the scan and flyback, thyristors Thy671 and Thy672 and their parallel diodes D673 and D676. D676 is a conventional efficiency diode providing the first part of the forward scan, Thy672 acting as a switch to provide the second part of the forward scan. It's switched on roughly a third of the way through the forward scan by the waveform fed to its gate from tag 4 on transductor Tr672. Easy part over. The problem is how to switch Thy672 off to provide the flyback, since this can't be done by feeding a control waveform to its gate (once a thyristor is switched on at its gate, it remains conductive until the current through it falls below the hold-on value). This is the purpose of the flyback thyristor Thy671, whose gate is controlled by the output from the line oscillator (via a two-transistor buffer circuit).

Thy671 is switched on just before the end of the forward scan. Because the components in its anode circuit – Tr672 winding 2-7 and the tuning capacitors C681/C677/C678 – form a tuned circuit, there is a rapid build up of current in the form of a sinewave. This current flows through Thy672 in the opposite direction to the scan current, and when it exceeds the scan current Thy672 switches off. Thereafter Thy671 and D673 conduct alternately to complete the current path during the flyback.

Transductor TD673 across the input coil (Tr672 winding 3-5) provides width stabilisation: it's driven by T673 which samples the h.t. voltage (via R689/P672) and the waveform at tag 13 of the line output transformer Tr671.

For further information on the operation of thyristor line output stages, see the June 1976 issue of *Television*.

Flyback Switch Failure

Perhaps the most common failure is when either the thyristor Thy671 or diode D673 in the flyback part of the circuit goes short-circuit. The electronic protection circuit then triggers, causing the motorised mains switch to shut off the power. Any attempt to reset the mains switch under these conditions simply causes the trigger circuit immediately to throw the mains switch out again, so it's pretty obvious that there is something drastically wrong with the set. A quick check with a multimeter on the ohms range will reveal a short-circuit between chassis and the 270V line. Thyristor Thy671 is number one suspect, with an anode-to-cathode short-circuit, though the culprit is sometimes a short-circuit diode D673.

When replacing a short-circuit thyristor it's good policy to check D673 because if this diode is open-circuit it will overload the replacement thyristor, causing it to break down. The difficult task of replacement will then have to be repeated.

Both thyristors are mounted on a plate forming part of the main chassis. They are sandwiched between a heatsink, a mica insulating washer and a moulded plastic insulator, all these pieces being held together by two nuts and bolts which are surrounded by many components. Replacement is far from easy!

The mica washer is very thin, sometimes breaking down where there is a weak spot. This results in a short-circuit between the chassis of the set and the anode of the thyristor. The effect is the same as a short-circuit thyristor, the trigger circuit switching off the power.

The thyristor can be overloaded, with consequent damage, should C676 ($3\cdot3\mu$F) or R684 (150Ω) become disconnected or open-circuit, this fault resulting in the waveform at test point V4 becoming distorted and suppressed in amplitude. An oscilloscope is a very useful tool when trouble shooting in the line output stage, often saving much time and trouble when trying to locate the exact nature of a fault such as failure of C676 or R684. This fault can otherwise be very expensive, causing continual failure of thyristors.

Capacitor Troubles

Although capacitor troubles are less common it's worth noting some failures that have been experienced and their effects.

C677, C678 and C681 are connected in a T network to form the tuning capacitance. Failure of any of these components can cause a variety of effects. Should C678 go short-circuit the result is excessive picture width with R692 (270Ω) overheating, whilst a short-circuit C681 will cause the beam current limiter to come into operation with a resulting blank raster and no video information present.

The scan-correction capacitor C686, a large $0\cdot68\mu$F paper component, tends to fail rather violently, issuing forth clouds of smoke whilst the metal casing of the component bulges almost to bursting point. At the same time there is complete loss of e.h.t., with the electronic trigger circuit occasionally switching the set off. Should there be no warning smoke, a check with the oscilloscope will reveal that the waveform at test point T6 is incorrect and increased in amplitude to around 530V.

The 12μF capacitor C691 occasionally goes short-circuit, with a resulting loss of e.h.t. The waveform amplitude at test point T4 is then reduced to a mere 200V. Should the capacitor go open-circuit however the effect is unmistakable: a 2kHz whistle issuing from the line output stage, with the waveform at T4 again being affected.

