

TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

20p

OCTOBER
1972

delay
lines
for
colour
tv



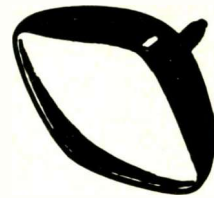
also:

SIMPLE
RECEIVER-MONITOR
CONVERSION

WIDEBAND BAND I
PREAMPLIFIER

SERVICING THE
BUSH/MURPHY TV141/V159
SERIES

LAWSON BRAND NEW TELEVISION TUBES



SPECIFICATION: The Lawson range of new television tubes are designed to give superb performance, coupled with maximum reliability and very long life. All tubes are the products of Britain's major C.R.T. manufacturers, and each tube is an exact replacement. Tubes are produced to the original specifications but incorporate the very latest design improvements such as: High Brightness Maximum Contrast Silver Activated Screens, Micro-Fine Aluminising, Precision Aligned Gun Jigging, together with Ultra Hard R.F. High Vacuum Techniques.

DIRECT REPLACEMENTS FOR MULLARD-MAZDA BRIMAR GEC, ETC.

A21-11W	AW47-91	C19/AK	CME1902	173K
A28-14W	MW43-64	C21/1A	CME1903	212K
A31-18W	MW43-69	C21/7A	CME1905	7205A
A47-11W	MW43-80	C21/AA	CME1906	7405A
A47-13W	MW52/20	C21/AF	CME1908	7406A
A47-14W	MW53/80	C21/KM	CME2101	7502A
A47-17W	AW47-97	C21/SM	CME2104	7503A
A47-18W	AW53-80	C23/7A	CME2301	7504A
A47-26W	AW53-88	C23/10	CME2302	7601A
A59-11W	AW53-89	C23/AK	CME2303	7701A
A59-12W	AW59-90	CME1101	CME2305	CRM121
A59-13W	AW59-91	CME1201	CME2306	MW31-74
A59-14W	C17/1A	CME1402	CME2308	A50-120W/R
A59-15W	C17/5A	CME1601	CRM172	MW36/24
A59-14W	C17/7A	CME1602	CRM173	MW36/44
AW36-80	C17/AA	CME1702	CRM212	CRM141
AW43-80	C17/AF	CME1703	CRM211	
AW43-88	C17/FM	CME1705	23SP4	
AW43-89	C17/5M	CME1706	171K	
AW47190	C19/10AP	CME1901	172K	

LAWSON TUBES

18 CHURCHDOWN ROAD,
MALVERN, WORCS.

Malvern 2100

2 YEARS' GUARANTEE FULL TUBE FITTING INSTRUCTIONS

Tubes are despatched day of order by passenger train, road or goods taking far too long for customers satisfaction.

REBUILT TUBES

LAWSON "RED LABEL" CRTS are particularly useful where cost is a vital factor, such as in older sets or rental use. Lawson "Red Label" CRTS are completely rebuilt from selected glass, direct replacements and guaranteed for two years.

	New Tubes £	Red Label £	Colour Tubes old glass not required
14"	3-10	—	
17"	6-25	4-97	19" £39-50
19"	7-25	5-25	
21"	8-50	6-95	22" £43-50
23"	9-75	7-25	
19" Twin Panel	10-25	8-25	25" £47-50
23" Twin Panel	15-50	9-75	
16" Panorama	8-50	—	26" £49-50
19" Panorama	9-38	6-95	
20" Panorama	10-50	7-50	carr. £1-50
23" Panorama	11-95	8-75	

Carriage/Insurance: 12"-19" 62p. 20"-25" 75p

PADGETTS RADIO STORES

OLD TOWN HALL, LIVERSEDGE,
YORKS. WF15 6PQ.

Tel.: Heckmondwike 4285

The TV Graveyard of the North, as seen on TV Telewrecks! Close to the Motorway. Call in and see us any day 9-6. Closed Sunday. Est. 1935. Plenty of free parking space.

We are breaking up the following TV sets
Ferguson Model 506T. Bush TV75. TV85. TV95. TV105. Pye 11U 13U Range Murphy V310. V410. V500. Philips 1768U. 17TG100. Thorn 850 Range. We have other popular makes which are too numerous to mention. A S.A.E. with your query please.

The prices of spares for the above and other makes are as follows: L.O.P.T. Tested £1-45. Tuner with valves less knobs, from 75p. 75p P.P. Speaker Output Transformers 20p, P.P. Speakers all 3 Ohms 2½ Watts. 7 × 4 ins., 6 × 4 ins., 8 × 2½ ins., all 25p each. Post on any Speaker 10p. Silecon Diode Kits Ex TV BY100 types 30p Post paid.

Special Offer

We have just purchased from a TV firm 1,000 ex Rental TV Sets. These are complete but untested. 12 Channel TV Sets 17 in. £1. 19 in. TV £3. Carriage on any Set £1-50p. All these TV Sets are repairable and we guarantee that we can supply Spares and Tubes for any set we supply.

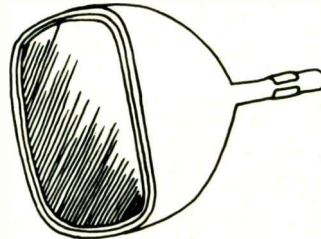
Reclaimed TV Tubes all with 12 months guarantee

AW43/88 £1-50p. AW43/80 £1-50. MW43/69 £1. Special offer Brand New Brimar Tubes C17PM £1. Many other types in stock. Carr. and Ins. on any Tube £1-50p.

valve list ex-equipment. All valves tested on a Mullard valve tester before despatch. 3 months guarantee on all valves. Single valves P.P. 3p. Over post paid.

ARP12	5p	PCC84	5p	U191	20p
EB91	4p	PCF80	5p	U251	12p
EF80	8p	PCL82	12p	6BW7	10p
EF85	12p	PCL83	12p	6U4	10p
EBF80	12p	PCL84	12p	20P1	20p
EBF89	12p	PL36	20p	20P3	10p
ECC81	10p	PL81	17p	20D1	10p
ECC82	12p	PY81	8p	30P4	20p
ECC83	12p	PY33	17p	30F5	10p
ECL80	8p	PY82	8p	30P12	20p
EF91	4p	PL82	8p	30FL1	20p
EY86	20p	PL83	8p	6/30L2	20p
EP50	60p per doz.				
EF50					

REBUILT TUBES!



YOU'RE
SAFE
WHEN YOU
BUY FROM
RE-VIEW!

HERE IS WHAT YOU PAY:

	Mono	Rimband	Colour
12-14"	£4-50	19" £6-00	19" £22-50
15-17"	£4-75	23" £8-00	22" £25-00
19"	£5-00	24" £9-00	25" £27-50
21"	£6-00	Twin Panel	26" £29-00
23"	£7-00	19" £6-50	Exchange Basis
		23" £8-50	Carriage £1

Cash or cheque with order, or cash on delivery
Guarantee 1 year

- ★ Each tube is rebuilt with a completely new gun assembly and the correct voltage heater.
- ★ Each tube comes to you with a guarantee card covering it for Mono Tubes, two years against all but breakage.
- ★ Each tube is delivered free England, Scotland, Wales, and insured on the journey.
- ★ Each tube is rebuilt with experience and know-how. We were amongst the very first to pioneer the technique of rebuilding television tubes.

RE-VIEW ELECTRONIC TUBES
237 London Road, West Croydon, Surrey
Tel. 01-689/7735

TV LINE OUTPUT TRANSFORMERS

ALL MAKES SUPPLIED and PROMPTLY by our RETURN OF POST MAIL ORDER SERVICE

All Lopts at the one price

£4.00 TRADE £4.50 RETAIL

Post and Packing 25p COD 30p
Dealers please include trade order.

All Lopts NEW and GUARANTEED for SIX MONTHS

THE TV LOPT SPECIALISTS
E. J. PAPWORTH AND SON Ltd.,
80, MERTON HIGH ST.,
LONDON, S.W.19.

01-540 3955
01-540 3513

BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1
THE LOPT SPECIALISTS Telephone 01-722 9090

OAZ 0.30	6AR5	0.30	6P24	0.68	7B7	0.32	20D1	0.49	50CD6G2-17	D63	0.20	EC92	0.34	EL37	0.74	KT8	1.75	PCL86	0.36	R10	0.75	U22	0.39
OB2 0.30	6AR6	1.00	6P25	0.51	7C6	0.30	20D4	1.05	50EH5 0.55	DAC32	0.33	ECC32	1.50	EL42	0.53	KT44	1.00	PCL800	0.75	R16	1.75	U26	0.53
OZ4 0.25	6AT6	0.18	6P28	0.60	7F8	0.88	20F2	0.65	50L6GT 45	DAF91	0.20	ECC40	0.60	EL81	0.50	KT63	0.25	PCL801	0.57	R17	0.88	U31	0.30
LA3 0.23	6AU6	0.19	6P32	0.15	7H7	0.28	20L1	0.98	72 0.33	DD4	0.53	ECC81	0.16	EL83	0.38	KT66	0.80	PD500	1.44	R18	0.50	U33	1.50
LA5 0.25	6AV6	0.23	6GH8A	0.50	7R7	0.85	20P1	0.50	85A2 0.43	DF33	0.37	ECC82	0.19	EL84	0.21	KT74	0.63	PEN4DD		R19	0.28	U35	0.83
LA7GT 0.32	6AW3A	0.54	6GK5	0.50	7V7	0.25	20P3	0.76	85A3 0.40	DP91	0.14	ECC83	0.21	EL85	0.40	KT76	0.63		1.38	R20	0.53	U37	1.75
1B3GT 0.35	6AX4	0.39	6G6U7	0.50	7Y4	0.60	20P4	0.89	90AG 3.38	DP96	0.34	ECC84	0.28	EL86	0.38	KT81	2.00	PEN45	0.40	R22	0.33	U45	0.78
1D5 0.38	6B8G	0.13	6H8GT	0.15	7Z4	0.50	20P5	1.00	90AV 3.38	DH77	0.18	ECC85	0.32	EL91	0.23	KTW61	0.53	PEN45DD		RK34	0.38	U47	0.62
1D6 0.48	6BA6	0.19	6J5G	0.19	19W6G	0.50	25A6G	0.29	90CG 1.70	DH76	0.28	ECC86	0.40	EL93	0.32	KTW62	0.63		0.75	SP42	0.75	U49	0.58
1PD1 0.33	6BC8	0.50	6J5GT	0.28	9D7	0.78	25L6G	0.20	90CV 1.68	DH77	0.18	ECC86	0.40	EL93	0.32	KTW62	0.63		0.75	SP61	0.33	U50	0.25
1G6 0.30	6BE8	0.20	6J6	0.18	10C2	0.49	25Y5	0.38	90C1 0.58	DK32	0.32	ECC87	0.16	EL94	0.23	KTW63	0.50	PEN46	0.20	TH4B	0.50	U52	0.30
1H5GT 0.33	6B6G	1.05	6J7G	0.24	10D7	0.50	25Y5G	0.43	150B2 0.58	DK40	0.55	ECC804	0.53	EM80	0.37	LZ319	0.26	PEN453DD		TH233	0.98	U76	0.24
1I4 0.13	6BH6	0.43	6J7(M)	0.38	10F1	0.75	25Z4G	0.28	301 1.00	DK91	0.26	ECC807	1.70	EM81	0.37	LZ339	0.55		0.98	TP2620	0.98	U78	0.20
1LD5 0.30	6BJ6	0.39	6J8A	0.50	10F9	0.45	25Z5	0.40	302 0.85	DK92	0.35	ECC808	0.27	EM83	0.75	M8162	0.63	PEN44	0.98	UABC80	3.00	U91	0.56
1LN5 0.40	6BK7A	0.50	6K7G	0.10	10F19	0.35	25Z6GT	0.43	303 0.75	DK96	0.35	ECC82	0.25	EM84	0.31	M814	0.75	PEN/DD		UA742	0.48	U93	0.31
1N5GT 0.37	6BQ5	0.21	6K8G	0.16	10LD11	0.53	30A5	0.44	305 0.65	DL33	0.35	ECC86	0.64	EM85	1.00	N308	0.95	4020	0.88	UBC41	0.45	U95	0.62
1R5 0.28	6BQ7A	0.38	6L1	0.98	10P13	0.54	30C1	0.26	306 0.85	DL92	0.23	ECC804	2.10	EM87	0.34	N339	0.44	PF1200	0.50	UBC81	0.40	U98	0.40
184 0.22	6B7	0.79	6L6GT	0.39	10P14	1.05	30C15	0.55	807 0.59	DL96	0.35	ECC81	0.63	EY51	0.29	N359	0.42	PL33	0.38	UBF80	0.28	U982	0.40
185 0.20	6B18	0.63	6L7	0.38	12A6	0.63	30C17	0.74	1821 0.53	DM70	0.30	ECC82	0.57	EY81	0.35	P61	0.44	PL36	0.48	UBF89	0.28	U901	0.40
1U4 0.29	6B87	1.25	6L12	0.32	12AC6	0.40	30C18	0.58	5702 0.80	DM71	0.38	ECC81	0.25	EY83	0.54	PABC80	0.32	PL81	0.42	UBL21	0.55	U403	0.33
1U5 0.48	6BW6	0.72	6L18	0.44	12AD6	0.40	30F5	0.61	5763 0.50	DW4500	0.38	ECC83	0.38	EY84	0.50	PAB6	0.44	PL82	0.28	UBC92	0.35	U404	0.38
2D21 0.35	6BW7	0.50	6L19	1.38	12AE6	0.48	30FL1	0.58	6060 0.50	DY876	0.22	ECC84	0.28	EY87/6	0.27	PC88	0.42	PL82	0.28	UCB83	0.48	U501	0.44
2CK5 0.50	6BZ6	0.31	6LD12	0.28	12AT6	0.23	30FL2	0.58	7193 0.53	EY902	0.29	ECC80	0.28	EY88	0.40	PC95	0.55	PL83	0.30	UC85	0.33	U4020	0.38
3A4 0.25	6C4	0.28	6LD20	0.48	12AT7	0.18	30FL12	0.67	7475 0.70	E900C	1.65	ECC82	0.28	EY91	0.53	PC97	0.36	PL84	0.28	UC80	0.31	VP13C	0.35
3B7 0.25	6C6	0.19	6N7GT	0.40	12AU6	0.21	30FL13	0.47	AI894 1.00	E90F	1.20	ECC83	0.52	EZ35	0.25	PC900	0.29	PL92	0.55	UCH21	0.60	VP23	0.40
3D6 0.19	6C9	0.73	6P15	0.21	12AU7	0.19	36FL14	0.46	A2134 0.98	E93F	1.20	ECC84	0.52	EZ40	0.40	PC884	0.27	PL904/500		UCH22	0.57	VP41	0.38
3Q4 0.38	6C2	0.25	6P28	0.58	12AV6	0.28	30L1	0.27	A3042 0.75	E83F	1.20	ECC85	0.60	EZ41	0.42	PC885	0.24		0.60	UCH81	0.28	VT61A	0.35
3Q5GT 0.35	6C17	0.63	6Q7	0.43	12AX7	0.21	30L15	0.55	AC044 1.16	E89CC	0.40	ECC86	0.30	EZ80	0.19	PC888	0.38		0.60	UC182	0.30	VT61	0.15
384 0.23	6CB8A	0.28	6Q8	0.43	12BA6	0.30	30L17	0.65	AC2/PEN	E83C	0.60	ECC87	0.28	EZ81	0.20	PC889	0.42		0.60	PL508	0.90	UC183	0.48
4CB6 0.50	6C16G	1.06	6H7	0.55	12BE6	0.30	30P4MR	0.95	0.98	E182C	1.00	ECC80	0.28	FW4/500		PC8189	0.46		0.60	PL509	1.30	UF41	0.50
5CG8 0.50	6C8A	0.60	6H7G	0.35	12BH7	0.27	30P12	0.69	0.98	E1148	0.53	ECC81	0.28		0.75	PC8005	0.55		0.60	PL802	0.75	UF42	0.60
5R4GT 0.53	6C16	0.43	6SA7GT	0.35	12CGT	0.30	30P16	0.28	AC2/PEN	E182C	1.00	ECC82	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5T4 0.30	6CL8A	0.50	68A7	0.35	12J7GT	0.33	30P19		DD 0.98	EA50	1.18	ECC81	0.58		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5U4G 0.30	6CM7	0.55	68CTGT	0.33	12K5	0.50	30P4	0.55	AC/PEN(7)	EA76	0.88	ECC82	0.58		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5V4G 0.33	6CW4	0.30	68GTGT	0.33	12K7GT	0.34	30P11	0.57	0.98	EACB80	0.29	ECC83	0.75		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5Y3GT 0.25	6C6U5	0.43	68H7	0.53	12Q7GT	0.28	30P12	0.29	AC/TH1	EAC91	0.48	ECC84	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5Z3 0.45	6D3	0.38	68J7	0.35	12RATGT	0.40	30P13	0.75	AC/TP	EAC92	0.95	ECC85	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5Z4G 0.33	6D6	0.15	68KGT	0.23	12SCT	0.25	30P14	0.62	AL60 0.78	EAC92	0.95	ECC86	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
5Z4GT 0.38	6D7E7	0.50	68QGT	0.38	12SCT	0.23	30P15	0.87	AR3 0.35	EAC92	0.95	ECC87	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6/30L2 0.53	6D7G6A	0.50	6U4GT	0.60	12SH7	0.15	35A3	0.48	ATP4 0.12	EAC92	0.95	ECC88	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6A8G 0.33	6E16	0.55	6U7G	0.53	12SK7	0.23	35A5	0.75	AZ1 0.53	EAC92	0.95	ECC89	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AC7 0.15	6F1	0.59	6V6G	0.17	12SK7	0.24	35D5	0.70	AZ31 0.46	EAC92	0.95	ECC90	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AG5 0.25	6F6	0.63	6V6GT	0.27	12SQ7GT	0.50	35L6GT	0.42	AZ41 0.53	EAC92	0.95	ECC91	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AK5 0.25	6F6G	0.52	6X4	0.20	14H7	0.48	35W4	0.23	B36 0.33	EAC92	0.95	ECC92	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AK6 0.30	6F13	0.33	6X5GT	0.25	14H7	0.75	35Z3	0.50	CL43 0.90	EAC92	0.95	ECC93	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AM6 0.17	6F14	0.40	6V6G	0.55	14QA5	0.24	35Z4GT	0.24	CV6 0.53	EAC92	0.95	ECC94	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AM8A 0.50	6F15	0.65	6V7G	0.63	19BG6G	0.80	35Z5GT	0.30	CV63 0.53	EAC92	0.95	ECC95	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AN8 0.49	6F18	0.45	7AN7	0.27	19G6	0.50	50B3	0.35	CY1C 0.53	EAC92	0.95	ECC96	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35
6AQ5 0.21	6P23	0.85	7B6	0.58	19H1	2.00	50C5	0.32	CY31 0.29	EAC92	0.95	ECC97	0.28		0.75	PC8006	0.65		0.60	PM84	0.31	UF80	0.35

We do not handle seconds nor rejects, which are often described as "New and Tested" but have a limited and unreliable life. No enquiries answered unless S.A.E. is enclosed for a reply.