Operation of the Stabilisation Circuit

The stabilisation circuit centred around T673 and D678

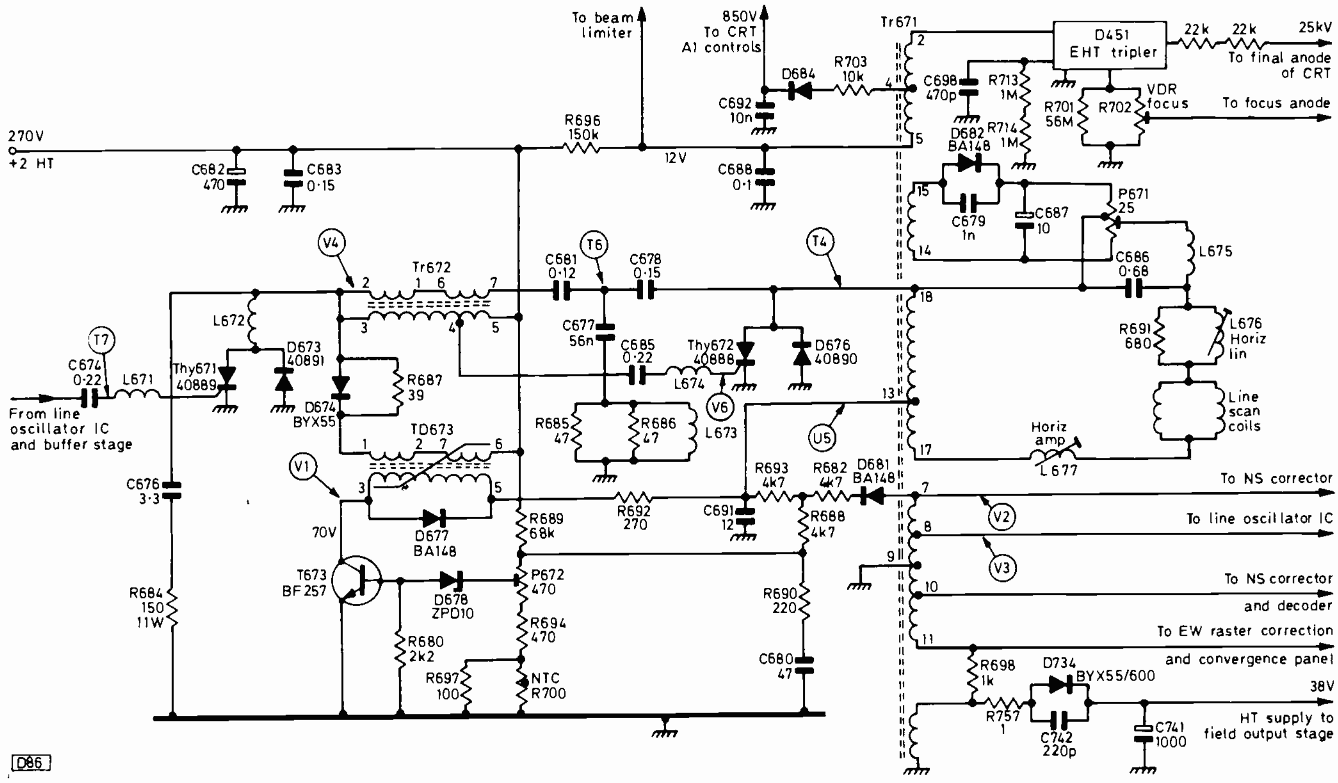


Fig. 4: Circuit diagram of the thyristor line output stage.

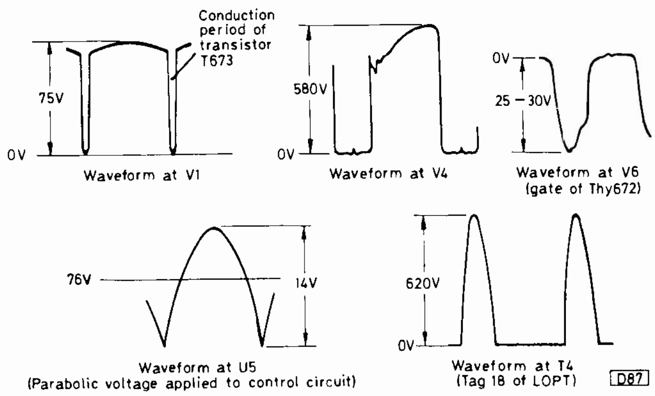


Fig. 5: Line output stage waveforms.

is rather interesting in its operation, so we'll take a more detailed look at it.

The sawtooth current flowing through the line output transformer produces a parabolic voltage (waveform U5) at the upper end of C691. This parabolic voltage sits on a d.c. level of about 76V, the d.c. being the mean value of the line pulses at point 18, the top end of the line output transformer (see waveform T4). A portion of this signal appears at the slider of P672. When the top of the parabola exceeds about 10V in amplitude zener diode D678 conducts, passing the parabolic voltage on to the transistor's base. It can be seen then that the transistor conducts only briefly. The waveform thus produced at the collector of transistor T673 shows a voltage collapse during the conduction period of the transistor, this conduction period being variable depending upon the amplitude of the parabola. Two factors determine the amplitude of the parabola.

First, the amplitude of the line pulse at point 18 varies with beam current, so the d.c. potential upon which the parabolic voltage sits varies in value. It's raised or lowered above or below the conduction potential of the zener diode for different periods of time therefore depending on the beam current. In addition, the peak-to-peak amplitude of the parabola will fluctuate in sympathy with variations in the amplitude of the sawtooth line waveform. In either case the transistor T673 will draw more or less collector current, depending upon the amplitude or position of the line parabolic voltage.

The transistor drives the control winding (3-5) of the stabilising transductor TD673, whose load winding (1-6) is connected in parallel with the line output stage h.t. input winding on Tr672 (tags 3-5) via diode D674 and R687. Thus the inductance of the charging circuit (Tr672 and the tuning capacitors) varies in sympathy with the length of conduction of T673 and stabilisation is in this way effected.

The control exercised by the circuit as described so far is insufficient to compensate for variations in the h.t. and operating voltages, so in addition the h.t. voltage is applied to the zener diode via R689 (68kΩ).

Picture width is adjusted by means of the preset potentiometer P672 which alters the amplitude of the control signal.

Diode D677 provides damping in order to protect the collector of T673 against the positive voltage swing that would otherwise occur when it switches off. Diode D674 also provides a damping action.

Stabilisation Circuit Faults

Having examined the control circuit we'll now look at its failings. The transistor T673 and zener diode D678 often fail, the result being excessive over or under scan. The zener diode occasionally goes short-circuit, so that there is a control voltage permanently at the base of T673. This turns the transistor hard on, the result being a very small picture (about six inches square). A similar thing happens when T673 goes emitter-collector short-circuit, but when the transistor goes open-circuit the result is an excessively wide picture. It is recommended that the zener diode and transistor are replaced together should a fault occur in either of them.

Scan Switch Failure

We saw earlier how failure of the flyback switch thyristor Thy671 or diode D673 could result in the set switching itself off. Failure of the scan thyristor Thy672 or diode D676 does not have quite such a drastic effect on the receiver, but when either goes short-circuit the outcome is loss of e.h.t. and sound, though sometimes short-wave radio stations can be heard from the speaker! This is because the i.f. strip is completely shut down when the line frequency gating pulses are missing from the a.g.c. circuit, though some radio signals can break through to the sound channel.

D676 has been known to go open-circuit. This results in a very small picture and usually damages the thyristor so that both components have to be replaced. When this happens the waveform at test point T4 is distorted, with a "ringing" effect during the line scan period.

Tripler Failure

The tripler all too frequently fails, and when it does it loads the line output stage to such an extent that line pulses to the gated a.g.c. circuit are again lost, with similar results to those given by scan diode/thyristor failure. Disconnecting the tripler from the line output transformer will in this case remove the load and restore normal sound. Fitting a replacement tripler will then restore the e.h.t. A clue to tripler failure is to remove the c.r.t. anode cap and examine the two resistors enclosed within. If these are badly burnt (they sometimes melt the anode cap!) the tripler can be thrown away!

Focus VDR

Not far from the tripler and connected to it is the focus v.d.r. R702. This is of a notorious type used for many years in German TV receivers. After several years' operation the control requires frequent resetting, possibly every two or three months. Investigation will reveal that the control is in a very fragile state, crumbling to a powder at the slightest touch. Replacements cost several pounds each, but unfortunately this provides the only lasting cure to the trouble.

Line Whistle

Thyristor timebases are extremely noisy in operation and whilst some increase in line whistle can be accepted there comes a point where it becomes really intolerable! The only way in which to attempt to cure this trouble is to remove the line output transformer from the printed circuit board and try to tighten the bolts holding the core together. These bolts are accessible only when the transformer is removed, so it's fortunate that the transformer is unpluggable after first unsoldering the two clips holding it into the printed circuit. Sadly, if this tightening doesn't cure the whistle the only answer is to replace the transformer and hope that the new one proves less noisy.

Field Collapse

It's worth mentioning that the 38V supply for the field output stage is derived from the line output transformer. The rectifier is D734 and its reservoir capacitor C741. D734 (BYX55) occasionally fails, its surge limiting resistor R757 (1Ω) burning out along with the expected loss of field scan. Thus both these components have to be replaced. The field timebase itself is reliable, the only trouble we've had being occasional failure of the field output transistors T276 and T278 (BD697 and BD698).

Next Month

The next instalment will take a look at the front-end tuning and the ultrasonic control system used in the S6716, S6735 and associated models. The operation of the circuits is interesting and they are not trouble free....

ON-SCREEN CLOCK

COMPONENTS LIST

Resistors:

R1	10k	R9	100k	R17	AOT
R2	10k	R10	100k	R18	AOT
R3	22k	R11	100k	R19	10k
R4	1k	R12	AOT	R20	22k
R5	100k	R13	AOT	R21	2k2
R6	100k	R14	AOT	R22	22k
R7	100k	R15	10k	R23	56k
R8	10k	R16	AOT		

RV1–RV6 10k subminiature linear horizontal presets.

Capacitors:

C1	33pF ceramic plate	C6	6n8 Polyester
C2	330pF ceramic plate	C7	100n ceramic plate
C3	100n ceramic plate	C8	2200μF 25v electrolytic
C4	1μF 35v tantalum bead	C9	470n polyester
C5	100μF 25v electrolytic		

Plus 7 off 10n ceramic plate for decoupling i.c.s.

Semiconductors:

Important: IC3, IC4, IC5, IC6, IC7, must be RCA B series CMOS. This should not be confused with A series or Jedec B series which are 15 volt rated. The RCA B series can be identified by the suffix BE or UBE.

IC1	AY-5-1203A	IC7	4016 BE or UBE
IC2	AY-5-8320	IC8	7812
IC3	4011 BE or UBE	TR1, TR2, TR4	2N3704
IC4	4049 BE or UBE	TR3	2N3702
IC5	4011 BE or UBE	D1–D5	1N4148
IC6	4016 BE or UBE	Bridge rectifier:	BY164

Miscellaneous:

Mains transformer: 18v secondary @ 1A

P.c.b. reference No. DO45 from Readers' PCB Services Ltd.

The Television monochrome portable can now be seen working at Manor Supplies, 172 West End Lane, London NW6.

TV Servicing: Beginners Start Here...

Part 6

S. Simon

SOME followers of this series, which is intended to be very down to earth, may have felt that we have been flying rather high these last two months, what with the theory of line output stage operation, flywheel line sync and so on. If this has resulted in iced wings or lost interest, fear not: we are at ground level again, with mainly practical matters.

To clear up some matters arising though, we did jest a little here and there and perhaps caused some misunderstandings. For example, in talking about the line output transformer we said "all that heavy insulation". In fact the insulation is the minimum necessary and requires only slight deterioration for a breakdown to occur – the basic reason for line output transformer failure. Heavy insulation would result in a vast increase in size etc. and would defeat several objects.

Capacitance

We also said something about the self-capacitance of the windings in relation to the insulation, and this could have been confusing since we've had little to say so far about capacitance or capacitors (capacitance the property, capacitors the things that have it). At this stage we'll briefly brush the surface as it were. If two conductors are in close proximity, separated by a thin layer of insulation, and are at different potentials (say one at 1V, the other at 2V, meaning a difference between them of 1V, which is the important factor) one will have less electrons than the other and there will therefore be (however briefly) a storage effect between them. The closer the conductors are (i.e. the thinner the insulation) the greater the capacitance effect for a given area.

To get a very small capacitance value we can make the capacitor out of a length of flex (for a practical example, check back to C1 in the article on *Adding AFC* last month). At the other extreme, two large metal plates very close to each other will give us a large capacitance. We can take a long length of tin foil, lay it on a similar length of waxed paper and then another length of foil, roll up all three to a convenient size and add leadout wires to each foil, giving us a capacitor of say 0.1μF. The voltage rating will depend on the breakdown voltage of the paper used, say 300V.

Now the windings on a transformer have a different voltage between the turns, be they the same winding or separate ones, while the thickness of the insulation between each turn may be only that of the wire's enamel covering.

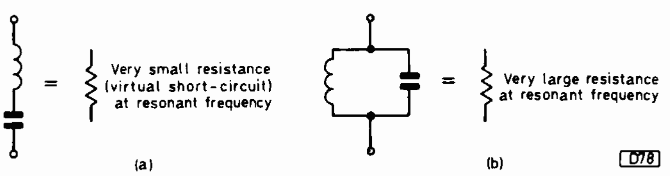


Fig. 1: Series (a) and parallel (b) tuned circuits.

There is therefore a considerable capacitance present in a transformer. This can be calculated and employed for tuning purposes. Tuning? Ah yes! Something else we've mentioned without saying anything much about it by way of explanation.