**Fully guaranteed
Individually packed
VALVES**

BI2H	£1.75	ECH84	45p	N78	£1.75
CY31	35p	ECH200	62p	OA2	35p
DAF96	45p	ECL80	45p	OB2	35p
DF96	45p	ECL82	35p	OB3	35p
DK96	48p	ECL83	70p	PC97	35p
DL92	32p	ECL86	40p	PC900	48p
DL94	45p	EF36	45p	PC84	40p
DL96	45p	EF37A	£1.25	PC89	50p
DM70	30p	EF40	50p	PC189	55p
DM86	33p	EF41	65p	PC800	75p
DY87	32p	EF80	25p	PCF80	25p
DY80C	32p	EF83	55p	PCF82	35p
E88CC/01	£1.00	EF85	35p	PCF84	60p
		EF86	30p	PCF86	60p
E180CC	42p	EF89	28p	PCF200	75p
E181CC	90p	EF91	30p	PCF201	75p
E182CC	£1.20	EF92	35p	PCF801	50p
		EF95	35p	PCF802	50p
EA50	20p	EF183	30p	PCF805	80p
EAB8C0	32p	EF184	35p	PCF806	70p
EAF42	55p	EFL200	75p	PCF808	85p
EB91	18p	EL34	50p	PCH200	70p
EB93	50p	EL41	60p	PCL81	47p
EB31	52p	EL42	58p	PCL82	35p
EBF80	40p	EL84	35p	PLC83	65p
EBF83	40p	EL85	42p	PCL84	42p
EBF89	30p	EL86	40p	PCL85	42p
ECC81	30p	EL90	35p	PCL86	43p
ECC82	28p	EL95	35p	PFL200	66p
ECC83	30p	EL500	85p	PL36	53p
ECC85	40p	EM31	25p	PL81	50p
ECC86	45p	EM80	40p	PL82	40p
ECC88	40p	EM84	35p	PL83	42p
ECC89	37p	EM87	70p	PL84	35p
ECC189	52p	EY1	40p	PL500	73p
ECF80	35p	EY86	40p	PL504	75p
ECF82	35p	EY81	40p	PX4	£2.50
ECF83	75p	EY88	40p	PY33	60p
ECF801	62p	EZ20	25p	PY80	50p
ECH42	75p	EZ80	25p	PY81	27p
ECH81	28p	EZ81	27p	PY82	35p
ECH83	45p	EZ82	58p	PY83	35p
		EZ37	70p	PY88	37p
		KT66	£2.05	PY800	40p
		KT88	£2.40	PY801	50p

**SPECIAL OFFER
OJ TUBE £2.50 p. & p. 50p**

OA5	20p	OC71	12p	IN823A	£1.30
OA10	25p	OC72	20p	IN4785	50p
OA70	10p	OC73	30p	I2MT5	35p
OA73	10p	OC76	25p	I2MT10	33p
OA74	7p	OC81	20p	I2T5	63p
OA79 (6D15)	10p	OC81D	20p	I2T10	64p
		OC82	25p	2G385	51p
OA81	8p	OC82DM	20p	2G403	51p
OA91	7p	OC82	25p	2N918	37p
OA200	48p	OC2	25p	2N1304	22p
OA202	10p	OC3	25p	2N1306	25p
OA210	25p	OC3B	15p	2N1307	25p
OA211	30p	OC4	25p	2N147	64p
OA220	55p	OC122	50p	2N2411	£1.50
OA2200	55p	OC139	25p	2N2904A	25p
OAZ201	50p	OC140	40p	2N2989	£4.00
OC16	50p	OC170	25p	2N3055	64p
OC22	50p	OC171	30p	2N3054	50p
OC25	40p	OC172	37p	2N3055	64p
OC26	25p	OC200	40p	2N3130	50p
OC28	60p	OC201	75p	2N3731	£2.75
OC29	60p	OC206	95p	2N3732	£2.50
OC35	50p	IN21B	30p	SZ303	50p
OC36	56p	IN25	60p	3F100	62p
OC39	42p	IN43	37p	3FR5	32p
OC44	17p	IN70	7p	3N128	87p
OC45	12p	IN77	12p	3N139	£1.75
OC70	12p	IN702-725	36p	3N140	97p
QQV03-10	£1.25	UAF42	55p	UY85	40p
		UBC41	47p	VR105/30	35p
QQV06-40A	£5.40	UBF80	40p	VR150/30	35p
		UBF89	35p	5B254M	£2.20
R17	48p	UCB85	40p	Z801U	£2.00
R19	37p	UCF80	55p	Z803A	£1.25
STV280/40	£3.40	UCH42	70p	Z900T	95p
STV280/80	£9.00	UCH81	40p	IR5	15p
		UCL82	35p	5Y4G	40p
		UCL83	60p	5Y3GT	35p
TT21	£3.00	UF41	50p	5Z3	55p
		UF80	30p	5Z4	75p
U26	80p	UF89	40p	5ZAGT	60p
U27	50p	UL41	£5p	2K25	£7.50
U91	73p	UL84	60p	3A4	35p
U801	80p	UU5	55p	3D6	15p
UABC80	35p	UY41	65p	3Q4	45p

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves
U.K. P. & P. Up to £1 12p, £1-£2 17p, £2-£3 22p. Over £3 post free. C.O.D. 20p extra

TRANSISTORS, ZENER DIODES

3N154	95p	BC108	10p	GET115	45p
3N159	£1.45	BC113	10p	GET116	50p
6FR5	45p	BC118	20p	GET86	£1.50
I2FR60	73p	BCV72	15p	NKT222	20p
40594	£1.25	BF115	25p	NKT304	40p
40595	£1.25	BF173	20p	RAS310AF	£1.50
40636	£1.25	BFY51	20p		
40668	£1.25	BFY52	20p	SD915	25p
40669	£1.40	BS	45p	SD925	31p
AC126	25p	BS2	47p	SD935	32p
AC127	25p	BSY29	25p	SD94	21p
AC128	20p	BU100	£1.80	SD98S	40p
AC176	20p	BYZ13	25p	V405A	40p
ACY17	25p	BYZ16	63p	Z2A51CF	78p
ACY28	17p	CRS1/10	25p	ZR11	33p
AD149	50p	CRS1/20	38p	ZR21	42p
AD161	35p	CRS1/30	40p	ZR22	46p
AD178	48p	CRS1/40	48p		
AF139	30p	CRS3/05	30p		
AF178	48p	CRS3/20	38p		
AF186	50p	CRS3/30	43p		
ASY26	25p	CRS25/025	55p		
ASY28	25p	CRS3/40	50p		
ASV67	48p	CS2	65p		
BAW19	28p	CV102	25p		
BC107	10p	GET103	23p		
6AKS	32p	6BGG6	55p		
6AL5	15p	6B6	45p		
6AL5W	40p	6BQ7A	40p		
6AM6	30p	6BR7	85p		
6AN8	50p	6BW6	80p		
6AQ5	35p	6BW7	80p		
6AQ5W	50p	6C4	30p		
6AS6	37p	6C6	25p		
6ASTG	80p	6CH6	55p		
6AT6	30p	6CL6	49p		
6AU6	25p	6D6	20p		
6AX4GT	60p	6E8	55p		
6AXSGT	70p	6F2	75p		
6B7	30p	6F33	£1.50		
6BKT	60p	6H6M	20p		
6BA6	25p	6J4WA	75p		
6BE6	30p	6J5	40p		



**ALL valves
guaranteed**

615GT	25p	14S7	75p	6060	50p
616	20p	19AQ5	40p	6064	45p
617G	35p	19G3	£4.25	6065	65p
617M	40p	19G6	£1.50	6080	£1.50
6KA6GT	50p	19H4	£5.00	6146	£1.75
6K7G	20p	25L6GT	40p	8020	£2.25
6K8GT	40p	30C15	80p	9002	25p
6K25	70p	30C17	90p	9003	50p
6L6M	£1.50	30C18	80p	9004	15p
6SA7	40p	30F5	85p	9006	15p
6SA7GT	32p	30FL1	75p		
68C7GT	25p	30FL12	£1.20		
68G7	35p	30FL13	50p		
6S17	37p	30FL14	85p		
6S17GT	32p	30L15	85p		
6SK7	40p	30L17	80p		
6SL7GT	32p	30P12	85p		
68Q7	39p	30P19	80p		
68Q7GT	35p	30PL13	92p		
68Q7GT	35p	30PL14	92p		
6V6GT	17p	30PL14	90p		
6X4	30p	35L6GT	45p		
6X5G	30p	35Z4GT	45p		
6X5GT	30p	50C5	50p		
6V6G	60p	50CD6G	70p		
6-30L2	80p	50EH5	60p		
6Z4	36p	75	40p		
7B7	45p	76	40p		
7Y4	60p	78	40p		
9D6	37p	80	50p		
11E2	£2.80	723A/B	£7.00		
12A76	30p	83	£3.25		
12A77	30p	805	£8.00		
12AU7	29p	807	50p		
12AV6	38p	813	£3.75		
12AX7	30p	832A	£3.00		
12BA6	37p	866A	£7.50		
12BE6	40p	931A	£4.00		
12BH7	27p	95A	40p		
12C8	32p	955	25p		
12E1	£2.70	956	20p		
12K5	55p	957	30p		
12K7GT	40p	991	40p		
12K8GT	45p	2051	55p		
12Q7GT	35p	5933	£1.15		
12SG7	35p	6057	50p		

C.R. Tubes

VCR97	£4.50
VCR517B	£5.50
VCR517C	£7.50
5FP7	£1.32
88D	£9.00
88J	£9.00
88L	£9.00

Photo Tubes

CMG25	£4.75
931A	£4.00
6097C	£17.50

Special Valves

CV2339	£20.00
JP9/7D	£37.50
K301	£5.00
K305	£12.00
K308	£16.00
K337	£4.00
KRN2A	£3.50
WL417A	£1.50
3C22	£37.50
5C22	£18.00
714AY	£4.00
725A	£16.00

Colomar (Electronics) Ltd.

170 GOLDHAWK ROAD, LONDON W12.
RETAIL: 743 4946
Open 9-12.30, 1.30-5.30 p.m. Thursday 9-1 p.m.

COLOUR TUBES STANDARD TUBES

METAL BAND TUBES

TWIN PANEL TUBES

Rebuilt with new Electron Guns at under 50% normal list price

SUFFOLK TUBES

LIMITED

261 CHURCH ROAD,
MITCHAM, SURREY
01-640 3133

Britain's largest INDEPENDENT
TV Tube rebuilder

NEW VALVES!

Guaranteed and Tested
24-HOUR SERVICE

1K5	25	DK91	25	EF92	26	PFL200	49
1S5	21	DK92	47	EF183	25	PL36	45
114	14	DK96	43	EF184	27	PL81	41
354	24	DI92	24	FL33	54	PL82	29
3V4	46	DL94	46	FL84	21	PL83	31
6/30L2	52	DL96	36	FY51	36	PL84	28
6AQ5	21	DY86	21	EY86	27	PL500	59
6BW7	48	DY87	21	EZ80	19	PL504	59
6E1	57	DY802	28	LZ81	21	PY81	23
6F23	67	FABC80	30	KT61	54	PY82	24
6F25	49	EB91	09	KT66	75	PY800	30
6SN7GT	28	FBC33	38	N78	85	PY801	30
12AU7	18	FBI89	27	PC86	44	R19	27
251.6GT	18	FCC81	17	PC88	44	U25	63
30C15	56	FCC82	18	PC97	35	U26	54
30C17	75	FCC83	21	PC900	28	U191	57
30C18	56	FCF82	26	PCC84	27	U251	60
30F5	63	FCH35	53	PCC89	41	U329	65
30FL1	59	FCH42	56	PCC189	46	U801	75
30FL14	67	FCH81	26	PCF80	25	UBF89	29
30L17	66	FCL80	35	PCF86	44	UCC85	34
30P19	63	ECL82	27	PCF801	27	UCH81	28
30BL1	58	ECL86	32	PCF802	38	UCL82	31
30P1.3	87	FF39	36	PCF805	56	UF89	28
30P1.4	63	BF80	22	PCL82	28	UL84	37
DAF91	21	EF85	26	PCL83	53	UY41	37
DAF96	35	EF86	28	PCL84	31	UY85	22
DF91	14	FF80	24	PCL85	36	W77	42
DF96	35	FF91	12	PCL86	35	Z77	18

Post/Packing on 1 valve 7p. plus 3p per valve on each extra valve. Any parcel insured against damage in transit 3p extra. Office address, no callers.

GERALD BERNARD
83 OSBALDESTON ROAD
STOKE NEWINGTON
LONDON N.16

Sound with Vision

Sound Techniques for
Television and Film
E. G. M. Alkin

Sound in television production is an art in itself, and the crafts needed are quite different from those used in radio or studio recording.

For the first time the methods developed by the BBC are here made available in book form for the benefit of television sound operators and production staff. The book discusses the problems of simultaneous production of sound and picture, giving practical instruction in methods of overcoming them. There are detailed discussions of operation equipment and trends which will be useful to designers and manufacturers of sound equipment.

1972 288 pp. illus. 0 408 70236 2
£6.00

Video Recording

Record and Replay Systems
Gordon White

This book describes the principles of video recording and discusses the various systems which are on the market or will soon make an appearance. Inevitably the book is technical, but it is designed so that people who have an interest in the subject should find no difficulty in understanding the principles, advantages and disadvantages of the various systems.

Those in professional broadcasting who are not directly involved in video recording will find a description of this specialist technique an advantage to their overall understanding of the broadcasting system.

1972 216 pp. illus. 0 408 00085 6
£3.25

Obtainable from leading booksellers or

The Butterworth Group
88 Kingsway, London WC2B 6AB
Showroom and trade counter:
4-5 Bell Yard, London WC2



EX-RENTAL TV's (UNTESTED)

Complete with 13 channel tuners. Good cabinets.
Carriage £1.50 extra.

19"/21" slimline (110" tube)	25.00
23" slimline	27.50
19" BBC 2 sets	£14.50

TUBES EX-EQUIPMENT TESTED

SINGLE PANEL

19"/21" any type	£3
23" any type	£4

TWIN PANEL (BONDED)

19" bonded	£5
------------	----

All tubes add £1 carriage

VALVES EX EQUIPMENT

EB91	5p	30L15	12½p	PL86	22½p
EBF89	12½p	30P4	12½p	PL81	17½p
ECC82	12½p	PC97	17½p	PY81	15p
ECU80	7½p	PCF86	17½p	PY800	15p
EF80	12½p	PC84	7½p	PY82	7½p
EF85	12½p	PCF80	7½p	PY83	22½p
EF183	12½p	PC880	12½p	U191	17½p
EF184	12½p	PCL85	22½p	6F23	17½p
EY86	17½p	PCL82	17½p	30PL1	22½p
30PL13	20p	PCL86	17½p	30PL2	20p
630LZ	12½p	PCL83	12½p	30F5	10p

Add 2½p per valve p. & p., orders over £1 p. & p. free

UHF TUNERS

For Ferguson 850 900 chassis. Adaptable for most U.H.F. Chassis £2.50. p. & p. 50p.

SLOT METERS

Smiths reconditioned switchmaster MK 111. Decimalized. Perfect working order. 12 for £25 delivered. For sample send £2.50 c.w.o.

TRADE DISPOSALS (Dept. PT/TS)

Thornbury Roundabout, Leeds Rd., Bradford.
Telephone: 0274-865670

COLOUR T.V.

19" £125
25" £160

Completely overhauled — variety of makes and models available.
FABULOUS WINTER VIEWING:

MONOCHROME

UHF—Single Standard—Push Button Tuner.

20" Tube £34.95
24" Tube £44.95

Carriage + Ins. £2.50

Famous make D/5 Chassis, thoroughly overhauled; latest "Square Screen" Tube; Transistorised "Push Button" Tuner; fitted in an attractive Cabinet, refinished in a choice of Oiled Teak, Walnut, or Mahogany Veneers (state 1st and 2nd choice).

12-Month Written Guarantee with Every Set. Leaflet and Copy Guarantee Form sent on receipt of your stamped, self-addressed envelope.

The above models can be seen working in our Langley Showroom.

Working and overhauled BBC2 TVs (Ferguson 900 and similar sets) £20 Carr. £2.00.

UNTESTED

Ferg. 900 and similar sets supplied together with a UHF Tuner: £12. 405/625 T.B. Sets, complete, £4. 405 Sets—2 for £4.

Carr. £1.50 per set.

**SUMIKS T.V., 7 HIGH ST.,
LANGLEY, WARLEY, WORCS.**

WILLOW VALE



BY RETURN WHOLESALE SUPPLIERS OF:

COMPONENTS

Dubilier capacitors. Erie wire-wound resistors. $\frac{1}{2}$, 1 and 2 watt carbon film hi-stabs. Sprague bias and smoothing electrolytics. Egen presets. AB metal volume controls. Smoothing electrolytics. Printed circuit aerial panels. Valve bases. Belling and Egen co-axial plugs, Din Plugs and sockets. Thermistors (ITT).

TRANSISTORS AND SEMI-CONDUCTORS

Full range of current colour transistors. AC, AF, BC, BF, BD, OC, etc., types always in stock. Rectifiers and VDRS. Full trade discount. Reputable makes. Mul-lard, Siemens, Valvo, etc.

VALVES

Entire range of entertainment types in stock at 41 per cent or 48 per cent discount. See catalogue for details. *Twelve months' guarantee.*

C.R.T.'s

Full range of monochrome and colour tubes. Rebuilt and new. 2-year and 4-year guarantees. All sizes from 17 in. to 25 in. stocked. Panorama, Rimguard, Mono and Twin-Panel.

LINE OUTPUT TRANSFORMERS

All makes supplied. Exchange units or new replacement transformers. *(Subject to availability.)* Bush, Philips, Pye, Ekco, Sobell/G.E.C., Ferguson, Philco, Ferranti, Peto-Scott, etc., etc.

SERVICE AIDS

Electrolube, Servisol, Multicore Solders, tools, multi-meters in stock.

WE ARE THE ONLY SPECIALIST WHOLESALE TO THE SERVICE ENGINEER

TWO DEPOTS:

Excellent Trade Discounts. Purchase our catalogue, 20p in stamps please. Refunded on first order. Strictly trade only.

OUR REPRESENTATIVES COVER THE COUNTRY AND WILL BE PLEASED TO CALL

4 & 5 THE BROADWAY, HANWELL, LONDON, W.7

Telephones: 01-567 5400 01-567 2971 01-579 3582

42 WEST END, STREET, SOMERSET 045-84 2597

TELEVISION

VOL 22 No 12
ISSUE 264

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS OCTOBER 1972

CABLE PROSPECTS

A recent late-night BBC programme on the first three months of the local TV cable set-up at Greenwich left us in some bewilderment as to what exactly such cable link-ups are trying to achieve. The basic idea seems to be to create a "people's television". Local residents commented that "the BBC and ITV are unapproachable", "now we can phone up Barry and ask him to sort out our problems", and so on. But when people were asked what they actually wanted to see they asked for general programmes such as Old Time Music Hall, Sports, Pop Music etc.—not exactly local material! In fact an analysis would probably show that what they want is what they are getting already from the big networks.

Some subscribers to the service complained that the material provided so far seemed "boring". Which brings us to the economics of the enterprise. The Greenwich experiment is run by a staff of four and is gravely restricted in what it can put out by its limited resources. Yet subscribers are obviously basing their expectations on the standards set by the major broadcasters. This clearly leaves a local company in something of a quandary.

A spokesman claimed that while the BBC and ITV cannot please everybody, cablevision can. If this is indeed the case we wonder why so many people spend so much time viewing the output of the major networks. An explanation given for the popularity of community TV in the States was the poor quality of the network programmes there, but in this respect we are much better served in the UK.

There are also disturbing aspects to local TV. For example local pressure groups could exercise undue influence, and the possible need for local funding could result in the majority subsidising a largely unwanted service.

We'd be the first to admit that the major networks are far from perfect. Local TV could provide a valuable supplementary service. But it is going to be quite a problem identifying and then providing in a professional way for genuine local requirements. It is of course early days yet and perhaps rather unfair to jump in and comment before things have got going. Yet it's only four years till the whole future of broadcasting comes up for review once again. The local operators have not a great deal of time to establish their case.

W. N. STEVENS—*Editor*

THIS MONTH

Teletopics	534
Delay Lines for Colour TV <i>by Peter H. Beards, B.Sc.(Eng.), C.Eng., M.I.E.E.</i>	537
Wideband Band I Preamplifier <i>by Roger Bunney</i>	542
Renovating the Rentals—Part 7—Varicap Tuner Conversions <i>by Caleb Bradley, B.Sc.</i>	544
Circuit Notes <i>by H. K. Hills</i>	550
Servicing Television Receivers—Bush TV141/ TV148 Series <i>by L. Lawry-Johns</i>	551
Receiver-Monitor Conversion <i>by P. M. Delaney, B.Sc.</i>	555
Long-Distance Television <i>by Roger Bunney</i>	556
The TELEVISION Colour Receiver—Part 7— Cabinet Construction	559
Your Problems Solved	568
Test Case 118	571

THE NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED OCTOBER 16

Hold-overs: We regret that due to limited space we have again had to hold over the next instalment in Gordon J. King's *Colour Receiver Circuits* series. This series will be resumed next month.

Cover: Our cover this month features three type DL1 delay lines, with their covers removed to show the glass block and the input and output transducers. These delay lines were kindly lent to us by **Manor Supplies** who hold stocks of these and most other colour receiver delay lines.

TELETOPICS



TIMEBASE IC

It has been quite common for some time for sync separation to be carried out in an i.c. but until very recently this was as far as i.c.s had gone in television receiver timebase circuitry. With the recent introduction of the GEC C2110 colour series however i.c.s have gone a step further since this chassis uses a TBA920 as sync separator and line generator. A block diagram of this Mullard i.c. is shown in Fig. 1. The video signal at about 2.7V peak-peak is fed to the sync separator section at pin 8, the composite sync waveform appearing at pin 7. The noise gate switches off the sync separator when a positive-going input pulse is fed in at pin 9, an external noise limiter circuit being required (this facility is not used in the GEC chassis in which pin 9 is earthed). The line sync pulses are shaped by R1/C1/C2/R2 and fed in to the oscillator phase detector section at pin 6. The line oscillator waveform is fed internally to the oscillator phase detector circuit which produces at pin 12 a d.c. potential which is used to lock the line oscillator to the sync pulse frequency, the control potential being fed in at pin 15. The oscillator itself is a CR

type whose waveform is produced by the charge and discharge of the external capacitor (C7) connected to pin 14. The oscillator frequency is set basically by C7 and R6 and can be varied by the control potential appearing at pin 15 from pin 12 and the external line hold control. Internally the line oscillator feeds a triangular waveform to the oscillator and flyback phase detector sections and the pulse width control section. The coincidence detector section is used to set the time-constant of the oscillator phase detector circuit. It is fed internally with sync pulses from the sync separator section, and with line flyback pulses via pin 5. When the flyback pulses are out of phase with the sync pulses the impedance looking into pin 11 is high (2k Ω). When the pulses are coincident the impedance falls to about 150 Ω and the oscillator phase detector circuit is then slow acting. The effect of this is to give fast pull-in when the pulses are out of sync and good noise immunity when they are in sync. The coincidence detector is controlled by the voltage on pin 10. When the sync and flyback pulses are in sync C3 is charged; when they are out of sync C3 discharges via R3. VTR use has been taken into consideration here. With a video recorder it is necessary to be able to follow the sync pulse phase

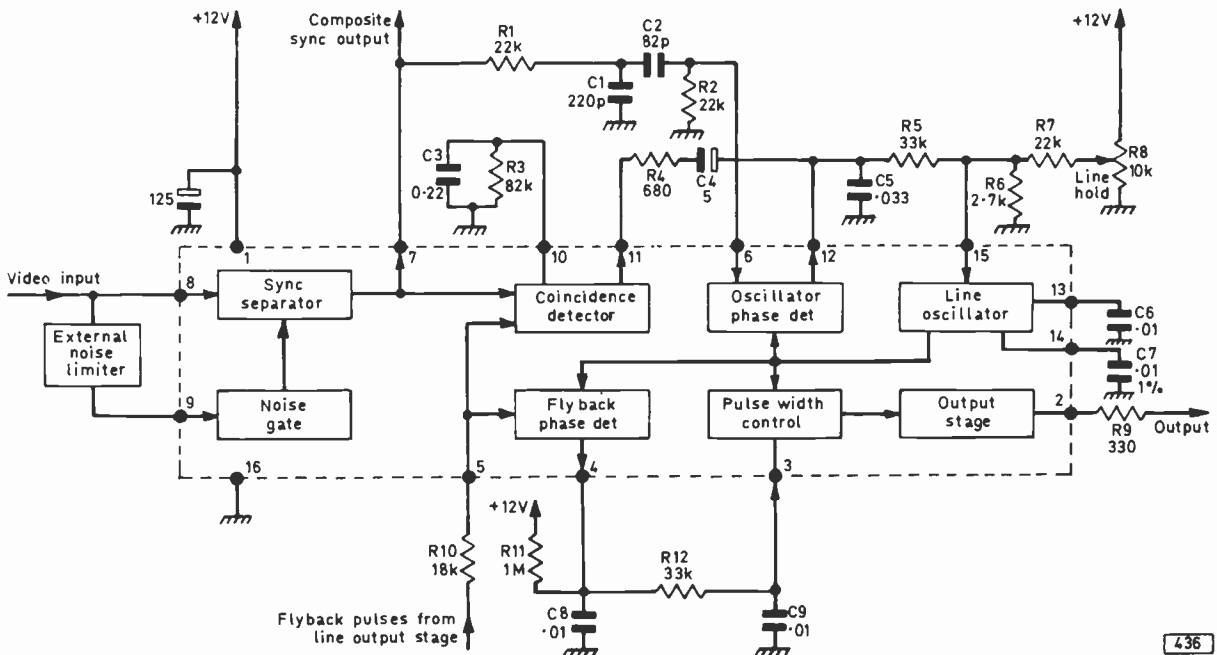


Fig. 1: Block diagram of the TBA920, the first line generator i.c. to be used in a UK produced chassis.

variations that occur as a result of wow and flutter in the tape transport system, while noise is much less of a problem. For use with a VTR therefore the network on pin 10 can simply be left out so that the oscillator phase detector circuit is always fast acting.