Tuning

To understand tuning is to understand the whole basis of radio and television. A great deal could be said about it therefore, but for our purposes the basic ideas can be put over quite briefly.

We have already mentioned that when a wire passes through a magnetic field a voltage is induced across it – the whole electrical industry depends on this basic effect. Conversely, if a current, however small, passes through a wire a magnetic field builds up around the wire. If the current is varying, the magnetic field varies in accordance. This is the principle of the transformer, the varying field around one winding producing a varying voltage across and current through an adjacent winding.

Inductance

The field around a winding will also induce an opposing current in the winding itself however. This current opposes the initial current produced by the voltage applied across the winding. Because of this inducing of an opposing current, a winding is said to have the electrical property of *inductance*. The effect of a particular value of inductance varies with the frequency of the applied voltage waveform. When considering the effect of an inductance at a particular frequency we refer to its *inductive reactance*. Like resistance, this is measured in Ohms: unlike resistance, it varies with frequency. The electrical characteristic of *impedance* is the combined reactance and the d.c. resistance of the wire.

The net result of the inductance of a winding is that the current flowing through it lags 90° behind the voltage applied to the winding. The inductance of a winding depends on its physical construction, i.e. the diameter of the winding, the number of turns, the wire used and the material on which it's wound. Since the reactance of a winding varies with the frequency of the applied waveform, we can wind coils that will have maximum effect at various frequencies. This is one aspect of tuning, i.e. arranging for a circuit to have maximum effect at a particular frequency, be it the line or field frequency, a video or audio frequency or the frequency of the transmitted signal we wish to tune in.

Capacitive Reactance

Now consider a capacitor. This charges when a voltage is applied to it. Since a discharged capacitor is a virtual short-circuit, there will be zero voltage across it when it's discharged. As it charges, so the voltage across it increases but the current flowing into it decreases. We are talking about varying currents/voltages, i.e. a.c. waveforms, and what we have here then is the opposite effect to that of an inductor, i.e. this time the voltage lags 90° behind the current. We have in fact another form of reactance, *capacitive reactance,* and this again is frequency dependent, a given value of capacitor having maximum reactance at a particular frequency. What happens when we combine capacitance and inductance?

Tuned Circuits

This is what we do to produce a tuned or resonant circuit. We can connect the capacitor and the inductor in series or in parallel (see Fig. 1). Since in the case of an inductor the current lags the voltage by 90° while in the case of a capacitor the voltage lags the current by 90°, if we connect a capacitor and an inductor which have the same reactance values in series the reactances will cancel out and what we have is a short-circuit (maximum current, minimum voltage) at a particular frequency – a very convenient state of affairs since it gives us a method of getting rid of an unwanted signal at a particular frequency. Suppose on the other hand that what we want to do is to select and pass on a signal at a particular frequency (or to generate one at a particular frequency, which is what we are coming to)?

If we connect the capacitor and inductor in parallel (see Fig. 1 again) the effect is that the reactances add: thus the combined reactance is maximum at a particular frequency, i.e. at one frequency (called the resonant frequency) there is minimum current flow but maximum voltage across the combination.

As we have seen, the inductance of a coil depends amongst others things on the material on which it's wound. By winding the coil on a former and inserting the core material inside the former we can make the value of the winding variable – by varying the position of the core, i.e. screwing it farther in or out of the former, the inductance of the coil can be varied. Similarly the tuning can be varied by altering the value of the capacitor in series or in parallel with the coil. Left to itself, a coil has a natural resonance due to the capacitive effect of its own windings (self-capacitance), which is why a coil can often form a tuned circuit without any external or added capacitance (remember the line output transformer mentioned in Part 4).

There are other possibilities. For example, a semiconductor diode has some capacitance due to the effect of the junction between the n and p regions. Some diodes (varicap diodes) are made with a capacitance that varies precisely as the applied voltage is varied, thus enabling tuning to be accomplished simply by adjusting the voltage. Another device which has a natural "resonance", i.e. it responds to a particular frequency, is a crystal. In this case the resonant frequency of the crystal depends on the way it's cut.

Whatever we use in order to tune to a particular frequency there will be some resistance present in addition to the reactance. Since resistance is not frequency dependent, this means that the circuit will have some response outside the required frequency. The "goodness" of a tuned circuit is taken as the ratio of its reactance to its resistance. We may not wish to tune to one frequency only however: in fact a TV channel consists of a band of frequencies. To broaden the tuning so that a band of frequencies is covered we can deliberately increase the resistance present in the circuit. This is called damping the circuit, and by carefully adjusting the reactance and resistance we can achieve a well defined bandwidth.

The Sinewave Line Oscillator

At the end of last month's article we mentioned the sinewave line oscillator. This is an oscillator that makes use of a tuned circuit to generate a sinewave signal at a particular frequency, in this case the line frequency which, in the 625-line system, is 15,625Hz. This type of line oscillator is now very widely used, especially in colour sets, due to its excellent stability. The operation of a tuned oscillator is based on feedback: i.e. if a valve or transistor is used to drive a tuned circuit and some of the output is fed back to the grid or cathode of the valve or the base or emitter of the transistor then the circuit will continue to oscillate at the frequency determined by the tuned circuit. This type of circuit is basically pretty reliable, but with one or two reservations. Let's take a practical example, that used in the Pye group hybrid colour chassis (see Fig. 2).

Typical Circuit

Now the first point to make is that the output provided by this particular circuit is not actually a sinewave. The tuned circuit consists of the coil L36 which is tuned by C209 and also be the triode section of the PCF802 valve since this acts as a capacitive reactance (more about that in a minute). The feedback is between the screen grid and the control grid of the pentode section of the valve, via the coupling capacitor C211. The output is taken from the anode of the pentode section of the valve, and because of the way in which the valve is driven and the shaping effect of the *RC* network C214/R217 is of the mixture of sawtooth and squarewave form we require to drive the line output valve rather than being a sinewave. The sinewave developed by the tuned circuit is present across R211 and is fed to the cathode of the triode section of the valve by C212. Thus there's a sinewave at the anode and cathode of the triode, and as the anode voltage lags the current by 90° the valve is acting as a capacitor and in so doing forms part of the tuned circuit. The value of the capacitance which it contributes to the circuit is determined by its control grid voltage, which is supplied by the flywheel sync circuit, and also by the d.c. cathode voltage which is set by the line hold control. Thus the use of a valve as a variable capacitor enables us to use a flywheel line sync circuit to control a sinewave oscillator.

Flywheel Sync

It will be seen that the flywheel sync circuit is almost identical to the one in the Thorn 1500 chassis described last month. Negative-going sync pulses are fed to the cathodes of the two diodes via C203, while a flyback pulse from the line output transformer is fed to the circuit via C204 and integrated by R203/C206 to provide a reference sawtooth. An extra pulse is fed in via C202 to sharpen the falling edge of the sawtooth – the sharper the sawtooth, the greater the output from the circuit per degree of displacement between the sync pulse and the sawtooth and hence the more effective the control action.

Fault Conditions

Now what goes wrong? In this particular circuit, a very frequent fault is R203 changing value. It falls to a very low

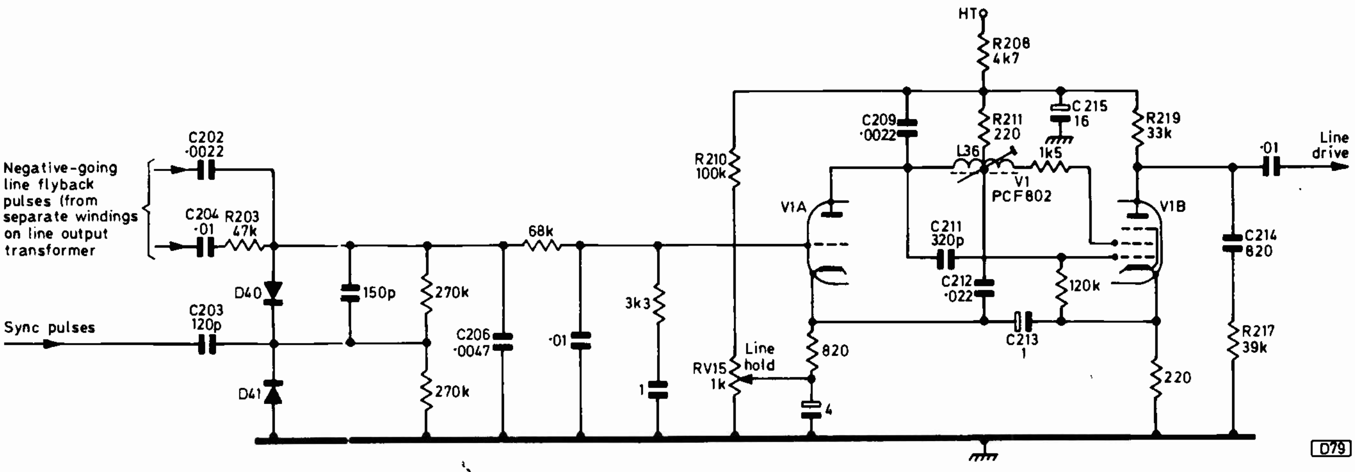


Fig. 2: Typical sinewave line oscillator circuit (Pye group hybrid colour chassis).

value with the result that the oscillator is driven way off frequency. Another consequence is that the diodes can be damaged by the changed conditions.

A similar situation occurs when R210 falls in value from it's correct figure of 100kΩ. As it falls in value, so the voltage developed across the line hold control RV15 increases and its setting has to be adjusted in order to maintain line lock. Eventually the slider of RV15 ends up at the end of the track and no further adjustment is possible. Now there's a sinister aspect to this fault. As the voltage across R210 falls (as its value decreases) so the h.t. supply to the stage (via R208) also falls. RV15, which is only 1kΩ, gets hot, and the line drive to the output valve falls (reduced voltage at the anode of the pentode section of the valve). This results in the PL509 line output valve overheating, the width coming in at the sides, and the PY500 efficiency diode working harder. The net result can be an expensive repair merely because R210 has changed value.

The lesson is always to check the values of R203 and R210 when the line hold varies. There are other items which give trouble, but these are the naughty ones.

Capacitor C213 is a small electrolytic which has the job of providing feedback between the cathodes of the two sections of the valve. The purpose of this is to reduce the damping across the tuned circuit and thus preserve the shape of the sinewave. It often becomes open-circuit (it dries out) however. The result is that the waveform is distorted, the visible sign on the screen being sudden loss of width with a bright kink or vertical line down the centre of the screen.

There are several other faults that occur from time to time in this circuit but as this isn't a servicing article on this particular chassis we musn't get carried away. We would point out however – and this is in line with our studies – that C215, which decouples the h.t. supply to the stage, also dries up from time to time. Now when this happens R208 is left undecoupled and instead of simply acting as part of an h.t. supply filter it's added to the oscillator circuit. Adding a resistor in series with a tuned circuit will seriously reduce its efficiency: in fact in this case there will be such a heavy damping that the circuit no longer functions. You will remember from Part 4 what to expect: no e.h.t. and serious overheating in the line output stage valves.

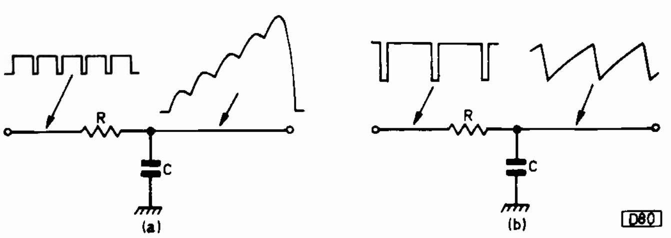


Fig. 3: Integrating circuits. (a) Obtaining a single, large-amplitude pulse from a series of pulses. (b) Converting a pulse waveform into a sawtooth waveform. The output obtained depends on the time-constant of the components.