A second control loop is used to adjust the timing of the pulse output obtained from pin 2 to take into account the delay in the line output stage. The fly-back phase detector compares the frequency of the flyback pulses fed in at pin 5 with the oscillator signal which has already been synchronised to the sync pulse frequency. Any phase difference results in an output from pin 4 which is integrated and fed into the pulse width control section at pin 3. The potential at pin 3 sets the width of the output pulse obtained at pin 2: with a high positive voltage (via R11 and R12) at pin 3 a 1:1 mark-space ratio output pulse (32 μ s on, 32 μ s off) will be produced while a low potential at pin 3 (negative output at pin 4) will give a 16 μ s output pulse at the same frequency. The action of this control loop continues until the fly-back pulses are in phase with a fixed point on the oscillator waveform: the flyback pulses are then in phase with the sync pulses and delays in the line output stage are compensated. The output obtained at pin 2 is of low impedance and is suitable for driving valves, transistors or thyristors: R9 is necessary to provide current limiting.

AUDIO ICs for TV

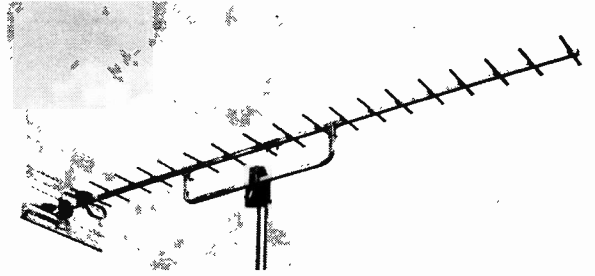
Amongst the applications suggested for another recently introduced Mullard i.c., the TCA160 audio amplifier, is use in small TV receivers. This i.c. gives an output of more than 2W into 8 Ω and can be used with supply rails between 5 and 16V. It is also available fitted with a heatsink to give an output of more than 2.5W. A similar i.c., type TBA820, is announced by SGS. This will give 0.75W into 4 Ω when operated from a 6V rail, 1.6W into 4 Ω with a 9V rail and 2W into 8 Ω with a 12V rail. It can be used with rail voltages between 3 and 16V. A further i.c. manufacturer has announced a range of i.c.s for domestic electronics applications: Sprague intend to introduce a range of some 34 devices including video processing and complete TV sound systems.

WIDEBAND UHF PREAMPLIFIER

In addition to their range of single- and two-stage group A, B and C/D masthead amplifiers S, A. Collard Ltd. (Wetherby Road, Derby) now have a two-stage wideband u.h.f. preamplifier designed to cover the u.h.f. frequencies from groups A to C/D inclusive. An average gain of 13-14dB is quoted, with a comparatively flat response of \pm 1dB and a noise figure in the region of 7dB. Type number is A/1057. Obviously a help for those able to receive alternative transmissions in different channel groups and of course DX enthusiasts.

MAZDA ENTER UHF AERIAL MARKET

Mazda, well known for their valves and c.r.t.s, have now entered the u.h.f. aerial market. To make stocking and handling easy the range consists of six basic aeri- als, a standard and a high-gain one for each of the aerial groups A, B and C/D. The aeri- als have



The Mazda MB20 high-gain u.h.f. aerial array. The first letter of the type number stands for Mazda, the second letter indicates the channel group while the numerals indicate the number of elements, 20 for the high-gain version and 12 for the standard version.

been newly designed and are competitively priced—in fact there are just two prices, the standard aerial for each group having a recommended retail price of £3 while the high-gain version is priced at £3.75, including universal tilting mast attachment in each case. There is a supporting range of masts and rigging kits. The aim has been for strong though lightweight construction, with optimum gain and front-to-back ratio over the group bandwidths.

SERVICE EXTENSIONS

The BBC-Wales service from the Carmel (Carmarthenshire) main transmitter is now in operation on channel 57 (horizontal polarisation, aerial group C). The following relay services are now in operation: Aldeburgh BBC-1 channel 33 aerial group A. Skipton Yorkshire TV channel 49 aerial group B. Lark Stoke ATV channel 23 aerial group A.

All these transmissions are vertically polarised. The first UK community cable TV service, Greenwich Cablevision, is now operating. The 14,000 subscribers pay £7.30 a year (15p a week) and the operators have permission to provide the service within an area of 25 miles from the home base.

DEVELOPMENTS

On show at the recent Internavex 72 (International Audio-Visual Aids Conference and Exhibition) at Olympia was the first videocassette player from Thorn, Model 8200. This was shown playing into a 26in. schools' colour TV receiver, Model 8733, on the Radio Rentals stand. Decca were demonstrating their latest Teldec colour videodisc player while Sony showed their $\frac{3}{4}$ in. tape VCR in harness with a monitor using a large-screen Trinitron tube.

A flat video display panel of the plasma (gas discharge) type has been demonstrated by the Control Data Corporation. The panel measures 12 x 6in. and is only $\frac{1}{4}$ in. deep: it gives a 64 x 20 character display of high brightness and contrast. The panel is intended for military use at present and at a price of £2,900 it is clearly unlikely to displace the c.r.t. in most applications. It could nevertheless point the way in which things might go in the future, especially as multi-colour and three-dimensional versions are said to be under development.

A device called Odyssey to enable you to play games on your television receiver is to be introduced

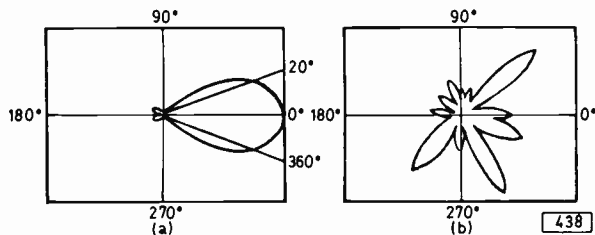


Fig. 2: These aerial polar diagrams produced by Antiference clearly indicate the importance of using the correct array. If a lower group array is used to receive channels in a higher group the forward gain falls substantially since the directors then tend to act as reflectors.

in the USA this Autumn by Magnavox. The set's screen is used as a game board or as an instructional display. The device itself operates on computer principles and has two stations which enable participants to control the position of spots of light on the screen of the set. For each game there is a separate printed-circuit card which is inserted in the control box and a coloured plastic overlay which adheres to the screen. A price of about \$100 is suggested for the device with a package of 12 games. A further accessory converts the set into a rifle range with a photoelectric rifle which is plugged into the control box and puts out a light on the screen when the target is hit.

CHECK YOUR AERIAL

With the increasing number of u.h.f. relay stations in operation and the extension of the services they provide to three-channel working it is to be expected that many viewers are now using incorrect or wrongly adjusted u.h.f. aerials and this is confirmed by a field survey recently carried out by the IBA in the Hemel Hempstead area. Many viewers were found to be still using aerials intended for the reception of the main Crystal Palace transmitter instead of the Hemel Hempstead relay station: these aerials were of course of the wrong channel group and polarisation and were often pointing in the wrong direction. Other viewers were found to be using aerials which were correct but were found to be optimised for the reception of the initial BBC-2 transmissions: such installations require adjustment for good signal balance between the three services now in operation, IBA, BBC-1 and BBC-2. Measurements showed that in many parts of the relay's service area there are strong standing wave patterns that make it necessary to adjust aerials carefully to allow all three channels to be equally well received. This situation is apparently typical of many local relay stations. The effects on the picture of using an incorrect or wrongly adjusted aerial are of course ghosting, interference and noise. The IBA state that modest u.h.f. aerials should be adequate within the service area of a relay station provided they are carefully installed.

What can happen in practice through the use of an aerial of the wrong group is strikingly demonstrated by the polar response diagrams shown in Fig. 2 which were produced by the Research Department of Antiference. The response shown at (a) was obtained

using an 18-element group C/D Antiference array on channel 59. The aerial was carefully adjusted and gave as shown a clean response with good gain and minimum side lobes. The equivalent group A aerial was then substituted and the exercise repeated: as the resultant polar diagram shown at (b) indicates the gain was substantially reduced and the directional characteristic completely lost.

J Beam state that they have improved the performance of their Multibeam range of aerials by retuning the director elements, using a larger reflector and readjusting the element spacing.

SLICE FIELD TRIAL

What then is "slice"? Well, you may have seen "Slice" signals just above the usual IBA test insertion signals and wondered what they are. Slice stands for "source label indicating and codec (coder-decoder) equipment" and has been developed by the IBA to overcome the problem of programme source identification in the complex ITV networking system. The prototype equipment is being field tested by ATV, LWT, ITN, Thames and Yorkshire Television and uses lines 16 and 329 during the field blanking interval of the TV waveform for the transmission of the coded signals. The coder-decoder unit, developed as an additional module for the IBA designed test line inserter equipment, inserts an eight-bit word data signal to provide source identification. The line 16 signal indicates the original source of the video signal while the line 329 signal indicates the studio centre so as to identify the point at which the programme is being inserted into the network. Thus at all points in the network it is possible to identify both the original source and the distribution centre. The decoder readout display unit provides a three-letter identification of the data—THS for example indicating Thames Euston centre.

NEW PRODUCTS

The first digital Avometer, Model DA114, has been announced by Avo. The completely new design features full multimeter facilities, high stability, internal calibration, automatic zero correction and a four digit non-blink display. There are separate models for mains only or battery-mains operation.

A portable, battery-operated lightweight miniature soldering iron, the Wahl "Iso-Tip", is being marketed by Van Dusen Aircraft Supplies Co., Oxford Airport, Kidlington, Oxford. The iron uses nickel-cadmium cells and gives up to 60 joints (depending on size) per charge: a recharging stand is provided and the cells recharge from dead to full charge overnight. The bit reaches soldering temperature within 5 seconds and the specially constructed tip eliminates the need for earthing. The recommended price is £8.75. Could be a boon for field service work.

A small but powerful 12V d.c. drill has been introduced by Expo (Drills) Ltd. and is particularly suitable for drilling accurate holes in printed circuit boards (attention colour set constructors!). A large range of tools is available for use with the drill, including standard twist drills, various cutters, burrs and saws. A drill stand cum lathe bed is also available. Details can be obtained from Expo (Drills) Ltd., 62 Neal Street, Shaftesbury Avenue, London WC2H 9PA. Prices commence at £3.

delay lines for colour tv

Peter H. Beards B Sc(Eng) C Eng MIEE

ALL colour receivers incorporate in the luminance channel a delay line which delays the luminance signal by about $0.5\mu\text{s}$. This is necessary because the corresponding chrominance signal is subject to greater delay than the luminance signal in the tuner, the i.f. circuits and the relatively narrowband decoder chrominance channel. The delay introduced in the luminance channel ensures therefore that the luminance and the corresponding chrominance information register correctly on the screen.

In addition a delay line providing a delay of approximately $64\mu\text{s}$ (the duration of one TV line in a 625/50 system) is incorporated in a PAL-D decoder to carry out the signal averaging process between each pair of picture lines which, in the PAL system, have an inverted V (weighted R-Y) component on alternate lines. The result of this processing is also

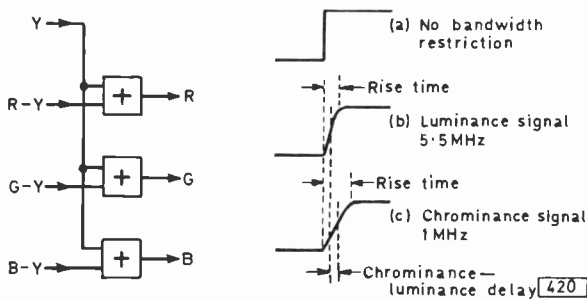
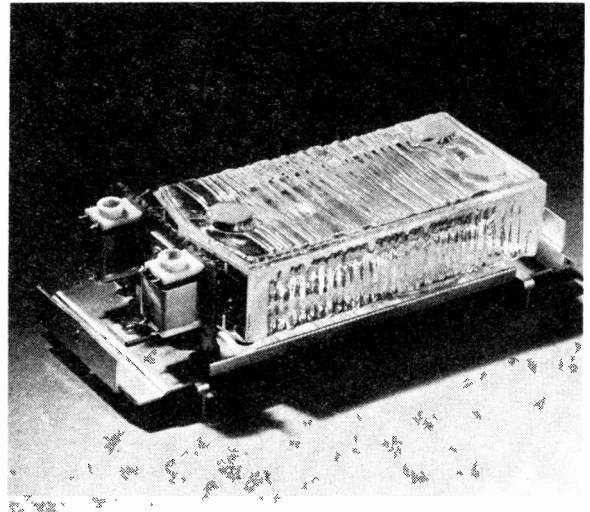


Fig. 1 (left): Recombining the luminance (Y) and the colour-difference signals (R-Y, G-Y and B-Y) in order to get the original R, G and B primary-colour signals.

Fig. 2 (right): The effect of circuits of different bandwidth on a signal corresponding to an abrupt change of detail in a scene.



to separate the U (weighted B-Y) and V components of the transmitted chrominance signal.

Registration of Luminance and Chrominance

The final part of the decoding process in a colour receiver is to recombine the luminance (Y) signal with the colour-difference signals in order to get back the original R, G and B voltages produced by the colour camera. This colour-difference/luminance signal matrixing process is shown in Fig. 1 and may be done by the c.r.t. itself (colour-difference tube drive) or by adding networks prior to the c.r.t. (RGB tube drive). As already mentioned if the colour-difference signals have been delayed more than the Y signal in their passage through the receiver circuits then the two will not be in registration, i.e. the result of the matrixing will be incorrect. There are several reasons why the chrominance information gets delayed with respect to the Y information and we must now consider these.

Delay due to Bandwidth

There is first the fact that the bandwidth of the chrominance signal is approximately 1MHz as opposed to the 5.5MHz bandwidth of the luminance signal, i.e. the chrominance channel circuitry has a much narrower bandwidth than the luminance channel. The effect of this where there is an abrupt change in the scene content during a line is shown in Fig. 2. If there was no bandwidth limitation the change in signal level would be instantaneous as shown at (a). But this ideal situation cannot happen in practice since all electronic circuits take a finite time to respond to a change of input. With a wideband circuit the response is quick: as shown at (b) the luminance signal rise time compared to (a) is not great. With a narrowband circuit the response is slower so that as shown at (c) the rise time is greater. The reason for this bandwidth/delay relationship is brought out when we remember that a squarewave can be regarded as a sinewave of the same frequency plus an infinite number of harmonics: clearly the

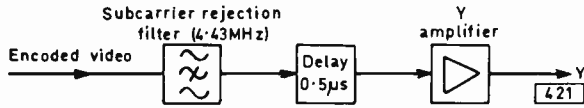


Fig. 3: Block diagram of the luminance channel.

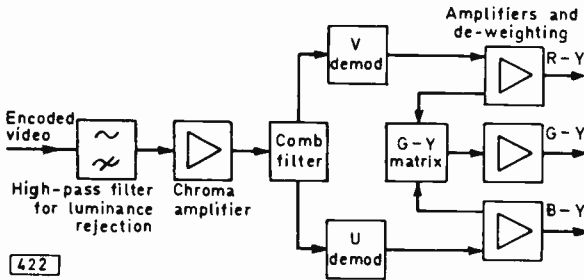


Fig. 4: Block diagram of the chrominance channel.

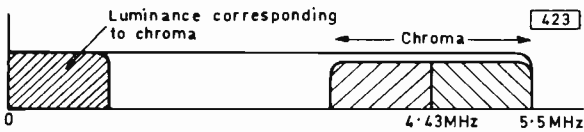


Fig. 5: The positions of the chrominance and corresponding luminance signals within the video bandwidth.

more harmonics we let through, i.e. the wider the bandwidth, the quicker is the response of the circuit to abrupt changes in signal level.

As Fig. 2 (b) and (c) show then the luminance signal rise time although finite is much faster than the chrominance signal rise time. Correct registration however is obtained if the time at which the two signals reach half their final amplitude is the same and this can be effected by delaying the luminance signal relative to the chrominance signal. (The delay of the chrominance signal relative to the luminance signal has been drawn in on Fig. 2.)

A second reason for the greater delay of the chrominance signal than the luminance signal in the receiver is the fact that the luminance channel is much simpler than the chrominance channel. Apart from the luminance delay line the luminance channel (see Fig. 3) requires only a subcarrier rejection filter and an amplifier. For comparison the basic elements required for chrominance signal processing are shown in Fig. 4: delays accumulate all the way along the chain.

Group Delay

There is also as we mentioned at the outset the delay of the chrominance relative to the luminance signal at an earlier stage in the receiver—in the tuner and the i.f. stages. Consider for example the frequency spectrum of an encoded video signal as shown in Fig. 5. Although the chrominance information is at the top end of the band, centred around the 4.43MHz subcarrier, this chrominance modulation actually represents components of the scene corresponding to the bottom 1MHz of video. Now if the signal delay in the i.f. channel is the same for all frequencies this would be of no consequence. But it is quite common for the i.f. stages to delay

the frequencies corresponding to the chrominance signal (top end of the bandwidth) some 100ns more than the corresponding luminance frequencies at the lower end of the band. Hence the two get out-of-step. By the same process we find that a similar delay occurs in the tuner.

Luminance Delay Time

The exact value of luminance delay required—taking into account these various delays—depends on the receiver design but 0.5µs is typical.

Electromagnetic Delay Lines

Since a length of transmission line inevitably has some inductance while there is also the capacitance between the two conductors a lossless transmission line can be represented as an LC ladder network as shown in Fig. 6. If the line is correctly terminated in its characteristic impedance, which for a lossless line is a resistance R_0 , then at any point along the line the impedance looking towards the end of the line is R_0 . Drawing a phasor V_1 as shown in Fig. 7 (a) to represent the r.m.s. voltage at any point along the line it can be seen that this phasor V_1 is made up of V_1 and V_2 which are the voltage across L and the voltage across the following section of the line. The current I lags V_1 by 90° but is in phase with V_2 since the impedance across which V_2 is dropped is R_0 . As can be seen from the resulting phasor shown at (b) V_1 leads V_2 by an angle θ . In the same way as we go along the line there is a progressive phase lag and therefore a time delay between the input and the output.

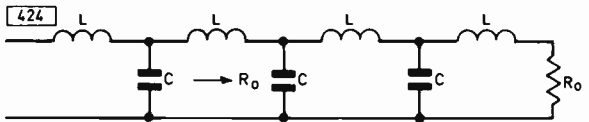


Fig. 6: Representation of a lossless delay line.

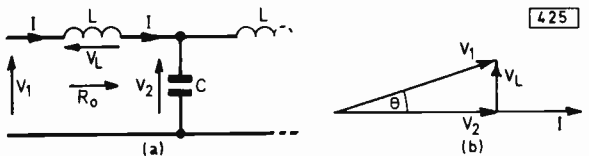


Fig. 7: Voltage relationships in one section of a line.

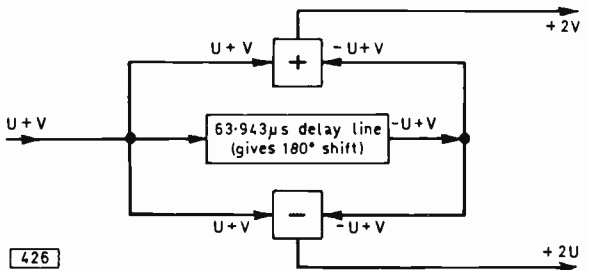


Fig. 8: Block diagram of the chrominance delay line circuit.

The velocity of propagation of a signal along a line is $1/\sqrt{LC}$ meters/sec where L and C are the inductance and capacitance per metre length of the cable. Therefore the larger L and C are the slower the signal travels along the line and the less the amount of cable required for a given delay. For a luminance delay of $0.5\mu\text{s}$ a solenoid is generally used, wound on earthed strips to increase the value of C .

Chrominance Delay Line

The delay line used in the decoder for chrominance signal processing (providing a delay approximately equal to the duration of one picture line) operates in conjunction with an add and a subtract network as shown in Fig. 8. Its operation is quite simple to understand. Suppose we have a line with positive V , i.e. the input to the arrangement shown is $U + V$. This means that as a result of the V signal inversion on alternate lines in the PAL system the previous line would be $U - V$ and this is what we would expect to find at the output of the delay line. In practice however for reasons that we shall give later the delay line introduces a 180° shift. Thus at the output of the delay line during the picture line in question we get $-U + V$. As Fig. 8 shows the result is $2V$ from the add network and $2U$ from the subtract network. The delay line and its associated networks have thus enabled us to separate quite simply the U and V components of the chrominance signal. These separated components are then fed to their respective demodulators. We also get hue error cancellation, but more on that shortly. First a more detailed look at the way in which the chrominance delay line together with the add and subtract networks act as a comb filter.

Comb Filter Action

Consider first the frequency spectrum of the encoded PAL signal. The Y signal has frequency components from 0Hz up to about 5.5MHz separated at line frequency (f_L) intervals. In the PAL system the chrominance subcarrier is three quarter offset from the line frequency (subcarrier frequency = $283.75 \times f_L$). Now in a PAL coder the U signal modulates the subcarrier while the subcarrier fed to the V modulator is in effect switched $\pm 90^\circ$ on alternate lines so that V is always in quadrature with U (a basic requirement in colour TV systems) but is in advance on one line and retarded on the next to give the V signal inversion on alternate lines (i.e. $\pm 90^\circ = 180^\circ$). Thus as shown in Fig. 9 the U components of the signal are separated from the Y components by $f_L/4$ (neglecting the 25Hz offset) while the inversion of the V signal line by line shifts its frequency spectrum by $f_L/2$ from the U spectrum. To separate

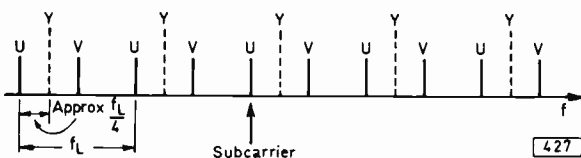


Fig. 9: PAL signal spectrum around the subcarrier frequency, showing the relationship between the Y , U and V sidebands of the composite video signal.