Other causes of failure to oscillate include defective polystyrene capacitors (the small silver "see through" type), e.g. C211. We shall have more to say about capacitors at a later stage however. Suffice it for now to say that their common defects include a tendency to leak, thus introducing the damping factor already mentioned or putting a d.c. voltage where it shouldn't be (the leak perhaps becoming worse so that it constitutes a short), and to lose their capacitance, i.e. their ability to accept a charge.

Sync Pulses

Another point we've mentioned without explaining is sync pulses. These are included in the signal information received via the aerial and are required to synchronise the receiver's scanning with the camera scanning at the studio. The line sync pulse occurs at the end of each line and is easily removed from the video signal and applied to the flywheel sync circuit. For field synchronisation a series of pulses is included at the end of each field. These are integrated and used to ensure that the field flyback occurs at the right time. The integrating process is shown in Fig. 3(a): by feeding a succession of pulses to a capacitor via a resistor the capacitor adds them up to produce one large pulse which can be used to trigger the field oscillator. This is one form of integration. Depending on the applied waveform and the values of the components used we can achieve different results – basically because the capacitor in the circuit takes a certain time to respond to a voltage fed to it via a resistor. This time is known as the time-constant of the circuit. Another form of integration we've mentioned is when we convert a line flyback pulse to a sawtooth reference signal for the flywheel line sync circuit. The idea here is shown in Fig. 3(b). If a series of negative-going line flyback pulses is fed to an *RC* integrating circuit with a longish time-constant the capacitor will not follow the input waveform: it will take its time over charging and discharging, with the result that a sawtooth output is produced.

We hope then to have tidied up a few loose ends this month: next month we'll be looking at various semiconductor devices and ways of testing them.

Your PROBLEMS solved

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GEC C2110 SERIES

There is excessive green on the picture: on monochrome the picture is green whilst on colour green predominates. The excessive green tends to fade out after three hours or more, but there is still a green cast.

The first thing to do is to set up the grey scale. Turn off the colour, reduce the brightness to a low level and then adjust the three controls on the lower part of the left side convergence panel so as to obtain a reasonable grey background. Then, with the brightness turned up more, set the drive controls for a good white level – these are P304 and P305 on the left side colour drive panel. If the green tends to vary, check the small preset control P303 (set G–Y level) lower down on the same panel: this often seems to develop a dud spot, altering the level of the G–Y output from the TBA990 chrominance demodulator i.c. (IC301).

SOBELL 1018

The picture is very good but keeps on floating or drifting from side to side of the screen – as if the picture is swimming slowly from side to side, with the result that the verticals are bent. I've noticed this fault on several other sets.

The trouble is caused by the use of a stable oscillator which is not being held in sync. The line oscillator is of the PCF802 sinewave variety and is controlled by a flywheel sync circuit. We suggest you check the flywheel sync discriminator diodes MR1/2 and the feedback pulse integrating resistor R114 (47kΩ), preferably by substitution. Less likely possibilities are the sync separator's anode load resistor R112 (47kΩ) and capacitors C160 and C162 (both 470pF) which couple the antiphase sync pulses to the discriminator diodes.

PHILIPS G8 CHASSIS

Near the top of the picture, to the left and the right, there are shaded light grey areas. I understand that these are caused by the teletext signals: are there any steps that can be taken to overcome the problem?

Most of these sets suffer to some degree from this. The cure is to very slightly extend the field flyback blanking period in order to black out the teletext information (no more, no less). To do this, find the BC148 field flyback blanking transistor T4488 on the lower right side. Identify its base connection to the junction of R4486 and C4515, and cut through the track between the base and these components, as near as you can to the base. Insert a resistor of about 390Ω, the final value being found by trial and error – a 500Ω preset control could be used to find the exact value required. When doing this, decrease the height in order to show the teletext effect and the effect of the added resistor.

B AND O 3400

The red verticals on this set cannot be converged. The static controls operate correctly, but red verticals won't converge dynamically with the green and blue.

Whenever we've encountered this fault it's been due to a faulty capacitor in the convergence box. The ones to check are 7C15 (25μF), 7C14 and 7C16 (both 10μF), preferably by substitution.

BUSH TV125

This dual-standard monochrome set works well on 405 lines but when switched to 625 lines the raster appears only briefly, about two inches wide in the centre of the screen, then quickly disappears. At the same time the DY86 e.h.t. rectifier rapidly fades out. The system switch contacts and wires have been checked and are in order. A u.h.f. tuner is not fitted: can a transistor one be added?

The 625-line raster will fade out if the 625-line frequency is wrong. There's a hold control to the left of the 405-line one and this should be adjusted. A transistor u.h.f. tuner can be used provided you can devise a 12V supply for it – ways of going about this are to use a large wirewound dropper of some 20kΩ fed from the h.t. line, or to use a potential divider (10kΩ plus 1kΩ) connected between the h.t. rail and chassis. In the latter case the 10kΩ resistor must be rated at 10W or more.

PHILIPS G8 CHASSIS

There is pincushion distortion on all sides of the raster, the top edge being the worst and the left-hand edge the least affected. This is presumably due to a fault in the transductor circuit, but I'm not sure which components to change.

The pincushion distortion correction transductor on this chassis frequently causes problems, but the trouble can also be due to the associated 120Ω ½W resistor (R4484). This is on the left-hand side of the transductor, viewed from the back, or just in front on panels using BD124 field output transistors. Replacing the transductor usually cures the fault, but if it's not too severe it could be a tolerance fault – scan coils etc. close to their acceptance limits – and will thus have to be lived with.

THORN 8000 CHASSIS

The trouble with this set was severe blue misconvergence. On examination, it was found that the blue tilt control R502 on the convergence panel had burnt out. A replacement was fitted and as the associated components seemed to be in order the set was switched on. The new control failed after an hour however, before readjustment of the convergence was attempted.

Make sure that the new control is of the correct type, and adjust it soon after fitting since wrong setting can lead to excessive dissipation. Ensure that the blue amplitude control R505 and its 3·3Ω series resistor R506 – these are in parallel with the tilt control network – are not open-circuit.

THORN 8500 CHASSIS

When the set is switched on the picture appears in monochrome with eight or so identical horizontal rainbows superimposed, completely covering the picture. The predominant colour in the rainbows varies with the colour content of the scene. A normal picture can be obtained by switching the set off and then on again after an interval of about five seconds or so.

We've often found this trouble to be due to the f.e.t. d.c. amplifier transistor VT110 (BF256LC) in the reference oscillator control loop. Other possibilities are C154 which provides the reference signal feedback to the burst detector circuit, the burst detector diodes W106/7, or the 4·43MHz crystal (XTL101). When you've cleared the fault, adjust the set oscillator frequency control R163 for a quick colour lock-in with a weak, noisy aerial signal.

PYE 697 CHASSIS

With the green and blue beams switched off, i.e. red only on, the picture is quite dark while the focus is very poor (due to trying to get too much brightness?). Also the best focus position for red is different to the other colours. Feeding the green and blue outputs to the red gun seems to indicate that the trouble is due to the tube, or maybe the yoke. What do you think?

There seems to be no doubt about it: the emission of the c.r.t.'s red gun is down. You can either have the tube regunned, fit a new one, or reactivate the red cathode to improve its emitting surface for a while.

ALBA T14 (THORN 1591 CHASSIS)

The sound quality deteriorates when the set has been on for some time – it may take an hour or more for the distortion to develop. The picture remains unaffected.

The most likely cause of the trouble is a defective loudspeaker, with the cone rubbing as the temperature of the cabinet rises. Its impedance is 12Ω.

TELEFUNKEN 709 CHASSIS

The colour comes up very brightly for a fraction of a second, then returns to normal. This happens every few minutes.

We suggest you check the a.c.c. detector transistor T301 (BC213) on the decoder panel, and the associated smoothing electrolytic C301 (5μF) and preset control R304 (500Ω). C311 (1μF) which provides supply line decoupling in the burst gate/amplifier circuit is also worth checking (T301 is driven by this circuit).

DECCA 20 SERIES CHASSIS

This set (Model CS2227) works very well but when the picture content goes there is more light on one side of the raster than the other. Is there some misadjustment?

Assuming that the effect is not confined to one colour, one set of c.r.t. electrodes has a line-rate sawtooth signal present on it. This is most likely to be the first anodes, in which case their common decoupler C402 (0·01μF, 1kV) is probably open-circuit. If the cathodes are sawtooth modulated however, check the flyback blanking transistor Tr205 and the associated components R235, C217 and D200. These are beside the PL802 luminance output valve.

PHILIPS G6 CHASSIS

The trouble is sound but no raster, with the line output valve glowing red hot. The line drive was found to be low, but replacing the PCF802 line oscillator valve made no difference. The line output transformer and most of the resistors and capacitors in the line output stage have been checked, also the line oscillator's anode load resistor and the coupling capacitor. Whilst checking I noticed that the field output pentode is also overheating, with excessive voltage at its cathode.

The field output valve will overheat when the line timebase fails, because absence of the boost rail means that no field drive waveform will be generated. Make sure that the field output pentode's screen grid resistor is intact, also that the two drop-off resistors in its cathode circuit are still present. In the line output stage we suggest that you first try new PL509 and PY500A valves. If there's a smell of hot plastic near the line output stage, check the d.c. feed choke (L5502) – it's on the focus panel near the PL509. If no joy, disconnect the scan coils by unsoldering the lead to the tag on plug 10 near the centre of the chassis. Another possibility is the shift circuit d.c. blocking coil L1517 which is at the top of the chassis. Disconnect the changeover leads associated with the shift potentiometer: if this cures the fault, change L1517 or the decoupling capacitor C1024. If all these checks fail to solve the problem you'll have to check the drive waveform from the line oscillator – for correct shape and amplitude (more than 200V peak-to-peak). If this is present and correct the line output transformer probably has shorted turns – a very common fault on this chassis. The field output pentode's cathode voltage should be set to 12·5V by means of R4105 after the set has been running for half an hour or so. Make sure that the boost voltage is not more than 570V (later transformer) or 590V (earlier one).

THORN 8800 CHASSIS

The convergence over the bottom two inches of the raster is badly out – red and green (mainly) can be clearly seen.

We suggest you try adjusting the R/G top and bottom controls R516 and R517 on the left-hand side of the convergence panel, also the adjacent R/G separation control R528. If the convergence suddenly jumps as you slowly rotate any of these, the track is faulty. If the trouble persists, suspect the green/red convergence driver transistors VT501/2 and the associated diode W509.

PHILIPS 170 SERIES

The picture rolls for about half a minute when the set is first switched on – this gets slower until the picture is almost stationary. Then, after about five minutes, the picture becomes dull at the centre and, when the brightness control is advanced, it expands and the screen goes blank. There's good contrast while the picture is present.

There are two valves in the field timebase, an EF80 and a PCL805. The latter is lazy and requires replacement. The inability to lock the field timebase is more likely to be a changed value resistor however. Check the EF80's anode load resistor R448 (33kΩ) and the sync separator's screen grid feed resistor R273 (also 33kΩ). The ballooning effect may be due to a low emission DY87 e.h.t. rectifier, or a poor connection at its base – check R503, which consists of resistance wire, for corrosion. If the width is insufficient at low brightness levels, check the PL500 line output valve and the two 8·2MΩ resistors in the width circuit.

BAIRD 700 CHASSIS

There's a good monochrome picture but we can't get correct colours. Blue is o.k. and there is some weak yellow, but no red at all – areas that should be red come through as blue. The c.r.t. red gun is o.k.

First ensure that the grey scale is set up correctly, then check the condition of V7 (PCC88), the double triode which provides the R—Y and B—Y outputs to the c.r.t. grids. Short out C229 (25μF) in the chrominance demodulator reference signal feed circuit if this has not already been done, and adjust the R—Y reference subcarrier tuned coil L210 for maximum red on colour bars or a test card. If the results are the same, check the tuning of the R—Y preamplifier's output coil L221, then the voltages in this stage (TR30).

PHILIPS G6 CHASSIS

The set is a single-standard version. Five minutes after switching on, the picture closes in on either side and the wirewound resistor between the bases of the PL509 and PY500 valves gets red hot. The line timebase valves have been replaced, but the fault remains. The picture also gets darker when the fault occurs, the heater of the EY51 focus rectifier going out.