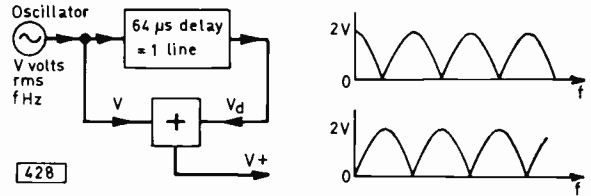


Fig. 10 (left): Addition of instantaneous and delayed signals.

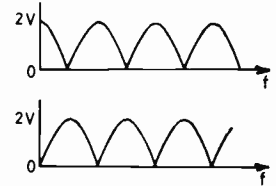


Fig. 11 (above right): Comb filter response obtained with signal addition.

Fig. 12 (bottom right): Comb filter response obtained with signal subtraction.

the U and V components of the signal therefore we require a filter with two outputs, one passing the U components and attenuating the V components while the other passes V and attenuates U .

In the circuit shown in Fig. 10 V and V_d would at 0Hz be equal so that the output $V +$ would be $2V$. Now as the frequency of the oscillator is increased there will be increasing phase difference between V and V_d because of the delay line. At $f_L/2$ V and V_d will be in antiphase and $V +$ is then $0V$. At f_L the phase difference will be 360° , i.e. the delay line will contain one complete cycle: V and V_d when added will then give $2V$. In fact when f is an exact multiple of line frequency $V +$ will equal $2V$ while at half line offset $V +$ will be $0V$. The frequency response is thus as shown in Fig. 11, its shape giving rise to the name comb filter. If now the adding network is replaced by a subtracting network we will by a similar process get the response shown in Fig. 12. We can see then how in practice with the arrangement shown in Fig. 8 and a signal with a spectrum as shown in Fig. 9 we get separation of the U and V components of the chrominance signal.

Delay Time

Now if the delay time was exactly one line, i.e. $64\mu\text{s}$, then at the subcarrier frequency the delay line would contain exactly 283.75 cycles of subcarrier. The odd quarter cycle means that V and V_d (Fig. 10) are in quadrature so that neither addition nor subtraction will give $2V$ or $0V$. The delay line must contain either an exact number of cycles, in which case addition produces $2U$, or an exact number of cycles plus one half cycle in which case addition produces $2V$. The latter condition is obtained when the delay line is shortened so that it contains 283.5 cycles. To find the precise delay time for 283.5 cycles of subcarrier then: using the exact subcarrier frequency a $64\mu\text{s}$ delay line would contain 283.7516 cycles (the 0.0016 is the 25Hz offset) and by simple proportion

$$T_d = \frac{283.5}{283.7516} \times 64\mu\text{s}$$

giving us a delay time of $63.943\mu\text{s}$ for the line to contain 283.5 cycles. Subtraction then produces $2U$ and since T_d is so close to $64\mu\text{s}$ the comb filter peaks are separated at almost line frequency intervals and correspond to the U signal spectrum. The zero points lie on the V spectrum to give cancellation. In the

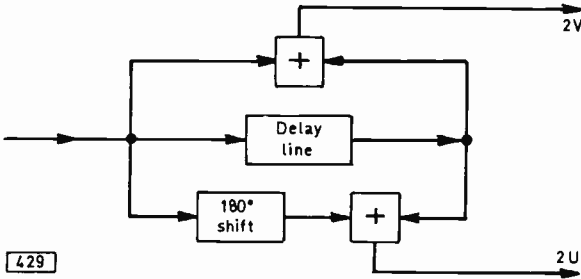


Fig. 13: In practice to subtract two signals we pass one of them through a 180° shift circuit and then combine the two in an adder network.

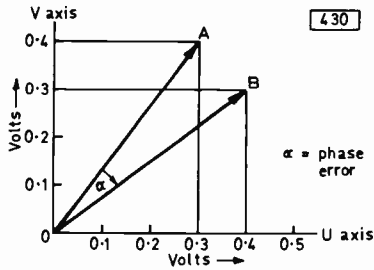


Fig. 14: The reason why a phase error in the NTSC system results in a change of hue (colour): the synchronous demodulators detect on the V and U axis, the output from each altering in proportion to signal phase shift.

same way the add output passes the V spectrum and rejects U.

It is the practice to shorten the line to contain 283.5 cycles rather than to increase it to contain 284 cycles of subcarrier because the latter would increase the total chrominance delay (by about 56ns) and the luminance delay would have to be lengthened correspondingly.

Because a PAL chrominance delay line contains 283.5 cycles of subcarrier it provides phase inversion and as a result of this V is as we have seen obtained from the add network and U from the subtract network. A further point is that in practice there is no such thing as a subtract network: subtraction is effected by inverting one of the signals in the subtract channel and then applying both to an adder, i.e. the arrangement needed is as shown in Fig. 13.

Hue Correction

The purpose of this PAL signal processing is not only to separate the U and V components of the chrominance signal but also to correct for the effect

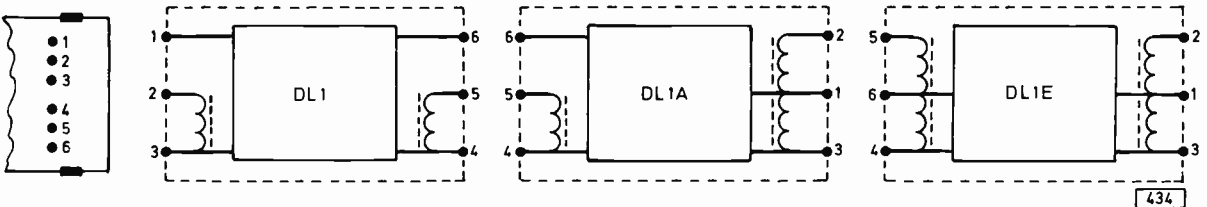


Fig. 18: Surplus delay line pin connections. These lines are available from Manor Supplies.

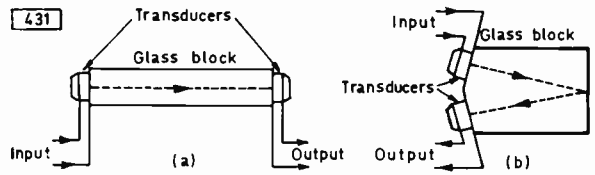


Fig. 15: Glass delay lines. (a) Straight; (b) reflection type.

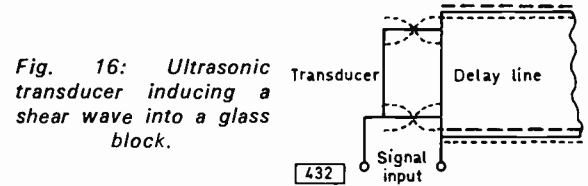


Fig. 16: Ultrasonic transducer inducing a shear wave into a glass block.

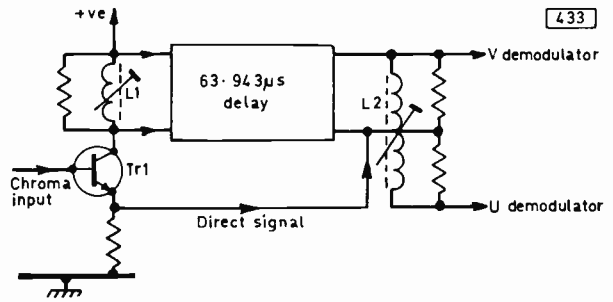


Fig. 17: Typical practical comb filter circuit.

of phase errors. To appreciate what happens let us first remind ourselves of the problem as it arises in the original NTSC colour system. With NTSC we simply use two separate synchronous detectors to demodulate the U and V signals. Suppose that the phasor A in Fig. 14 represents the correct signal. The V demodulator would open on the V axis and give us an output of 0.4V while the U demodulator would open on the U axis and give us an output of 0.3V, 0.4V of V and 0.3V of U giving us the correct colour. But suppose now that due to a phase shift somewhere in the transmission path what we actually receive is a signal with a phase error of alpha, i.e. we receive a signal corresponding to the phasor shown as B. The V detector will now give us 0.3V of V and from the U detector we shall get 0.4V of U. The result of mixing these is of course a different colour to the correct one.

How does the delay line circuitry compensate for this? Well for a start it doesn't actually correct the phase error. What happens is that as a result of the addition of information from successive PAL system lines in the chrominance delay line and its associated

add and subtract networks the effect of the signal phase shift becomes an equal reduction in the amplitudes of both the U and V signals. If you plot the situation shown in Fig. 14 as it would be affected by the steps shown in Fig. 8 you will find this to be so. There is still a phase error in the signals passed on to the demodulators but it is no longer of consequence: as U and V are effectively reduced in amplitude by the same proportion the colour remains correct though its saturation, i.e. strength, is decreased. A slight reduction in saturation is negligible compared to the actual hue change that occurs with the NTSC system.

Ultrasonic Delay Lines

The disadvantage of using a conventional electromagnetic delay line in a PAL comb filter circuit is that because of the substantial delay time a very great length of cable would be required. For this reason ultrasonic delay lines are used instead. The chrominance signal is converted by a transducer into a mechanical wave which travels at about 3,000 metres/sec (about 1/100,000th the speed of a signal along an air-spaced cable) through a glass block. A similar transducer then converts the chrominance signal back into an electrical one.

Various physical arrangements are possible. An early version shown in Fig. 15 (a) uses a block with transducers at each end, the signal being fed in at one end and taken out at the other. The arrangement shown in Fig. 15 (b) is however generally used, with the transducers at the same end. The signal passes into the block at an angle and is reflected back from the far end. The most recent designs make use of multiple reflections to reduce the amount of glass used in the delay line. The glass used in these delay lines is made so that as temperature rises and the glass expands the wave velocity increases so that the delay is kept constant: such glass is said to be isopaustic.

Transducer Action

The transducer is usually designed to transmit a shear wave along the block, that is as the signal is applied the transducer distorts the glass as shown in Fig. 16, and is a half wavelength thick at 4.43MHz so that it resonates at this frequency. Electrically the transducer is capacitive and it is tuned to the sub-carrier frequency by a parallel inductance. A resistor in parallel increases the tuned circuit bandwidth to about 2MHz. The delay line introduces a loss of about 12dB for which compensation is required.

Practical Details

A basic practical circuit is shown in Fig. 17. The input transformer L1 offers a high impedance to the amplifier at the subcarrier frequency: thus the gain in the collector circuit compensates for the loss in the line. The output transformer L2 is wound so that the chrominance signals from the emitter of the transistor and from the delay line are added and subtracted as required before being fed to the demodulators.

Connection data for chrominance delay lines currently available on the surplus market is given in Fig. 18. ■

NEXT MONTH IN

TELEVISION

LARGE-SCREEN TV

For large-screen public TV displays it is necessary to adopt some system other than the simple direct viewing of a c.r.t. screen. Many systems have been tried and used and some are suitable for colour TV displays. Development work is still in progress on some techniques. A particularly interesting large-screen colour TV system was used at EXPO 70: this employed mechanical scanning and, as the light source, gas lasers. We shall be looking at this and other systems—such as Eidophor techniques—next month.

RENOVATING THE RENTALS

Caleb Bradley tackles another colour chassis widely used for first-generation rental purposes, the Bush-Murphy CTV25/CV2510 series.

POLISH TV RECEIVERS

Quite a number of Polish monochrome receivers have been imported and distributed in the UK in recent months. The Unitra series uses a high-gain chassis with a number of interesting features such as a noise-cancelled sync separator, gated a.g.c., etc. We shall be taking a detailed look at the more unusual circuit features next month.

COLOUR RECEIVER CIRCUITS

Gordon King resumes his series, investigating vertical shift techniques and line oscillator circuits, both valve and transistor.

WORKSHOP HINTS

The care of test equipment is essential to successful servicing. Vivian Capel provides helpful guidance on various points that need to be watched.

PLUS ALL THE REGULAR FEATURES

ORDER YOUR COPY ON THE FORM BELOW

TO.....
(Name of Newsagent)

Please reserve/deliver the NOVEMBER issue of TELEVISION (20p), on sale OCTOBER 16, and continue every month until further notice.

NAME.....

ADDRESS.....

.....

Wideband BAND I PREAMPLIFIER

Roger Bunney

IN the May 1972 TELEVISION we featured information on the construction of various Band I aerial arrays with coverage over the complete European transmission segment, channels E2-4 inclusive. At that time we were considering a companion wide-band amplifier using field effect transistors. Unfortunately problems arose with this so we had to consider alternative approaches. We eventually decided to use the familiar silicon planar npn BF180 transistor since it is widely available at very low cost. A simple basic circuit was drawn up, the unit constructed and aligned and was found to work immediately with good gain and a low noise figure.

As the circuit (Fig. 1) shows there are five stages in all. The input signals are coupled to Tr1 emitter by C1, the emitter being biased by R1 through a v.h.f. choke. All the stages are operated in the grounded base mode. Tr1 base is biased by the potential divider network R2, R3 and decoupled to chassis by C2. The same technique is used in the other stages. The collector tuned circuit of the first three stages comprises a coil of 10 turns tapped at turn 5, the output being capacitively coupled to the emitter of the next stage. The output from the third stage Tr3 is split and fed to two separate stages. The

two output stages Tr4 and Tr5 have low gain and serve mainly as isolation between the output of the third stage and the final amplifier outputs.

The complete amplifier draws 15mA from 9V. The circuit of a simple mains power unit is also shown in Fig. 1.

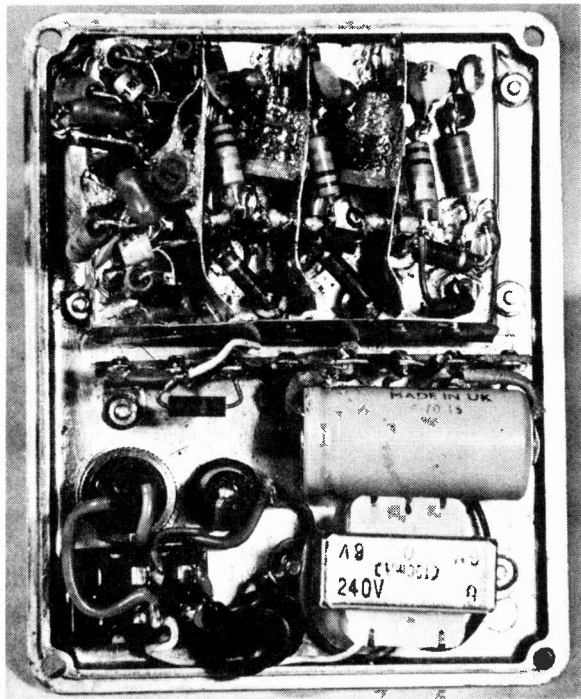
Alignment is extremely simple as there are only three coils to tune. Assuming that the range ch. E2-4 inclusive is required L1 is tuned to E4, L2 to E3 and L3 to E2. The coils themselves are rather broad in tuning and no sharp peak should be found. A simple noise generator as shown in the August 1969 PRACTICAL TELEVISION page 505 is of great assistance in obtaining a level response over the bandwidth.

The complete prototype unit was constructed in an Eddystone diecast box type 6908p though any appropriate metal container will of course suffice. We prefer the Eddystone boxes however because of their very strong construction and complete screening. The layout (see photograph) follows the basic circuit arrangement. Because of the limited space available I found it best first to cut to size the tin subchassis on which the amplifier is mounted, next to drill and solder in the feedthrough decouplers, then to solder the interstage screening on to the subchassis and after this to fit the transistors into place. Maximum screening for the transistors is obtained by using holes cut out for them in the screening, with the connections to the emitter and base on one side and that to the collector on the other; the shield connection is soldered directly to the screen and actually supports the transistor. Some thought must be given to the sequence of fitting the rest of the components in order to ease construction: basically one starts in the middle and builds outwards.

The prototype has two outputs but a single output stage could be used instead. In this case resistors R16 and R17 are omitted and the coupling to the final stage is via C13 only as with the previous stages.

The unit is extremely stable over the bandwidth. The gain depends of course on the bandwidth required. To cover ch.E2-E4 vision (48-67MHz) a gain of 25dB can be expected. The prototype was aligned to cover ch.E2-B5 and had a gain of around 22dB. This is demonstrated in practical terms by measurements using a signal strength meter/attenuator. A ch.B3 signal without amplifier measured 160 μ V into the 75 Ω input: with the amplifier in circuit the signal increased to 2.2mV. Unfortunately no facilities were available for the measurement of the noise figure but results observed off screen on weak signals indicate an extremely good noise figure.

All components are available from Home Radio (Components) Ltd. It may be found necessary to



Prototype with cover removed to show construction.

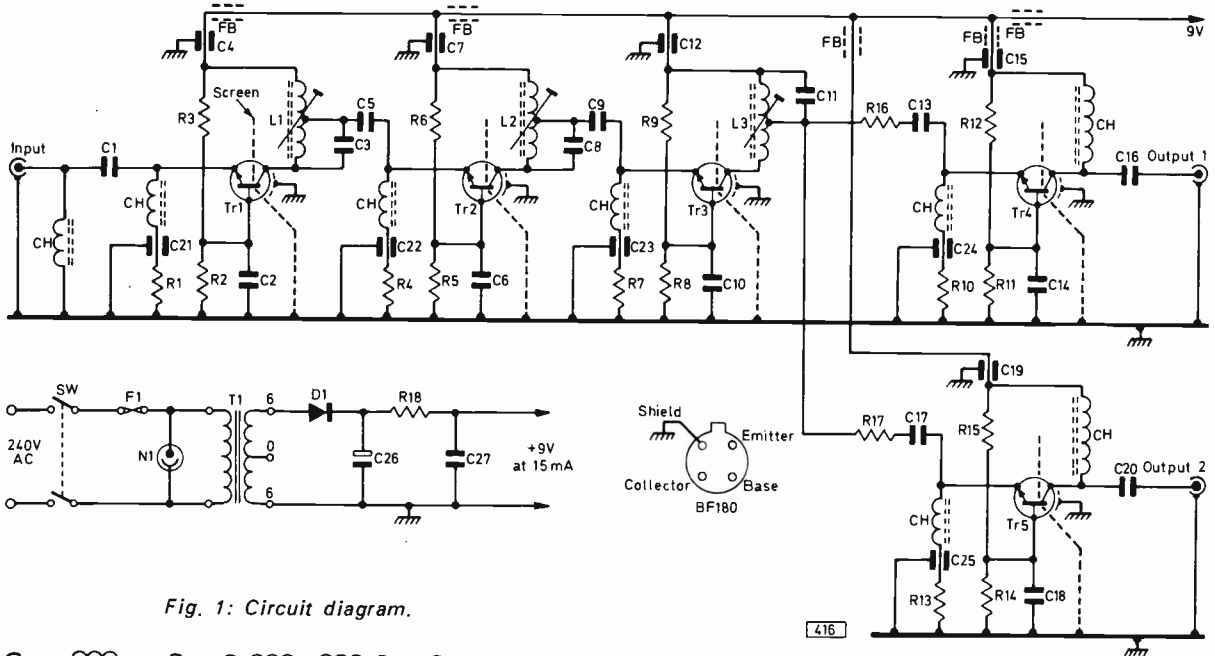


Fig. 1: Circuit diagram.

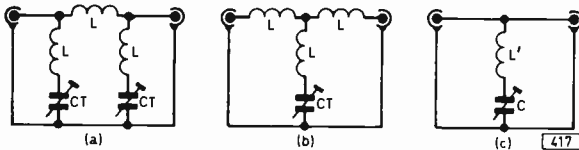


Fig. 2: Filters: (a) u.h.f. pi type; (b) u.h.f. T type; (c) acceptor for f.m. radio rejection. L $2\frac{1}{2}$ turns $\frac{1}{8}$ in. diameter, use inner conductor of low-loss coaxial cable; CT 2-10pF ceramic concentric trimmer; L' 5 turns, other details as L, C' 3-30pF Philips concentric trimmer.

use a non-hexagonal dust core for L3 (i.e. one with a screwdriver slot) to maintain coverage below ch.E2.

As constructed the amplifier will cover ch.E2-B5 with no problems. Thus it may be of use for small relay systems, especially if the various higher frequency channels are translated to Band I frequencies for distribution.

Overloading

If this amplifier—and indeed many other amplifiers using bipolar transistors—is used close to a very high-powered TV transmitter overloading may occur. The effect has been observed with both home constructed and currently available commercial designs. In the case of a group of u.h.f.

—continued on page 549

★ components list

Resistors:

R1	1k Ω
R2	3.3k Ω
R3	10k Ω
R4	1k Ω
R5	3.3k Ω
R6	10k Ω
R7	1k Ω
R8	3.3k Ω
R9	10k Ω
R10	1k Ω
R11	3.3k Ω
R12	10k Ω
R13	1k Ω
R14	3.3k Ω
R15	10k Ω
R16	22 Ω
R17	22 Ω
All $\frac{1}{4}$ or $\frac{1}{2}$ W 10%	
R18	680 Ω
	$\frac{1}{2}$ W 10%

Semiconductors:

Tr1-5	All BF180
D1	Silicon power diode 100V p.i.v.

Capacitors:

C1	40pF
C2	0.01 μ F
C3	2.2pF
C4	1000pF
C5	10pF
C6	0.01 μ F
C7	1000pF
C8	2.2pF
C9	10pF
C10	0.01 μ F
C11	2.2pF
C12	1000pF
C13	10pF
C14	0.01 μ F
C15	1000pF

C16 25pF

C17 10pF

C18 0.01 μ F

C19 1000pF

C20 25pF

C21 1000pF

C22 1000pF

C23 1000pF

C24 1000pF

C25 1000pF

C26 500 μ F

C27 0.01 μ F

2.2pF silver mica 5%

40pF tubular ceramic 20%

0.01 μ F miniature ceramic 20% 20V wkg.

1000pF feedthrough

10pF tubular ceramic 10%

25pF tubular ceramic 20%

500 μ F 25V electrolytic

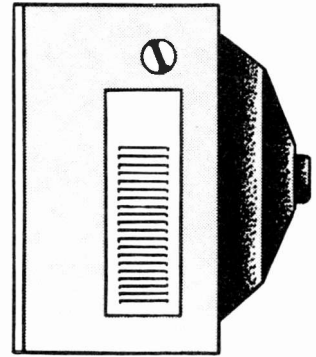
Miscellaneous:

CH	Radiospares v.h.f. choke, 1A (total 8)
FB	Radiospares ferrite bead (total 5)
L1-3	10 turns close-spaced 26 s.w.g. enamelled wire tapped at 5th turn, wound on $\frac{1}{4}$ in. coil former with dust core
Coaxial sockets (3)	
SW	DPST toggle switch
F1	Miniature 100mA fuse with panel mounting $\frac{1}{4}$ in. holder
N1	Mains neon indicator
T1	Miniature mains transformer, 0-240V primary, 6.0-6V secondary (Eagle)

Renovating the RENTALS

CALEB BRADLEY B Sc

7 VARICAP TUNER CONVERSIONS



WHEN television transmissions on the u.h.f. Bands IV and V began (at first BBC-2 only, in monochrome—remember?) suitable transistors for use at u.h.f. were not readily available and in consequence valve u.h.f. tuners were used exclusively. Even as high-performance transistor tuners became available, typically using low-noise transistors such as the BF180 and BF181, many set makers preferred until comparatively recently to stick with valve tuners on the grounds of cheapness and compatibility with the h.t. and heater supplies of valved sets. As a result there are now tens of thousands of dual-standard sets in use in which one can find the common PC88/PC86 valved u.h.f. tuner. The following faults are often found on these tuners.

UHF Tuner Troubles

- (a) Low gain. This causes a weak, grainy picture on 625 and is usually due to wear of one or both valves or, much less commonly, to an open-circuit decoupler or resistor value change. In fringe areas the PC88 r.f. amplifier valve may need replacing every two years or less.
- (b) Tuning mechanism troubles. Scores of different slow-motion rotary and pushbutton tuning arrangements have been used, some fiendishly complicated. Almost all can suffer from seizure, cords snapping, gears stripping, backlash, stiffness or poor repeatability of station selection.
- (c) Tuning drift with warmup.
- (d) Burnup of internal resistors due to valve inter-electrode shorts.

The i.f. output level obtained from this type of tuner is rather less than that from the corresponding two-valve v.h.f. tuner and extra i.f. gain is provided in the receiver to compensate for this. The amplification may be provided by extra (or different) i.f. stages switched into use for 625 or, more economically, by the injection arrangement where the u.h.f. tuner feeds into the v.h.f. tuner which acts as an i.f. preamplifier on 625.

Straightforward transistor tuners overcome many of these troubles and give better fringe area performance. But they still need tuning mechanisms. Sometimes the v.h.f. and u.h.f. tuners are combined into a single transistorised "integrated" tuner: these are good until they go wrong when they may be found virtually impossible to service and have therefore to be exchanged with the manufacturer. Some makes suffer more than others from patterning troubles due to internal instability.

Something better than these, types of u.h.f. tuner

is needed for this single-standard age. Colour receivers especially need much better tuning stability than monochrome receivers. This is because slight mistuning on monochrome merely causes reduced picture definition whereas on colour the position of the chrominance subcarrier on one sloping side of the i.f. response curve is critical. The best pushbutton transistor tuners are barely stable enough for colour.

The solution is now with us in the form of the varicap tuner which has no moving parts.

The Varicap Diode

All semiconductor junction diodes have the property of capacitance when reverse biased, the capacitance varying with the reverse voltage applied. The "plates" of the capacitor (see Fig. 1) consist of the conductive p- and n-type materials which form the anode and cathode respectively. The "dielectric" between the plates consists of the insulating depletion layer which is present at all pn junctions when not biased and increases with increase in reverse bias. As Figs. 1(b) and (c) show, the depletion layer widens as the reverse bias increases, effectively increasing the distance between the "plates" of the capacitor. Since capacitance is inversely proportional to the distance between the plates of a capacitor the capacitance at a reverse biased semiconductor pn

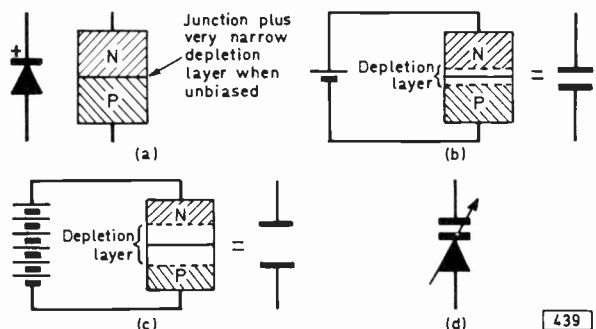


Fig. 1: (a) Symbol and basic construction of a semiconductor junction diode. (b) The depletion layer which is present at the junction is increased when reverse bias is applied. As shown the combination of the depletion layer plus the n- and p-type regions forms a capacitor. (c) As the reverse bias is increased the depletion layer widens and the capacitance decreases. (d) Circuit symbol for the varicap diode which exploits this property.

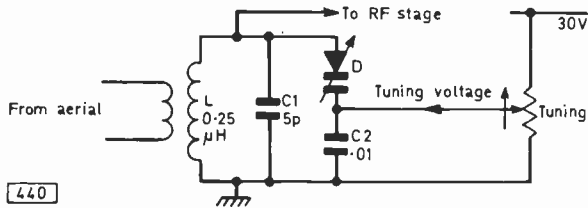


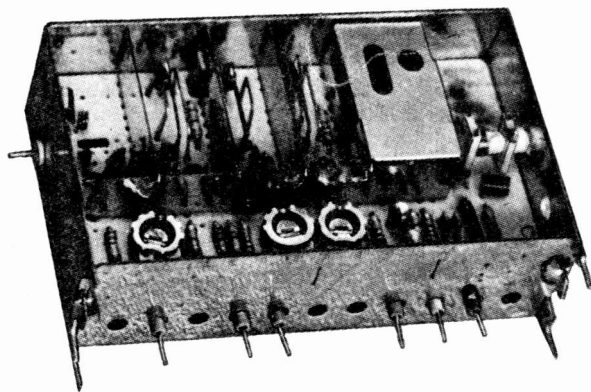
Fig. 2: Simple example of the use of a varicap diode for tuning. The arrow on the tuning potentiometer shows the direction of increasing frequency (i.e. decreasing capacitance).

junction decreases as the reverse bias is increased.

Normally this capacitance property of diodes (and transistor junctions) is ignored, or deliberately minimised in components for high-frequency use to reduce feedback effects. Varicap (or varactor) diodes however have large junction areas to give a wide and closely specified capacitance range so that they can be used as solid-state substitutes for mechanical tuning capacitors. A possible varicap tuning arrangement such as could be used for the r.f. stage of a v.h.f. radio receiver is shown in Fig. 2. Coil L is tuned by the parallel capacitances of C1 and the varicap diode D. C2 is of large capacitance value and so does not affect the tuning but serves to isolate the varicap control voltage obtained from the potentiometer connected across the 30V supply. The supply must be well stabilised for adequate tuning stability: fortunately no great current need be drawn from it.

Electronic tuning of this kind is easily adaptable to give switched selection of preset stations and for remote control arrangements since the tuning potentiometer can be mounted any distance from the tuned circuit. In this case C2 in Fig. 2 should be large enough to bypass any hum and noise picked up on the tuning wire.

Mechanical tuning capacitors will be around for some time however since varicap diodes have definite limitations. The range of capacitance given is usually small, with the better diodes being very expensive. The capacitance values available are of the order of a few picofarads which generally speaking restricts the use of varicaps to tuned circuits for v.h.f. and higher. They are suitable for only small-signal circuits since large signals tend to modulate the



Mullard ELC1043 u.h.f. varicap tuner unit with top cover removed.

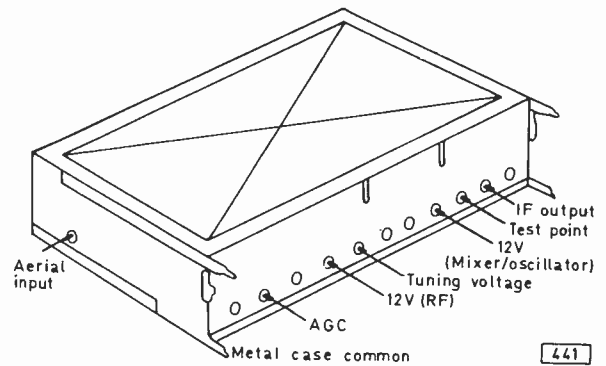


Fig. 3: External connections to the Mullard ELC1043 u.h.f. varicap tuner.

tuning bias, generating harmonics. The varicap has a significant leakage resistance so that the Q (selectivity) of the tuned circuit is less than could be obtained with conventional capacitors. Also it is expensive to select varicaps with near-identical characteristics, needed where several tuned stages have to be ganged to a single tuning potentiometer.

Virtually all varicap diodes are silicon rather than germanium since the latter semiconductor material cannot give the low leakage and high reverse breakdown voltage characteristics required.

ELC1043 UHF Varicap Tuner

This Mullard type ELC1043 u.h.f. varicap tuner shown in the photograph is now generally available (see end of article for a supplier) and this month we shall describe how it can be used as a superior replacement for other types of u.h.f. tuner. It has a light metal case with two snap-on covers, the overall size being 96 x 58 x 26mm for which room can easily be found in any set. Each tuned circuit in the tuner is in a separate screened compartment with additional screening of the mixer/oscillator stage to minimise radiation. The external connections are brought out via feed-through capacitors and are shown in Fig. 3.

Circuit Description

Two r.f. amplifier stages (using BF262 transistors) rather than one are used to compensate for the lower Q of the varicap tuned circuits, giving the tuner a good overall gain of 20dB. The aerial input circuit is untuned for optimum front-end noise performance, a typical figure of better than 8dB being achieved. Coupling between the first and second r.f. amplifier is by a half-wave tuned line and between the second r.f. amplifier stage and the mixer/oscillator transistor (BF263) by a pair of bandpass half-wave tuned lines. The secondary of the bandpass circuit is coupled to the emitter of the BF263 via a coupling loop which also serves to couple in the oscillator feedback from the oscillator tuned line. This coupling loop is terminated by a capacitor which is large enough to ensure that the emitter circuit presents a low impedance at i.f.

The four half-wave tuning lines, only about an inch long, are each terminated at one end by a fixed capacitor and tuned at the other end by a varicap

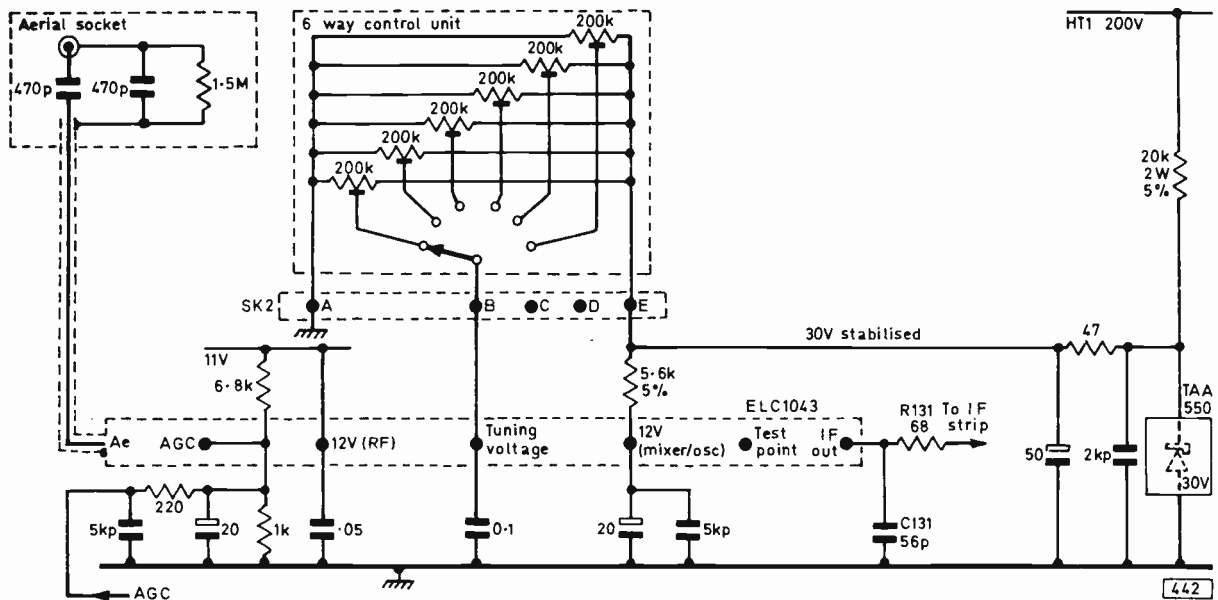


Fig. 4: The circuitry used with the ELC1043 varicap tuner in the Pye 769 chassis.

diode: with this arrangement stray capacitance at the point of connection does not restrict the tuning range. Four varicap diodes (type BB105B) are used and three factory-aligned skeleton presets control the tracking of the first three: they should on no account be adjusted.

Connections to Receiver

Figure 4 shows how the tuner is connected in circuit in a modern single-standard chassis, the Pye 769. The connections are as follows.

Aerial. This is connected via the usual isolating components to the terminal at one end of the tuner. When the tuner is used to replace an existing u.h.f. tuner the old aerial socket, the components on it and the aerial lead to the tuner can all be kept. The screen of the coaxial lead can be soldered directly to the tuner case or clamped under a small bolt screwed into the tapped hole provided near the aerial terminal. For tuners to be used abroad with 300Ω balanced aerial feeder Mullard can supply a 300/75Ω printed circuit balun transformer type number 4313/130/41080. Tuners already fitted with this carry the suffix /01.

i.F. Output. This can be fed by coaxial cable to the normal point in the receiver, i.e. the i.f. strip input or the 625 injection point on the v.h.f. tuner. Since this point is at h.t. potential in some valve circuits a 1,000pF series isolating capacitor should always be used if in doubt. It is prudent to keep the i.f. output lead short relative to a quarter wavelength at 37MHz, i.e. less than 2ft. This length adds about 40pF to the i.f. output loading. The i.f. output tuning coil is accessible at one end of the tuner (opposite end to the aerial input) and may require careful trimming with a non-metallic screwdriver for optimum resolution of the test card gratings. If the core has to go all the way in extra capacitance such as C131 in Fig. 4 is needed. For proper i.f. alignment a test point for connecting a

signal generator is provided on the tuner as usual.

A.G.C. Voltage. A swing of 2.5V to 6V increases the r.f. amplifier current from 6.5mA to 12mA causing a gain reduction of at least 35dB—see Fig. 5. Less than 500μA a.g.c. current is drawn. When adding the tuner to a receiver it is easiest not to bother with tuner a.g.c. and to fit instead a preset potentiometer to provide this voltage range. The potentiometer can be regarded as a sensitivity control which need only be backed off from its maximum gain extreme (2.5V) when used in strong-signal areas where cross-modulation occurs, i.e. simultaneous sound-on-vision and vision-on-sound, and patterning. In fact the tuner can give acceptable performance with an aerial signal as high as 8mV. For fringe area reception this sensitivity control is useful for locating the peak point on the a.g.c. curve (Fig. 5); this point varies slightly with frequency and different tuners. The a.g.c. voltage should be decoupled by say 20μF.

12V Supply to Mixer/Oscillator. This draws less than 4.7mA and can be supplied from the stabilised 30V tuning supply (see below) via a 5.6kΩ 5% resistor. A less stable voltage supply will cause tuning drift. The supply can be adequately decoupled by 20μF and 5,000pF capacitors in parallel, the smaller capacitor making up for the possible r.f. impedance of the 20μF electrolytic.

12V Supply to R.F. Stage. Since the current drawn here varies greatly with a.g.c. it should not be taken from the tuning supply otherwise the tuning will be affected by a.g.c. variations. If the receiver has a 12V rail as in Fig. 4 this can be used: a decoupling capacitor must be connected at the tuner. Alternatively a 12V supply can be derived from the valve h.t. line (200V approximately) by means of a 12V 400mW zener diode, 8.2kΩ 5W resistor and 20μF and 0.1μF parallel decouplers (see Fig. 8 later). Further possibilities include extracting 12V from across the cathode decoupling capacitors of the audio or field output valves.

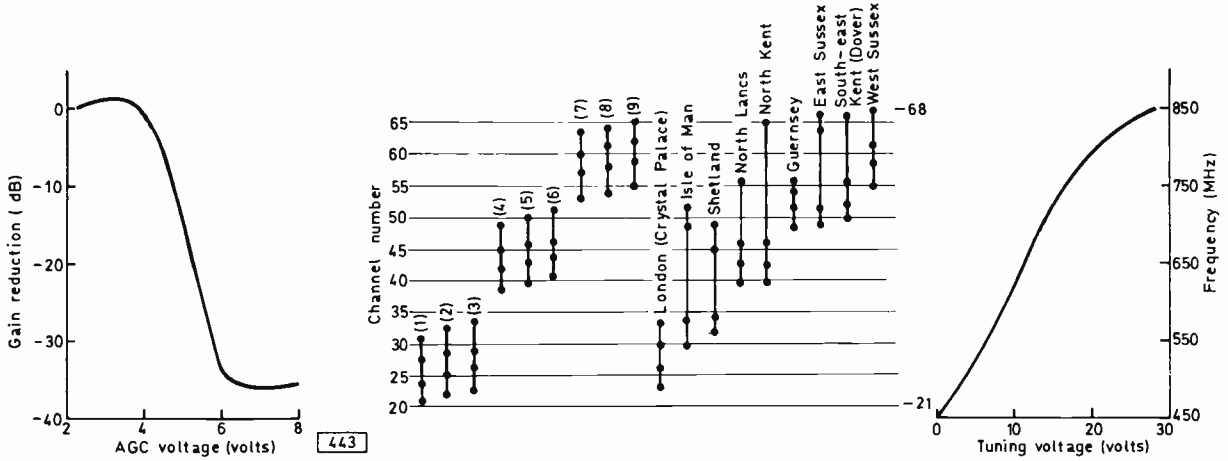


Fig. 5 (left): Plot of a.g.c. voltage against gain reduction. Peak gain occurs at about 3V but this varies slightly with different tuners.

Fig. 6 (right): Varicap tuner tuning range and UK u.h.f. channel allocations. Four channels are allocated to each transmitter. Channel groups 1-9 above are used by the following stations: (1)—Channels 21, 24, 27 and 31—*Divis, Caithness, Cardiganshire, East Lothian, Sandy Heath, Rowridge, Halifax*; (2)—channels 22, 25, 28 and 32—*Argyllshire, Caradon Hill, Belmont, Fermanagh, Hereford, Durris, Cumberland*; (3)—channels 23, 26, 29, 33—*Darvel, Banff, Stockland Hill, Lewis, Bilsdale*; (4)—channels 39, 42, 45 and 49—*Flintshire, Rosemarkie, Northumberland*; (5)—channels 40, 43, 46 and 50—*Sutton Coldfield, Dorset, Black Hill, Orkney, Pembrokeshire, Guildford*; (6)—channels 41, 44, 47 and 51—*Tunbridge Wells, Buchan, Caenarvonshire, Jersey, Kirkcudbrightshire, Londonderry, Emley Moor, Wenvoe, Suffolk, Redruth*; (7)—channels 53, 57, 60 and 63—*Llandona, Carmarthenshire, East Yorkshire, Northamptonshire, Perthshire, Beacon Hill, Wigtown, Reigate*; (8)—channels 54, 58, 61 and 64—*Hereford, Armath, Mendip, Dumbarton, Pontop Pike, Nottinghamshire*; (9)—channels 55, 59, 62 and 65—*Tacolneston, North Antrim, Huntshaw Cross, Selkirkshire, Winter Hill*.

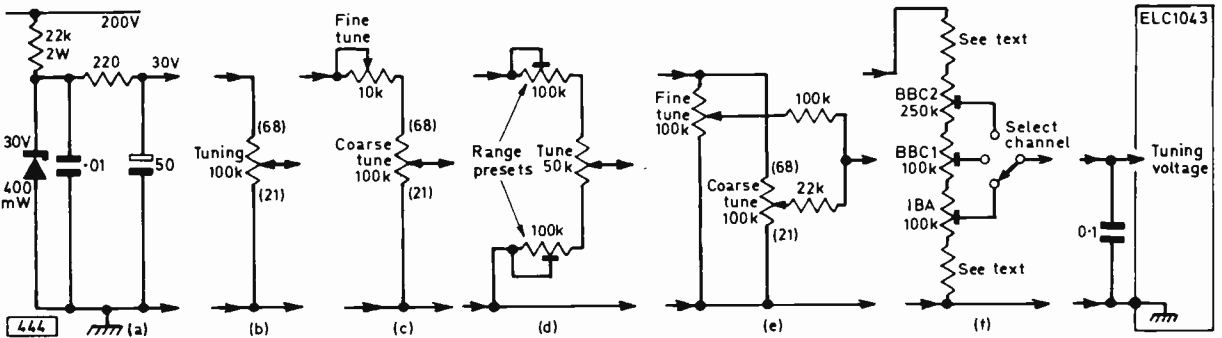


Fig. 7: (a) Tuning voltage supply. For greater stability use a TAA550 i.c. in place of the 30V zener diode. (b-f) Alternative tuning arrangements—all potentiometers are small carbon linear types. Services noted on (f) correspond to the London channel allocations.

Tuning Voltage. A swing of 0 to 28V is needed to tune over the full range of channels 21 to 68 in Bands IV and V, there being a margin of 2MHz available below channel 21 and above channel 68. The tuning range is shown in Fig. 6 which plots tuning voltage against frequency and summarizes the channel numbers used in different parts of the country. The tuning current drawn is very small, less than 75µA.

The recommended tuning voltage source is 28-30V from a Mullard TAA550 stabilizer as shown in Fig. 4. This is a special purpose i.c. which acts as a high-performance zener diode. For monochrome television where ultimate tuning stability is not essential an ordinary 30V 400mW zener is adequate and cheaper. This can be fed with a constant 8mA

by a 22kΩ resistor from the valve h.t. line (190 to 210V) as shown in Fig. 7(a).