The wirewound resistor is the line output valve's screen grid feed resistor R5030 (2·7kΩ). It's decoupled by a 12·5μF electrolytic (C5016) and it seems that this is leaky. The replacement doesn't have to be of exactly the same value: anything in the range 4-16μF will do provided the voltage rating is over 300V.

CORRECTIONS

TELETEXT DECODER

A couple of corrections are required to the display logic board. First, pin 9 of IC5 should be disconnected from the Row Clock (RCK) line and earthed. Secondly pin 7 of IC14 should be connected to +5V instead of being earthed. To sharpen the edges of the display and in some cases to reduce sound on vision a 470Ω resistor can be connected in series with the cathode of D1 and a 10kΩ resistor from pin 10 of IC6 to the cathode of D1.

MONOCHROME PORTABLE

The following errors occurred on the printed board layout shown in the December 1977 issue. First, the emitter of the line output transistor Tr2 is shown floating: it should be linked to the adjacent earth track. Secondly, the link is not shown joining two pads roughly half-way down on the right-hand side – linking R67 to the junction of C8 and D9. The connections for Tr10 are arranged for a TO18 device instead of the TO92 device (BC212L) specified in the components list.

It is possible to fit a BC212L in this position but it's probably better to use a TO18 device such as a BCY70, or alternatively to use a BC212K which although in a TO92 package has its leads formed in the TO18 configuration. Finally, Manor Supplies tell us that the quadrature coil (L8) assembly they provide has the tuning capacitor (C66) incorporated in the can: a separate component should not be fitted therefore.

ELIZABETHAN T12

The boost diode (D404) on this set went open-circuit, removing the e.h.t. I'm having difficulty finding a suitable replacement however – it's type FG-2Na. Can you suggest a UK equivalent?

This fault seems to occur quite often on monochrome portables. Thorn use two BYX70 diodes connected in parallel to perform this function in their 1590 chassis, and we've used this arrangement in other makers' sets with success. We've also found colour receiver EW modulator diodes suitable, e.g. MR854, MR856, BYX71/350 or BYX55/350.

THORN 3000 CHASSIS

The trouble is pulling on whites. On test card F there are distorted verticals where there's white on the extreme right-hand side, and on programme the effect appears whenever a highlight approaches and crosses the extreme right. The a.f.c., e.h.t., brilliance, sync and beam limiter adjustments have been made in accordance with the manual. Reducing the setting of the r.f. gain control eliminates the pulling effect but the colour is then lost. The contrast is satisfactory.

This sounds very much like a.g.c. lockout, and could well be caused by misadjustment of R125 (set a.g.c. control). Try backing it off until the contrast is low, and see whether the fault then clears. The trouble could also be due to the detector diode or, more likely, the luminance delay line driver transistor VT105 (it tends to go short-circuit from base to emitter) though this usually upsets the field sync as well. If the pulling is predominantly at the top of the screen, check the flywheel sync diodes (W501/2), the reactance transistor (VT501), the associated electrolytics (C506 and C511) and the thermistor in the line hold circuit (X501). Other less likely faults, which usually cause slight field jitter as well, are a defective a.g.c. amplifier transistor (VT106) or one of the i.f. amplifier transistors having low gain.

TEST CASE

183

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

A Decca colour set fitted with the 10 series Bradford chassis would work normally on colour for up to two hours after being switched on. The display would then flick intermittently on reds to cyan and on greens to magenta, just as though the lighting colour was being changed intermittently at the studio.

This appeared to be PAL switching trouble, so the PAL switch circuit was investigated first. The chassis differs from most in this area in that the R–Y chroma signal rather than the reference signal to the R–Y demodulator is inverted on alternate lines. The switch consists of a couple of diodes (D206/D207) and a phase-shifting transformer, followed by a BC148 emitter-follower (TR216). The diodes are switched on and off by the 7·8kHz output from the BC147 ident amplifier (TR215).

It was thought that perhaps one or both of the diodes had dropped below par, but replacing them failed to improve matters. Since the ident signal is derived from the burst phase detector's ripple output (TR221/D212/D213), the components here were checked; also the setting of the associated "set oscillator" preset. But still to no avail.

It was then discovered that by screwing the core of the 7·8kHz ident tuned coil (L207) all the way in the effect was less troublesome, though the stability of the ident action was still not perfect.

What was the most likely cause of this trouble? See next month's Television *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 182
– Page 217 last month –

Regarding the intermittent colour sync slip and low saturation described last month, the technician was correct with his initial reasoning. If he had also taken into account the saturation loss however – instead of concentrating solely on the colour sync slip – he would have had a much better chance of finding the defective component quickly.

Saturation can be reduced by a fall in the amplitude of the reference signal. This can also impair the stability of the reference oscillator locking, and hence the colour sync. The presence of colour and weak sync even under the fault condition implies that the reference oscillator itself must be operating. The point to have focused on therefore would have been the following reference signal amplifier. In the ITT CVC8 chassis there is a BC171B common-emitter stage (T39d) whose base is capacitively fed from the emitter of the BC172C oscillator transistor (T38d).

After normal checks in and around this stage, including replacement of the 27Ω emitter feedback resistor (R320d), the transistor itself was replaced. This completely cured the trouble: it's interesting to note that we are finding more transistors recently causing intermittent faults.

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TELEVISION MARCH 1978

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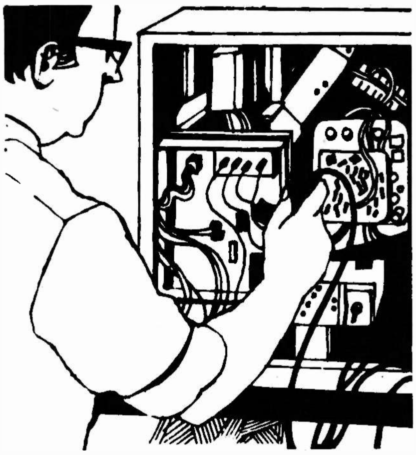

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