A variety of tuning arrangements is possible some of which are shown in Fig. 7(b)-(f). The simplest circuit—Fig. 7(b)—consists of a potentiometer across the 30V supply, its slider feeding the tuning voltage input of the tuner. The control knob can be calibrated directly in channel numbers 21 to 68: as the shape of the curve in Fig. 6 shows, the scale is almost linear with slight expansion towards the high-frequency extreme. The disadvantage of this scheme is that the control is too coarse to tune in a single channel easily. A multi-turn potentiometer if available would be more suitable. A less expensive solution is to fit two controls, coarse and fine, as in Fig. 7(c). This arrangement is workable but suffers

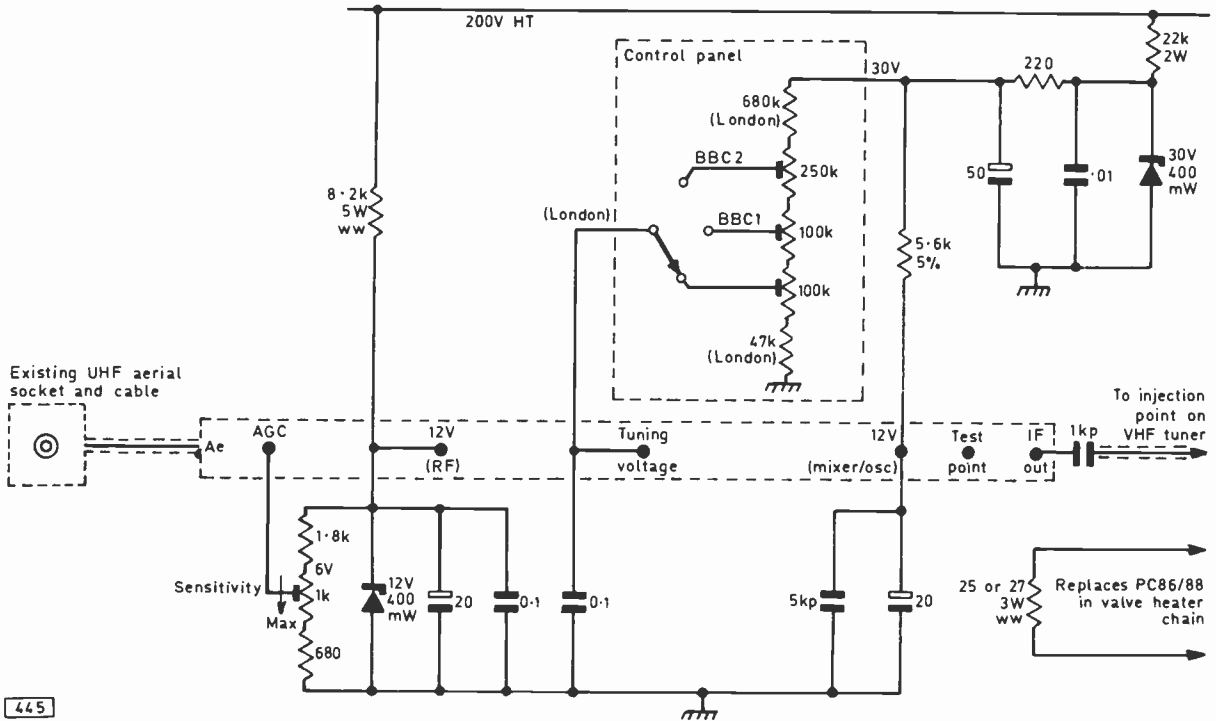


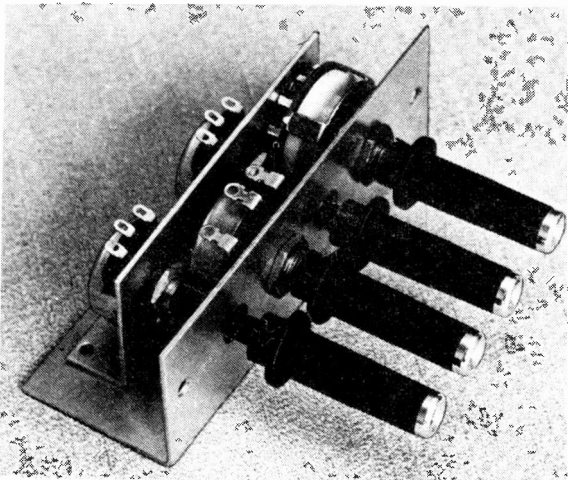
Fig. 8: Varicap tuner conversion to replace a valve u.h.f. tuner.

445

from the fine tuning range varying over the band. The more sophisticated arrangement shown in Fig. 7(e) solves this and in practice is easy to use. For fancy appearance the coarse control can be a slider type, fitted with a scale of channel numbers.

The arrangement shown in Fig. 7(d) is only intended to cover the local group of channels but has the advantage of easy one-knob tuning of all three stations. The two preset controls are set up so that the channel range swept by the 50kΩ potentiometer just covers the channels required. If it is fitted with a reasonably large knob tuning is quite easy.

An attractive method of tuning is by pushbutton



The varicap conversion control unit available from Manor Supplies.

or switch. Special pushbutton/potentiometer control assemblies are used on some sets but are not readily available at present (see supplier at end of article though). A circuit for switch tuning is shown in Fig. 7(f). Here the three local stations are preset on the potentiometers and selected by an ordinary three-way wavechange switch. The two fixed resistors are chosen to suit the local channel allocations (see Fig. 6). As the voltages to tune channels 21 to 68 are fairly linearly distributed across the total series resistance in Fig. 7(f) it is easy to choose appropriate values. For example for the London channels—or transmitters under (1), (2) or (3) in Fig. 6—the upper fixed resistor should be 680kΩ and the lower one 47kΩ.

The tuning voltage should be decoupled at the tuner by an 0.1μF capacitor to avoid freak effects due to noisy tuning potentiometers or interference pickup. Do not fit a large electrolytic decoupler here or there will be an unpleasant lag in the tuning.

The installation of the tuning controls can be contrived to suit particular receivers. An interesting bracket has however been developed by Manor Supplies. This allows the channel selection switch and tuning potentiometers shown in Fig. 7(f) to be mounted sufficiently closely to fit control panel holes intended for conventional pushbutton tuners. The controls (see photograph) are stagger-mounted on a two-piece bracket which can be adjusted slightly to fit different panel hole spacings. By using this bracket sets such as those in the Bush TV125 series can be very easily converted to varicap 625 tuning. A kit is available consisting of the bracket, most of the components in Fig. 4 (a 30V zener diode is supplied in place of the TAA550) and 7(f) and four slim-style knobs

Any of the control circuits shown in Figs. 7(b) to 7(f) can be built into a small plastic box and used remotely from the set. *Ensure that all parts of the circuit are adequately insulated from the user however since the receiver chassis can be at live mains potential.* For this reason turned metal knobs must not be used unless the controls have plastic spindles.

Typical Conversion

To investigate the performance of the varicap tuner as a replacement unit, one was fitted in place of the valve u.h.f. tuner originally used in a Pye set in the 11U series which we covered recently (see May 1972 issue). The circuit adopted is shown in full in Fig. 8. To maintain heater continuity a 25 Ω wirewound resistor was connected in place of the old PC86/PC88 valves in the heater chain.

To avoid tuning drift the tuner should be mounted in a cool position in the set; likewise the 30V zener diode. The three high-wattage resistors should be mounted away from the tuner as they run warm. In some sets it may be necessary to mount a metal sheet to shield the tuner from heat if drift proves troublesome.

The tuner case should be securely bonded to the receiver chassis at or near the v.h.f. tuner by a heavy wire since poor connection here can be a source of patterning—especially if the wire is more than a few inches long.

The improvement in 625 reception was remarkable. On my aerial the old valve tuner had brought in programmes from two transmitters with some grain (noise) always visible and with little or no "spare" contrast gain. Fitting the varicap tuner resulted in completely noise-free pictures on all the channels with enough gain in hand to drive the picture to "soot and whitewash" on advancing the preset contrast control. On this set, which is without flywheel line sync, the former raggedness of picture verticals was greatly improved. This is partly thanks to the high-level type viewer contrast control used on this chassis as this technique always allows fully

Gives extra IF gain for UHF tuner output

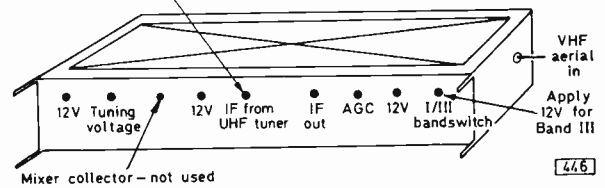


Fig. 9: Connections to the ELC1042 v.h.f. varicap tuner unit. This has exactly the same a.g.c. and tuning voltage requirements as the ELC1043 u.h.f. varicap tuner and can be used as a replacement for obsolete v.h.f. push-button or turret tuners.

amplified video to pass to the sync separator. The higher video level showed up some slight misalignment of the f.m. sound detector, but this was tweaked correctly without difficulty for minimum buzz on sound. The tuning stability has proved so good that the three station presets will shortly be relegated to a position at the back of the set, out of reach of unskilled hands, leaving just a three-way channel switch at the front of the set.

Supplier

Manor Supplies (172 West End Lane, London NW6) can supply the ELC1043 varicap tuner at £4.50 plus 25p post and packing and the kit of bracket, components and knobs described for £1.90 plus 15p post and packing.

Service Hint

We have heard reports of tuner unit drift in Philips colour receivers (520 series) fitted with the G8 chassis with varicap tuner being due to the 33k Ω resistor (R2143) which feeds the 30V tuning line going high-resistance. This resistor is mounted on the i.f. panel.

WIDEBAND BAND I PREAMPLIFIER

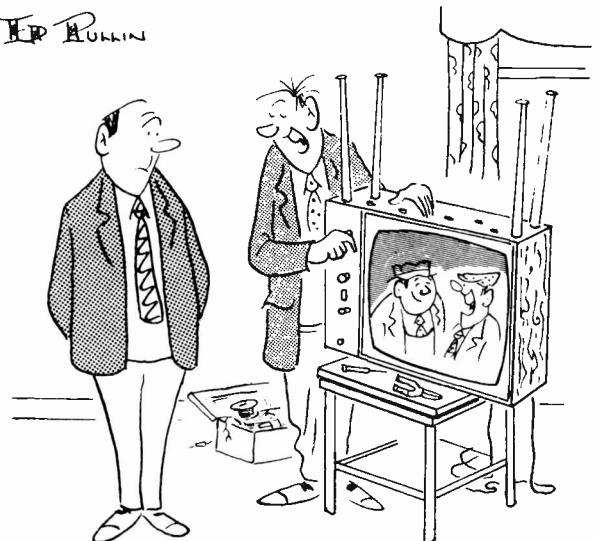
—continued from page 543

transmitters the problem usually shows up in the appearance of the u.h.f. transmissions on various frequencies in Band I. This can also occur in Band III although in this Band various f.m. radio services can appear. In most cases the problem can be overcome by using simple filters.

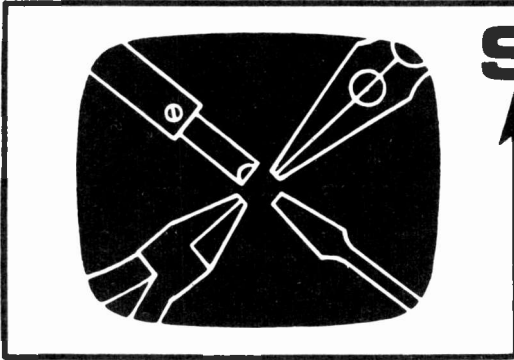
For the prevention of u.h.f. breakthrough a simple pi or T filter can be used. To align the pi filter shown in Fig. 2(a) the two variable capacitors are adjusted to provide maximum attenuation on the highest and lowest channel in the group. The T filter (Fig. 2(b)) is adjusted for maximum attenuation at the centre channel frequency. The adjustments are best carried out with the filter connected in series with a u.h.f. aerial feeding into a receiver tuned to the u.h.f. channel concerned.

The simple acceptor trap shown in Fig. 2(c) can be used to remove f.m. radio services breaking through in Band III. The variable capacitor is tuned until the interference disappears. ◆

FR RUKIN



"That'll stop the tube shorting out!"



SERVICING television receivers

L. LAWRY-JOHNS

BUSH TV141, TV148 SERIES

THESE models and the Murphy equivalents—Models V153 and V159—were released just before the partly transistorised TV145U, TV148CU and TV161U series which we dealt with in April and May 1970. Whilst the model numbers are so similar there is a good deal of difference between the two ranges. The earlier models which we are now covering used valves throughout except for the u.h.f. tuner. The timebases used in the two series were however very similar.

This means that the h.t. current flows through both 3SR1 and 3SR2 with 3SR2 also carrying the heater current. It is therefore more prone to break down. When it shorts the h.t. is unaffected as 3SR1 still rectifies but the valve heaters are grossly over-run (including the tube) and this can lead to many later failures after the basic fault condition has been detected and cleared. Fuse 3F1 should therefore feed two rectifiers, one for h.t. and the other for the heater supply—as is done in the TV161 series.

The Power Supply

The power supply circuitry is worth close attention as trouble will be experienced here. The arrangement of the two rectifiers in the circuit is one which the writer distrusts and alters when the occasion arises. It will be seen that the two rectifiers are in series, with the heater supply taken from the junction.

No Results

The most common fault which will be encountered is lack of h.t. at any of the h.t. points with the valve heaters operating normally. This is due to the 16Ω section of 3R57 failing. This section is between the third and fourth tags from the right (the first two sections are 3R58 which is the heater circuit dropper).

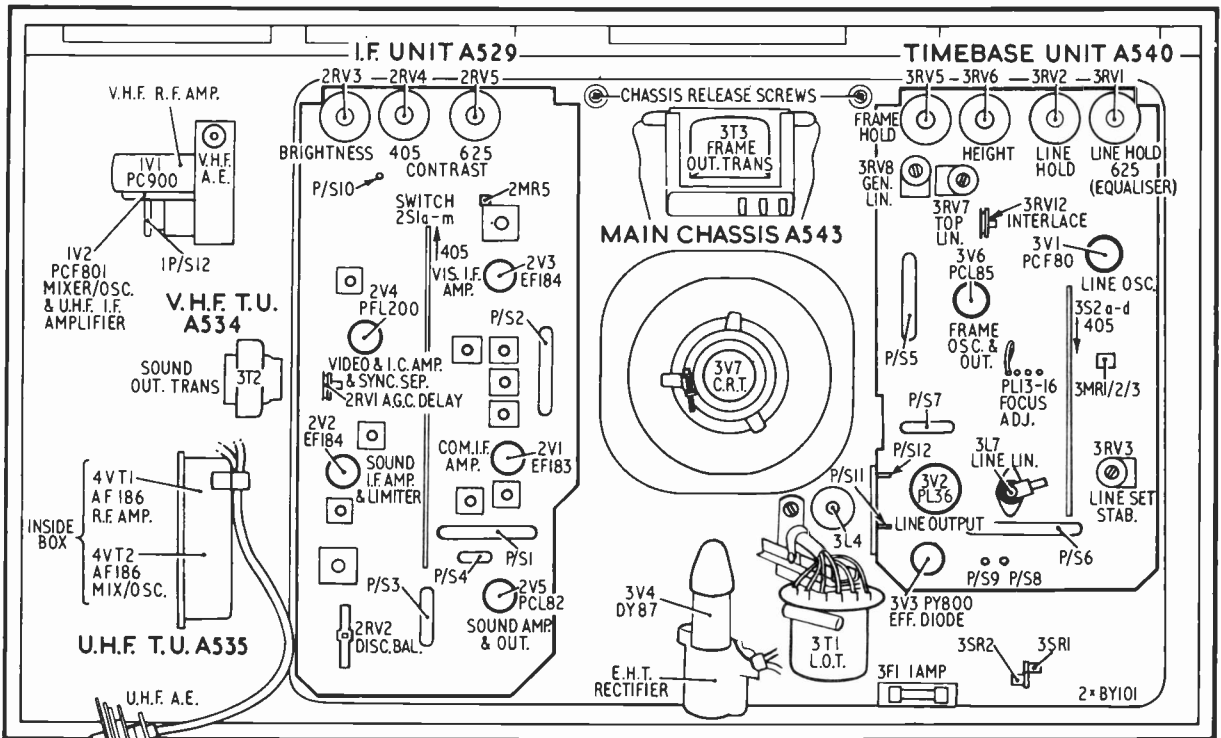


Fig. 1: Rear chassis view of the complete receiver.

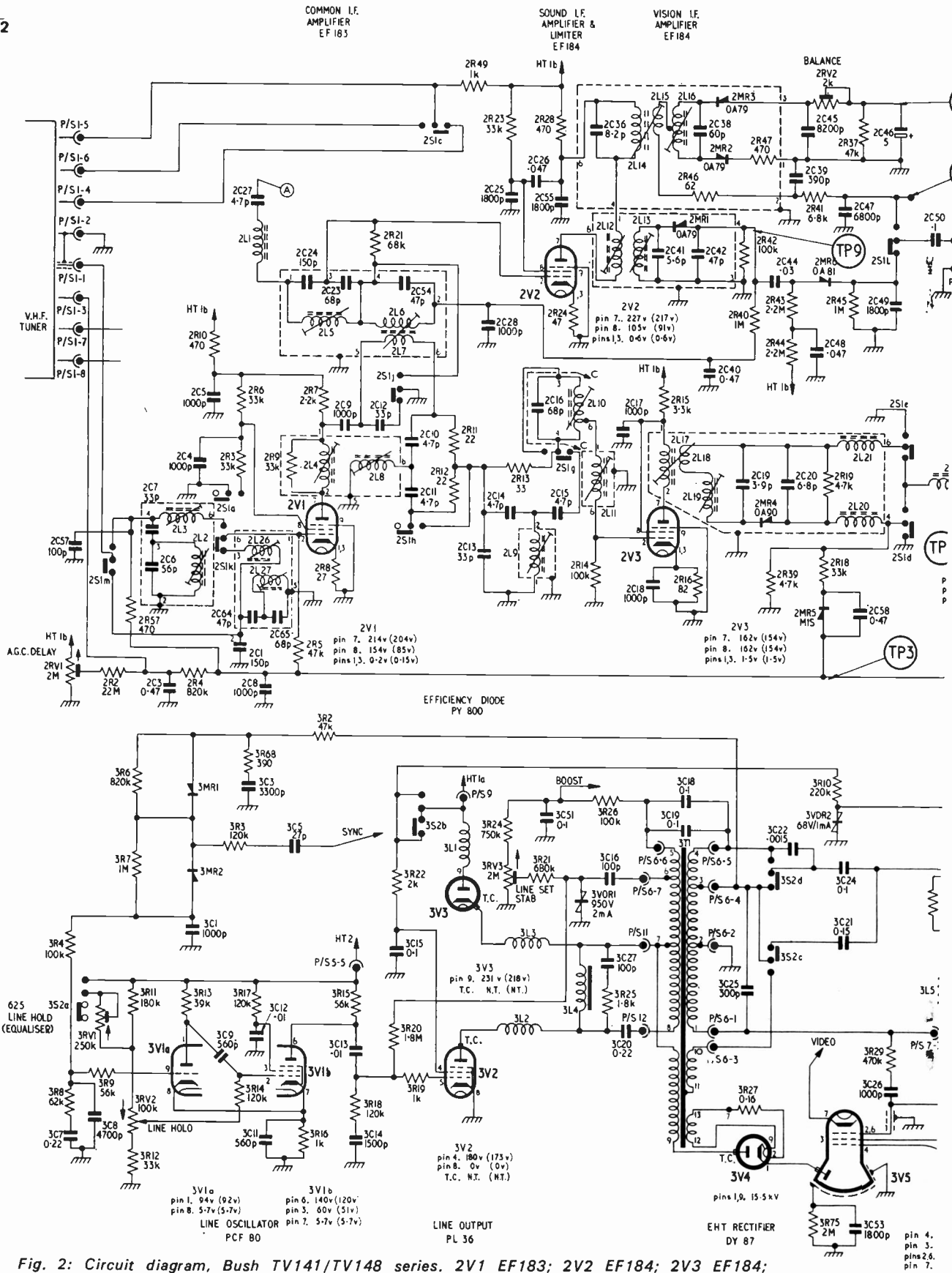


Fig. 2: Circuit diagram, Bush TV141/TV148 series. 2V1 EF183; 2V2 EF184; 2V3 EF184; 2V5 PCL82. 2V4 PFL200;

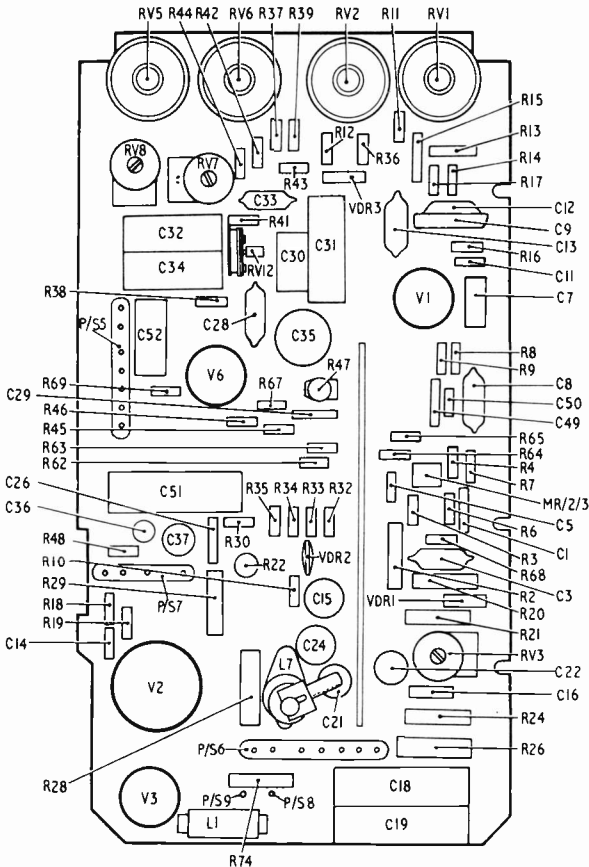


Fig. 3: Timebase board component layout.

The temptation to wire a replacement resistor across these tags should be resisted as it dissipates quite a lot of heat and would then be directly below the boost capacitors 3C18 and 3C19. The replacement resistor should be placed behind the panel where the dropper is situated and the wires passed through for connection round the tags.

Whilst the 16Ω section is the one which most commonly fails there are times when one of the others will be found open-circuit. This will leave only HT3 functioning. To maintain smoothing efficiency the correct value replacement must be fitted (within reasonable tolerance).

Rivet Your Attention!

A common fault on these and similar receivers is often of an intermittent nature and can be misleading. A typical complaint from the set owner might be "the picture goes small and wavy, there's hum on the sound and a smell of burning". The latter part of the complaint is the red herring. One tends to go immediately hot foot in pursuit of a short-circuit only to find that there isn't one and quite often that the set functions quite normally when switched on. When the fault does show however the conditions are just as described. The overheating takes place in the resistor between the two smoothing blocks, suggesting that the main $300+300\mu\text{F}$ capacitor block is not functioning.

Sparking may be seen at the earthing tag on the capacitor at the lead out. A sharp edge and a heavy clout effectively joints the all rivet to the tag and all is well again.

Why did the resistor overheat? Oh yes, well if the proper reservoir is out of action the nearest capacitor obliges and the resistor between takes a heck of a current which should be taken by the 16Ω section. That's reasonable enough, isn't it?

On the odd occasion the 94Ω resistor 3R58 goes open-circuit and this of course puts the valves out but leaves plenty of h.t. to tickle the unwary. It is mainly the h.t. side which gives the trouble however and this should be taken to include the electrolytics which normally show their lack of efficiency by producing a slightly wavy picture which rises and falls in a regular manner.

The Line Timebase

It is difficult to say whether the line or the field timebase gives the most trouble but as there is more to the line timebase we will deal with this first.

The most common fault is for one of the boost capacitors to short. This causes more trouble than usual since they (3C18-3C19) are returned to chassis through 3T1. Thus the effect of one of the capacitors shorting is that a heavy current will flow through the PY800 boost diode and this will normally blow the fuse 3F1. It is prudent therefore not only to check the h.t. line for shorts before replacing the fuse but also to check from 3V3 top cap to chassis. Quite often the fuse does not blow and the poor PY800 is left glowing red hot until some sympathetic soul turns the set off. Whilst only one of the $0.1\mu\text{F}$ capacitors may be at fault it is a good plan to replace both or to fit a single $0.22\mu\text{F}$ (1kV) one in place of both. The PY800 may not feel very well after this ordeal and may tend to arc internally: it is prudent therefore to replace this also.

The PL36 line output valve can be responsible for a number of fault symptoms but the usual ones are lack of width (due to low emission) or no picture at all when it may be found that the heater is not glowing due to the glass being cracked. This latter condition could be the result of the valve having been overheated by lack of line drive. Suspects here should be first the PCF80 line oscillator and then the flywheel sync discriminator diodes (3MR1 and 3MR2) one of which may be shorted or open-circuit.

Slight overheating of the PL36 may be due not to lack of line drive but to shorted turns in the line output transformer, a low PY800 or a shorted DY87 e.h.t. rectifier. The DY87 can be checked merely by lifting off its top cap and the PY800 by replacement. If line drive is present at the PL36 control grid (junction 3C13 and 3R19) it is highly likely that the transformer is at fault.

The line output transformer can give rise to a misleading fault condition in these receivers. The symptoms are that the picture tends to appear quite normal at low brilliance but expands rapidly and fades as the brightness increases. This would normally direct attention to the DY87 and indeed a new valve may seem to clear the condition up to a point. The basic fault may still be present however and will not be finally overcome until the transformer is replaced.

CONTINUED NEXT MONTH

RECEIVER MONITOR CONVERSION

P. M. Delaney B Sc

THE circuit shown in Fig. 1 was evolved whilst in the process of converting a domestic television receiver to act as a monitor as well. The set converted was one using the Philips Style 70 chassis (see TELEVISION May 1971 for the complete circuit of this).

The video preamplifier (Tr1) circuit follows the design by Keith Cummins published in the August 1971 issue of TELEVISION and raises the video input signal to the level required to drive the video output pentode in the TV set. Tr1 is connected in the common-base mode and raises the 1V across 75Ω input signal to 3V or so. D1 acts as a d.c. restorer following C5 and the output passes via a small low-capacitance slide switch to the grid circuit (see Fig. 2) of the video output valve.

The rest of the circuit shown in Fig. 1 is used to take a 1V video signal from the detector circuit in the receiver and convert it to a 75Ω impedance output. It is thus basically a source-follower. It was found however that a conventional source-follower field effect transistor (f.e.t.) circuit did not respond sufficiently to the sync pulses to enable the signal

from the receiver to lock the picture. Also a high impedance has to be presented to the receiver circuitry to avoid loading the detector stage and distorting the signal. The circuit adopted, using two field effect transistors Tr2 and Tr3, is known as a White source-follower. The upper field effect transistor Tr2 acts as a conventional source-follower with the lower field effect transistor Tr3 acting as its source resistor. The field effect transistors used are n-channel depletion-mode types, requiring negative gate bias. When a negative-going sync pulse arrives at the gate of the upper f.e.t. it is turned off. The resultant positive-going pulse across its drain load resistor R15 is coupled via C8 to the gate of the lower f.e.t., driving it on. The required signal thus appears at the output, the double 180° phase shift (through the two f.e.t.s) resulting in the sync pulse being in the correct relationship to the video signal at the output. The circuit also has a much lower output impedance than is normally associated with source-followers.

The complete circuit was assembled on a couple of small pieces of Veroboard which can be squeezed into convenient spaces in the set. A mains isolating

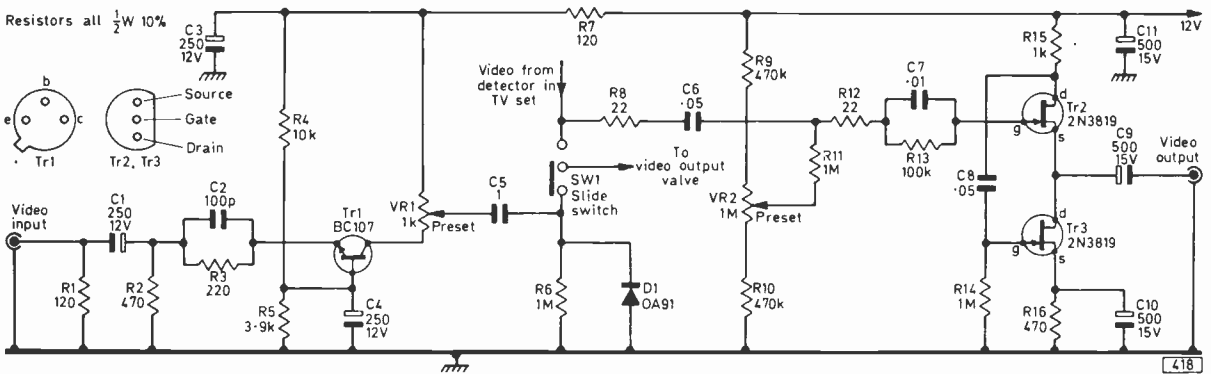


Fig. 1: The additional circuitry used in the receiver-monitor conversion.

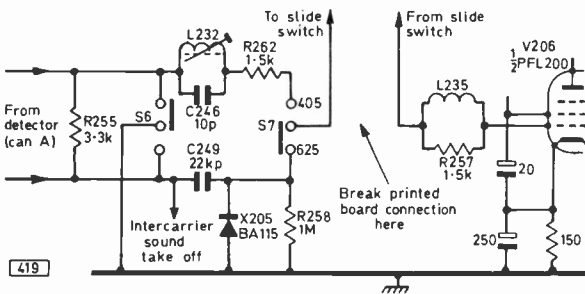


Fig. 2: Connections to the main chassis.

transformer, e.g. the Douglas No. 30 or 151 (obtainable from Barrie Electronics, 11 Moscow Road, Queensway, London W2 4AH), is also required of course: this should be connected between the mains on-off switch and the rest of the circuit. The physical positioning of this transformer needs care in order that its magnetic field does not affect the line and field circuits. The TV set case will need extending in order to hold the transformer—few sets have sufficient space for this bulky item.

The connection of the extra circuitry into the set is fairly easy. A convenient point in the set must be found and the printed circuit foil carefully cut

—continued on page 567

LONG-DISTANCE TELEVISION

ROGER BUNNEY

AS I write towards the end of July conditions are still fairly active. Sporadic E though not so good as at the end of May has produced some very good openings while with a high-pressure system stationary over the United Kingdom and Europe for much of the month Tropospheric have given some variety to the loggings of Sporadic E! I have also received some detailed news of "exotic DX"—more of this later. Firstly the log:

- 1/7/72 BRT (Belgium) E2; NOS (Holland) E4—both trop.
- 2/7/72 USSR R1; TVE (Spain) E2, 3, 4; BRT E2 (trop); plus unidentified signals.
- 4/7/72 TVE E2, 3, 4.
- 5/7/72 RAI (Italy) IA, IB; TVE E2; BRT (trop) E2.
- 7/7/72 BRT E2.
- 8/7/72 USSR R1; NRK E2; BRT E2, 10; NOS E4—latter three stations trop.
- 10/7/72 RAI IA, IB.
- 11/7/72 Unidentified R1 SpE.
- 12/7/72 TVP (Poland) R1; WG (West Germany) E2.
- 13/7/72 WG E2; RAI IA; MT (Hungary) R1, 2.
- 14/7/72 NRK (Norway) E2, 3.
- 15/7/72 BRT E2; NOS E4—trop.
- 16/7/72 TVE E2.
- 18/7/72 USSR R1, 2; TVP R1; MT R1; DFF (East Germany) E3; NRK E2; RUV (Iceland) E4; TVE E2, 3; ORTF (France) F2; NOS E4 (trop).
- 19/7/72 MT R1, 2, 4; JRT (Yugoslavia) E3, 4; TVE E2, E3 twice, 4; also many unidentified signals.
- 20/7/72 BRT E2—trop.
- 21/7/72 NRK E2.
- 22/7/72 JRT E4; RAI IA; WG E2; ORF (Austria) E2a; TVR (Rumania) R2; CST (Czechoslovakia) R1; ORTF F2; plus many unidentified signals.
- 23/7/72 TVE E2, 3, 4; JRT E4.
- 25/7/72 RUV E4; NRK E2; NOS E4 (trop); plus unidentified signals.
- 26/7/72 NOS E4—trop.
- 27/7/72 USSR R1; TVE E2, 4; SR (Sweden) E2.
- 28/7/72 JRT E4.
- 29/7/72 RAI IB; TVE E2, 4; RTP (Portugal) E2, 3; also unidentified signals.
- 30/7/72 TVE E2; NRK E2.

On July 6th and again from the 10th to the 22nd an

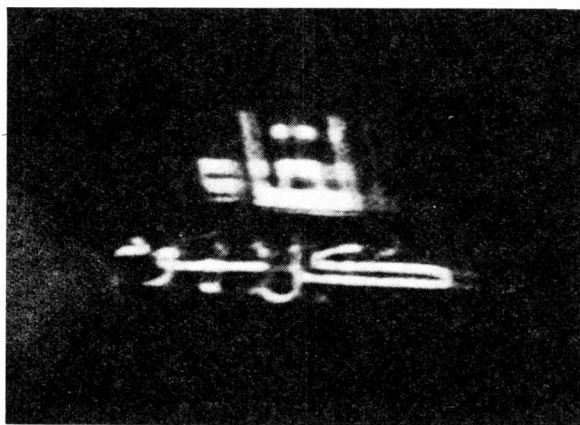
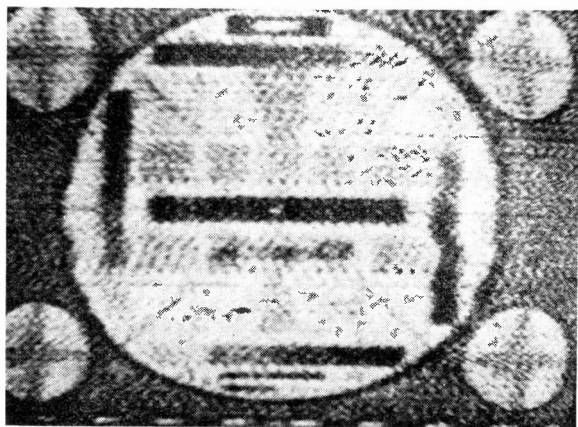
improvement in Tropospheric propagation was noted. Here in Southampton various ORTF (French) v.h.f. and u.h.f. transmitters were noted up to ch.E59. From more favourable locations I understand that various Low Country transmitters were received and at times West Germany at u.h.f. East German transmitters were received in Holland and the DFF ch.E5 transmitter was noted carrying a new identification slide. On a personal note I am again on the move, to another location some miles from Southampton in the Test Valley(!). Consequently from July 22nd I have been using the wideband Band I dipole described in last month's column. From the results since obtained it seems to work quite well.

In addition to the new slide in use by the DFF we have heard from Hugh Cocks at Mayfield that the DFF has been noted using the SWF/YLE type electronic card with identification "DFF Berlin-1". I have seen no evidence of this card in Band I so far but am keeping my eyes skinned! Hugh also mentions that in a recent opening the USSR changed from the conventional "0249" test card to a pattern of vertical stripes. Most of us will have seen the new Swiss card by now but apparently the French network in Switzerland is still using the old type card with only the identification letter "G" in the upper right-hand square.

I reported recently (August issue) reception of a new Icelandic transmitter on ch.E2. It seems that there is indeed a high-powered transmitter in operation on this channel as several enthusiasts in Holland have reported reception of it. As yet there is no EBU listing however!

Exotic Receptions

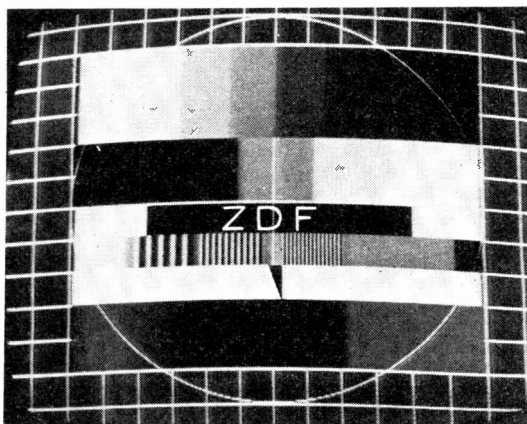
We now have detailed information on some exciting DX TV receptions during July. Seppo J. Pirhonen of Lahti, Finland has sent photographs of Amman, Jordan ch.E3 received at Lahti on July 4th between 1650-1735 CET (BST). These photographs clearly show the strength of reception and Seppo comments that the signals were mostly strong but with ghosting at times. Amongst the photographs are the test card (compare with photograph in the DX-TV column, TELEVISION November 1970), the Mosque, extract from the Koran and a caption in Arabic. Shortly after the above letter came another, from Rym Muntjewerff of Beemster, Holland. He too has received Amman ch.E3!! This reception occurred on



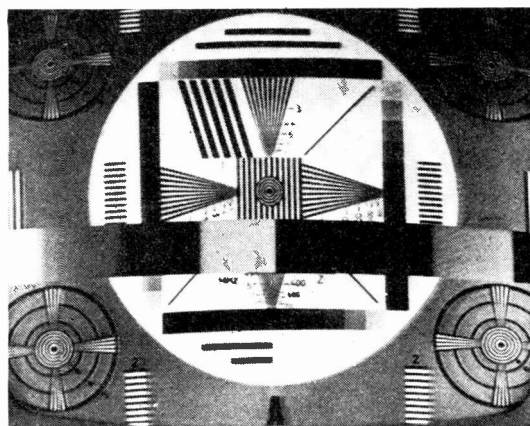
Amman Jordan ch.E3 test card (left) and arabic caption (right) received in Lahti, Finland (see text).

DATA PANEL 15—2nd series

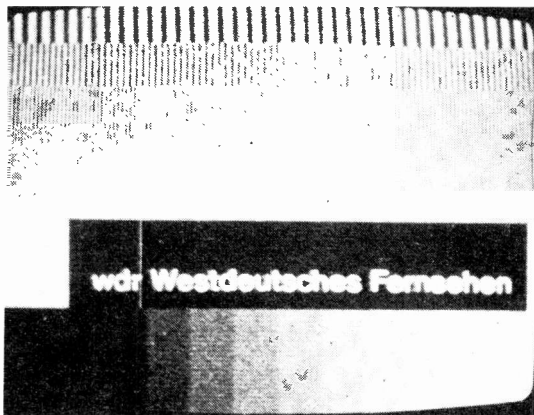
WEST GERMANY—1



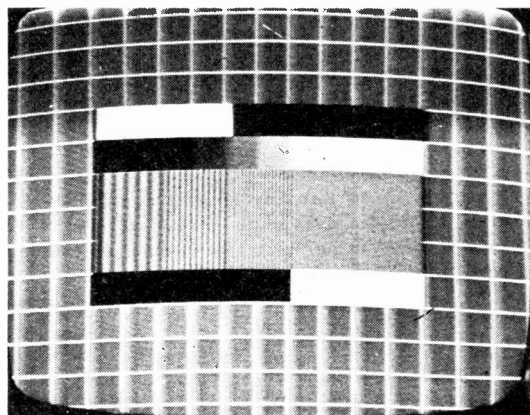
ZDF (Zweites Deutsches Fernsehen) test card.



TO5 (Telefunken) test card with colour bar used by WDR-1. Note transmitter initial letter at bottom centre of frame.



Electronic pattern used by WDR-3.



EBU bar pattern used by WDR (Westdeutscher Rundfunk).

Photographs this month courtesy Europese Testbeeldjagers.

July 9th from 1640-1658 CET when again the test card was noted. In view of the limited extent of the test transmissions from Jordan these two receptions were fortunate indeed. Rym goes on to say that on July 8th he received a clock which gave the time 0957 whilst it was 0657 here. This must locate the transmitter some distance into the USSR (the reception was on ch.R1). From research here I would suggest that the signal originated from between $+55^{\circ}$ - $+65^{\circ}$ East (+4 hours GMT). This basically "runs down the Ural Mountains" and could mean reception from Kazan, Ufa, Aktyubinsk or Tyumen. The photograph sent shows three ghost images as well as the main one. Congratulations to our two friends on these achievements.

Albania

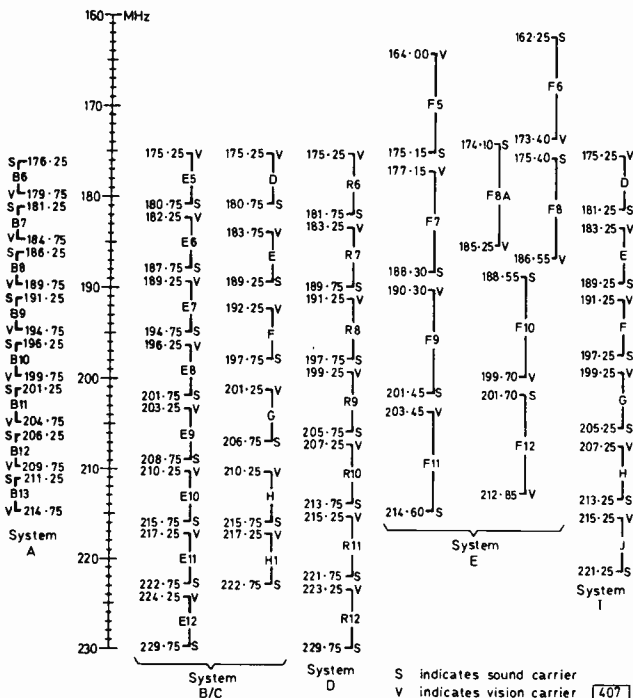
We have further information from our Italian contact Michele Dolci about Albanian TV. It seems there is now only one high-powered transmitter, on ch.C, using transmission system B (Western European). The programmes are picked up over a large part of South-East Italy.

Garry Smith of Derby tells us that the new TV centre opened on November 1st 1971 with four hours of programmes daily. The main transmitter is atop Dajti Mountain and is linked to a network of translator stations now being constructed to give complete coverage of the country. Television receivers are constructed in Albania—there is a large assembly plant at Durres. They are of up-to-date appearance and have "three holes for the push buttons"! Michele Dolci also mentions that Italy may be going into colour with SECAM in 1973 for "economical reasons of market competition with France."

EBU Transmitter List

The EBU has just published the *List of Television Stations No. 17*. The subscription of 300 Belgian Francs includes a map and six bi-monthly supplements. This is highly recommended as an accurate guide to European stations. The address is: EBU, Technical Centre, 32 Avenue Albert Lancaster, Bruxelles 18. A close check between the latest list and last year's one plus the supple-

EUROPEAN AREA BAND III CHANNEL ALLOCATION CHART



- System A:** UK, Eire 405-line system. Positive vision modulation, a.m. sound.
- System B:** Most of Western Europe (excluding France). Negative vision modulation, f.m. sound, 625 lines.
- Italy** as System B but with alternative frequency allocations (channels ID-IH1).
- System C:** Belgium. Positive vision modulation, f.m. sound, 625 lines.
- System D:** Eastern Europe (excluding East Germany). Negative vision modulation, f.m. sound, 625 lines.
- System E:** France, Monaco. 819 lines, positive vision modulation, a.m. sound.
- System I:** Eire. 625 lines, negative vision modulation, f.m. sound.

ments has brought to light some changes not previously noted here.

Bulgaria: Previously two ch.R1 and one ch.R2 transmitter was listed but it appears that these have moved to Band III. Certainly there are no Band I transmitters now listed in this country. This is something of a blow since Bulgaria has been received in the UK only a few times and if this information is accurate reception of Bulgaria here in future is going to be difficult if not impossible.

Spain: The e.r.p. of the transmitter at Vejer (ch.E2) situated near Gibraltar has been increased to 14kW.

Hungary: Pecs ch.R2 has been increased to 60kW. This would account for the increased number of loggings of this transmitter. Tokaj ch.R4 has also been increased, to 8kW.

Israel: The first u.h.f. transmitter in this area is operating from Mount Shalom, Tel Aviv, on ch.E27 with 7kW.

Poland: Warsaw ch.R2 is now listed as 100kW e.r.p.

Egypt: After some years Port Said is again listed on ch.E3 with 10kW. Our Cyprus contact has not as yet reported reception from it.

Luxembourg

Tele-Luxembourg are expected to be operating their new ch.E21 1000kW transmitter during September. We

hope those in good locations will keep a close watch on this channel and let us know of any activity.

Data Panel

This month we commence a series of West German test cards. There are problems with this country however as the cards tend to be changed rather frequently. Consequently some of the cards shown may have been discontinued, modified or used on other networks.

There are three programme networks in West Germany. The programmes on the 1st and 3rd networks are produced by the members of the ARD (a body similar to the IBA): the 1st network is a national one with some regional variations while the 3rd network is a regional one in which each ARD member provides his own service. The 2nd network is a national service produced by the ZDF (Zweites Deutsches Fernsehen): there are no regional variations and the service can be compared to BBC-2.

Programme times: The 1st network provides a schools programme 0700-0800, then morning programme 0900-1200, afternoon programme 1515-1655, regional programme 1700-1900, national programme 1900 till closedown. There are apparently *no* identifications during the evening national programme. The 2nd network operates from approximately 1630 till closedown and the 3rd network from approximately 1700 till closedown. Test transmissions occur as follows: 1st network, after schools and in main programme gaps; 2nd network, approximately 0600 till programme start; 3rd network, approximately 0630 till programme start. All times GMT. We will continue with more information on West German television next month. Our thanks to the Europese Testbeeldjagers for sending us the information!

Tropospheric Propagation

The Autumn months often produce excellent tropospheric reception in the UK as a result of settled high-pressure systems—by the time you read this conditions may already have produced enhanced "trops". For this reason a chart of the various Band III channel allocations at present in use is included this month. A cross reference against the UK 405-line channels gives accurate markers for finding the various channels. Although the extension of u.h.f. services has greatly increased tropospheric activity Band III can still provide excellent DX: remember that most of the East European countries use Band III extensively. Poland and Czechoslovakia have been received in Band III via this mode—who knows whether USSR in Band III may be possible this season! The mechanism of Tropospheric propagation was discussed in *Long-Distance Television*, January 1972.

From Our Correspondents

A very full bag this time. Garry Smith of Derby has returned from Switzerland with useful information (see above). His return coincided with improved tropes which enabled him to receive Dublin ch.B7 (a new country for him), Sweden E8 and Denmark E5, 8, and 10. Geoffrey Chapman of Blandford, Dorset has sent a photograph of the "CS U 01" Czechoslovakian pattern but with an alternative identification. This carried (on ch.R2) the inscription "02 K8". This is the third identification noted with this pattern.

From the USA we hear that veteran TV DX enthusiast Bob Cooper of Oklahoma is constructing a new aerial system, having recently moved. Preparations are well advanced for three towers which will be 160, 140 and 100ft. high. These will be arranged in triangular formation some 20ft. apart, with solid platforms at 50 and 100ft. An equipment building will be constructed at 50ft. We hope when this structure is complete and a photograph is available to publish it since this must be the World's most elaborate TV DX aerial structure!

THE 'TELEVISION' COLOUR RECEIVER

PART 7

CABINET CONSTRUCTION

ONE frequent request has been that details of the cabinet construction be brought forward. There seem to be two basic reasons: first that because of delays in the delivery of Component-Packs some readers have not been able to keep up with the electronics; secondly that a large number of garages, garden sheds and workshops appear to be unheated and their owners do not fancy cabinet construction around Christmas time! These are sound enough reasons so this month we are dealing with the cabinet.

The arrangement to be described is that used in the prototype and we emphasise at the outset that construction is quite straightforward. The author is not a cabinet-maker and indeed finds even a simple shelf rather an ordeal! The principle adopted in the design therefore was "if I can do it then anybody can"! Those of our readers who are more proficient at woodworking may prefer to modify the design or use different joints etc. That's up to them but the basic dimensions are laid down by the electrical components to be incorporated; also no course should be adopted that leads to a weaker cabinet (colour tubes are heavy—and expensive!).

Tube and Shield

Before you start you must decide on the tube size. The prototype is fitted with a 22in. Mazda tube and we feel that this size is likely to be the most popular. Any of the current 90° shadowmask tubes can however be employed—that is basically 19, 22, 25 and 26in.

We have been assured that there will be little or no difficulty in meeting the demands of readers of the magazine for tubes but we feel we should urge constructors to obtain their tube before starting cabinet construction just in case they are forced to use for example a 25in. tube rather than a 26in. one.

You must also decide whether your budget allows a new tube and whether in fact the additional outlay is worth while. There is no reason why a rebuilt tube should not be as good as a new one and also no reason why a rebuilt tube should not be guaranteed for the same period of time—usually four years. We would emphasise that a *rebuilt tube* is not the same as a *regunned tube*—the latter involves a lesser amount of work and will generally be at a lower cost. We have no experience of regunned colour tubes.

Whatever your decision you will find a number of suppliers advertising in the magazine. It's a large purchase and therefore worth taking your time over.

If a particular advertised tube seems attractive but you feel that insufficient information is given don't be afraid to ask the advertiser for further information. Be careful that the price quoted for a rebuild does not take into account a deduction for old glass being supplied. The difference in price may often be £7.50. There may also be quite large differences in the carriage charges involved in the supply of tubes and this should be taken into account.

If you have a very limited budget you might consider the possibility of using a faulty tube—often the fault is no more than a few missing phosphor dots or face scratches and these may have only a very small visual effect. But before you buy make sure you understand from the supplier what the fault is. There is no reason why the tube should not be guaranteed apart from the named fault condition.

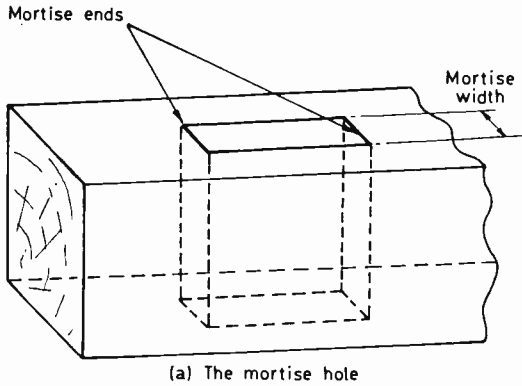
Once you have decided on the tube size the problem of obtaining a screening shield arises. Because of the number of tube sizes the suppliers listed cannot guarantee immediate delivery on receipt of an order. An ordering system which enables you to book a shield in advance has therefore been arranged. The shield will be supplied complete with earthing springs and lugs on to which the degaussing coil can be fitted. The suppliers are Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk, and they suggest a deposit of £1.00 for each shield ordered. Make clear which size tube you are using and enclose *two* stamped and addressed envelopes. The first will be used to acknowledge your order and the second will be used later to advise you that the shield is ready for delivery on receipt of the balance of your payment. Although this process may seem tedious it will give maximum efficiency and help to keep the supplier's costs—and therefore the price to you—down.

The maximum price of the shield (including springs) and postage will be £2.60.

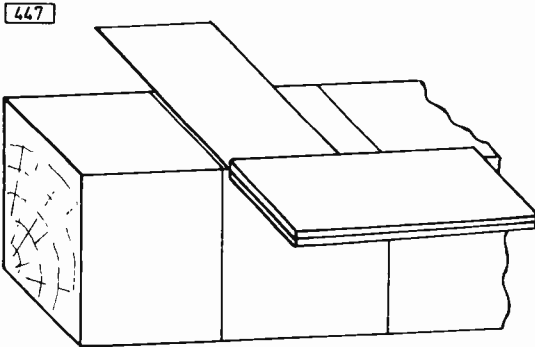
Basic Cabinet Requirements

The cabinet design is based on using a timber frame rather than proprietary boards. This decision will be obvious to those who have tried using this type of board for cabinet work: unless the lengths and angles are cut extremely accurately the whole assembly can be very weak. A timber frame makes the cabinet a little heavier but the important thing is that the tube is held solidly in place.

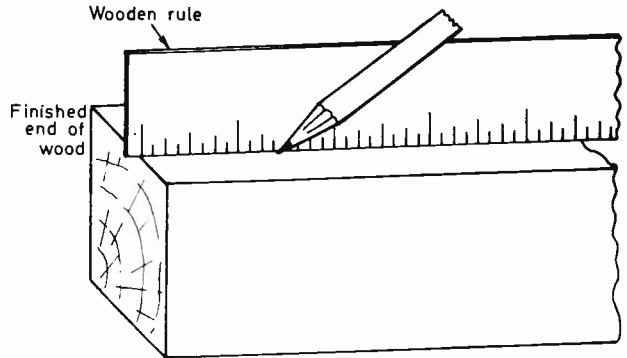
Other points to consider are that the receiver should stand at a comfortable height for viewing and that the size must be adequate to accommodate all the electrical sections. The limitations on the



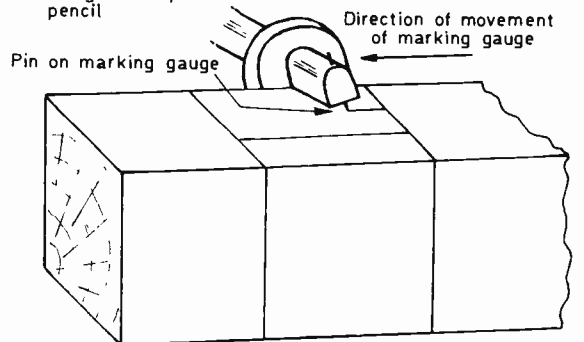
(a) The mortise hole



(c) Mark around wood at both ends of mortise using square and marking scribe or sharp pencil



(b) Mark off the mortise ends from finished end of wood using a sharp pencil



(d) Use marking gauge to scribe edges of mortise on both sides of the wood

Fig. 1: Marking off the mortise.

arrangement of the front of the receiver are the tube and its mounting brackets, the loudspeaker and the user controls.

There is also a slightly unusual feature in our design, a convergence drawer which pulls out at the front. This forms a bar across the whole width of the receiver beneath the tube—see photograph.

One of the nicest features of the newer 19, 22 and 26in. shadowmask tubes is the more pleasing aspect ratio created by the squared-off corners; also the push-through presentation so that a plastic mask is not required. Such masks are an additional expense, a great nuisance to fit and all too easily broken. They are also difficult to obtain.

The depth of the cabinet could be either sufficient to house the overall length of the tube or shorter with the end of the tube in a convex bulb on the rear cover. Bulbs of this sort present problems for the home constructor. However it is provided it must in order to offer the tube neck reasonable protection be strong enough to withstand a fairly hefty clout. This is only really possible using a single mould but the cost of providing a relatively small number by injection moulding for example is quite daunting. We decided therefore to make the cabinet depth greater than the length of the tube. This results in a cabinet depth of only 20in. for a 22in. tube so we doubt whether there will be too many objections.

Types of Joint Used

In order not to confuse the cabinet construction details we will first run over the three types of joint

used in the prototype cabinet: experienced cabinet makers can skip the next few paragraphs. The three joints used are the mortise and tenon, a form of lap joint and a dowelled joint.

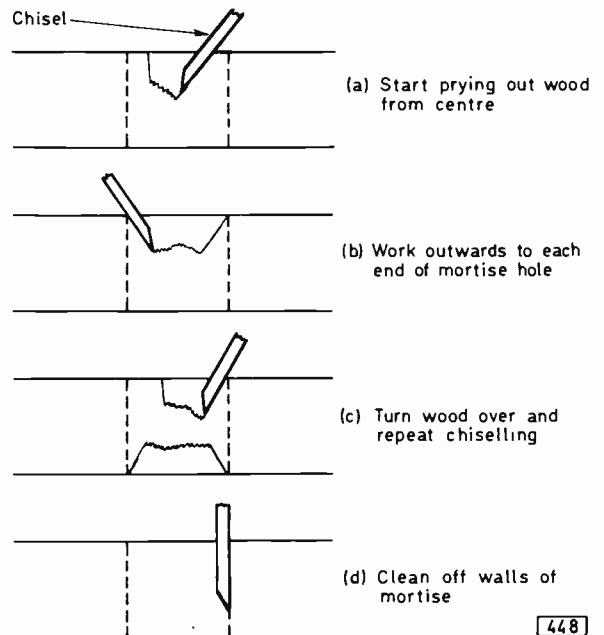


Fig. 2: Chiselling out the mortise.

The mortise and tenon is used to make a strong joint when one piece of wood meets another at right angles somewhere along its length. There is a number of slightly different versions of this joint, the one suggested being reasonably simple with no shoulders on the tenon. The mortise—see Fig. 1(a)—is a rectangular hole cut through the wood, the longer side of the hole being parallel with the length of the wood. The mortise width is about one-third the width of the wood.

To make the mortise first measure off the positions of the ends of the mortise from a finished end of the wood—see Fig. 1(b)—using a carpenter's wood rule (note: this is not the place to use a plastic ruler) and a sharp, hard pencil. Rule all round the wood from there using a square—Fig. 1(c)—so that there are two complete lines around the wood. The reason for completing the lines right back to the starting point is that this gives a good idea of the accuracy of the marking and a check on the squareness of the wood.

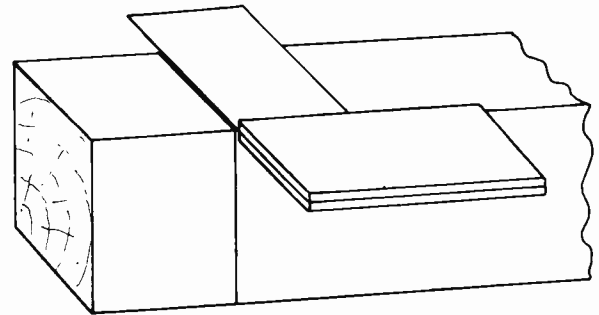
Now set a marking gauge—Fig. 1(d)—to a dimension equal to one-third of the width of the wood and mark off the edges of the mortise on both sides of the wood. Use the same setting of the gauge from opposite edges of the wood in order to mark the mortise and don't upset the setting just at the moment because the same setting will be used for the tenon. Always make sure that the shoulder of the marking gauge is pressed hard against the wood edge when marking off, and drag the pin across the surface of the wood rather than pushing it in the same direction of motion—otherwise the wood grain will beat you and you will end up with a wavy line.

The mortise must now be beaten out and it is conventional to do this using a chisel and mallet or hammer. Use a chisel of about the same width as the hole but no wider. Mark off the edge of the hole on both sides of the wood with the chisel, using hand pressure. Always have the back edge of the chisel (i.e. the completely flat side) facing the wood that is to remain. Now start to remove wood from the centre of the mortise, not being too greedy or fast and not using too shallow an angle of cut (Fig. 2). Hammer in the chisel and pry out a piece of wood and repeat in that way. Work out towards the ends of the mortise taking care not to damage the ends with the back of the chisel. Turn over the wood and pry out wood from that side as well in the same way. Finally clean up the walls of the mortise with the chisel vertical.

Now the tenon part of the joint: mark off from the end of the wood the width of the piece that the tenon is going into (Fig. 3). Use a square and scribe to mark round the wood the length of the tenon. Then, using the marking gauge already set for the mortise, mark off the thickness of the tenon. Mark from one side around to the other. Saw down the "cheeks" of the tenon and then the shoulders. Remember that when you saw there is wastage caused by the cut itself: this waste *must* be on the wood being removed otherwise the tenon will not be wide enough and the joint will be slack.

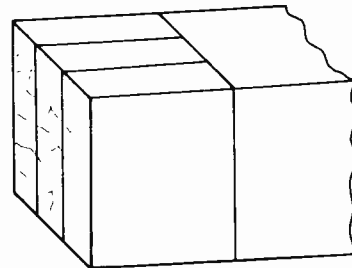
A full mortise and tenon joint would add extra shoulders on the tenon but the additional complication of the slightly improved joint is not necessary on this project.

The dowelled joint is necessary at the top cross-members where three pieces of wood meet orthogon-

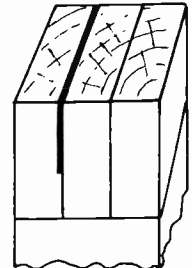


(a) Mark off length of tenon and square around wood

449



(b) Mark off width of tenon using marking gauge and saw down width of tenon (cheeks) and shoulders



(c) Remember to saw so that the wastage caused by the saw is on the piece being removed

Fig. 3: Making the tenon.

ally. It is the kind of joint favoured at the top of chair legs. The basic idea is shown in Fig. 4(a). The dowel-pins securely hold the pieces of wood together, the pins being inserted in holes of the same diameter in the two wood pieces to be connected.

Table 1: Stock Required for Cabinet Frame

$1\frac{1}{2} \times 1\frac{1}{2}$ in. timber:	4 lengths of 29in.* 2 lengths of $25\frac{1}{2}$ in.* 2 lengths of 17in.* 2 lengths of $28\frac{3}{8}$ in.* 2 lengths of $19\frac{3}{8}$ in.*
$1\frac{1}{2} \times 1$ in. timber:	2 lengths of $18\frac{1}{8}$ in.* 1 length of $19\frac{3}{8}$ in.*
3 x 1 in. timber:	1 length of $28\frac{3}{8}$ in.*
Dowelling:	16in. of $\frac{1}{4}$ in. diameter

Evostik Resin W

4 carriage bolts of at least 2in. length which *must* be threaded the full length. Threaded part of bolt to be $\frac{3}{8}$ in. diameter.

8 oversize flat metal washers for above

4 correct flat metal washers for above

8 full nuts for above.

4 machine bolts with $\frac{3}{8}$ in. diameter shaft, hexagonal heads and at least $1\frac{1}{2}$ in. length.

4 flat metal washers for above

4 full nuts for above.

$9\frac{3}{8}$ in. of 10 or 12 s.w.g. flat metal strip 1in. wide.

Note: Timber merchants generally supply and charge for lengths of timber to the nearest foot.

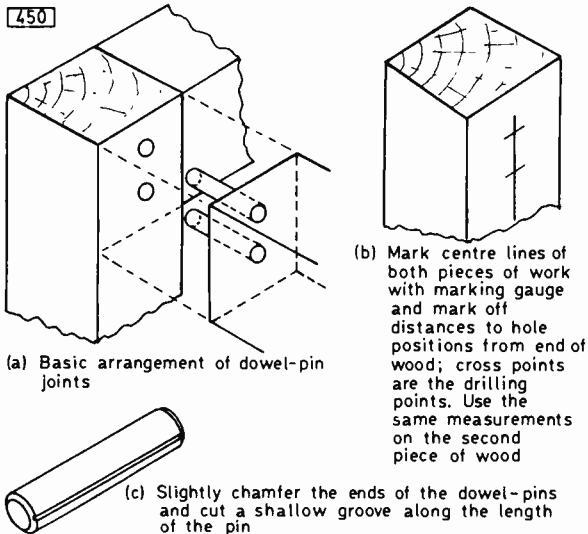


Fig. 4: Dowel-pin jointing.

The important things to remember when making a dowel-pin joint are that the dowel-pin should be a little shorter than the total depth of the holes in the two pieces of wood, that the holes must be accurately located on both pieces and that the holes are drilled vertically into the wood.

First mark the centre lines—see Fig. 4(b)—on both pieces of wood and measure off the positions of the hole centres—usually $\frac{1}{3}$ and $\frac{2}{3}$ of the height of the wood mating into the vertical. Drill your dowel-pin holes at the cross-points on your marking lines, being very careful to make them vertical—dowelling jigs are made to ensure this but would seem an unnecessary expense unless you are going into this very seriously in the future.

Drill the holes to the correct depth for the work: in the case of the prototype 1in. long dowel-pins were used with $\frac{1}{8}$ in. holes drilled in both pieces of wood. This gives $\frac{1}{4}$ in. tolerance of clearance at the ends of the holes for glue clearance later. To judge the depth of the hole being drilled you can use either a depth gauge clamped to the bit or a piece of Sello-tape fastened around the bit at the right point.

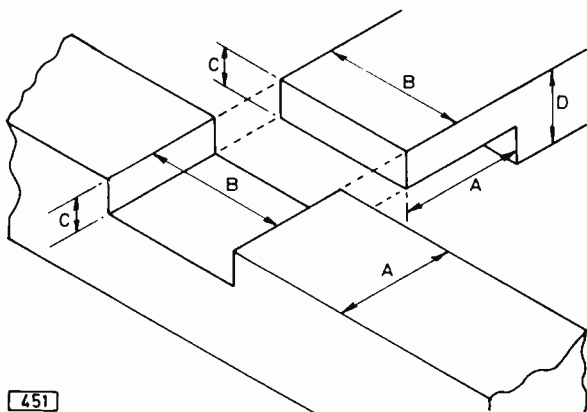


Fig. 5: Middle lap joint used in the receiver—note which dimensions are equal.

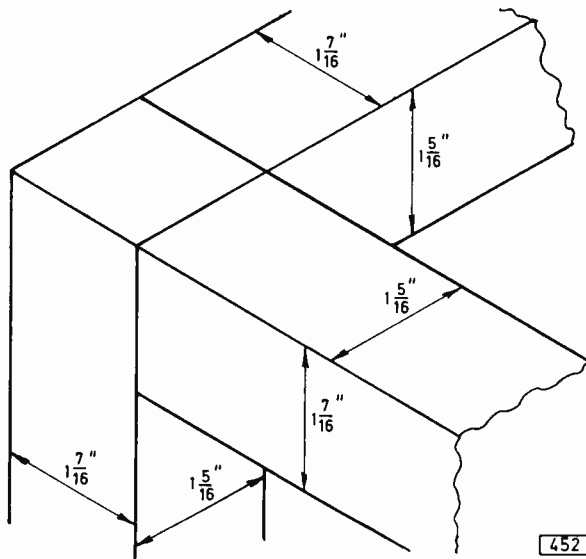


Fig. 6: Top left-hand corner of the cabinet, showing choice of lay of the timber dimensions for correct matching.

The dowel-pins— $\frac{1}{4}$ in. dowelling was used in the prototype—are cut off to the length wanted—say 1in. as noted above—and to allow the free escape of excess glue when the joint is finally completed it is wise to chamfer the ends of the pin very slightly and mark off with a knife a shallow groove along the length—see Fig. 4(c).

The half-lap joints used in the receiver appear only where there is little or no stress on the jointed section. The construction is shown in Fig. 5 and the procedure should by now be obvious. The material taken from the larger piece of wood is removed by chisel and it is both important and quite difficult to do this accurately. If you undercut too far the lap will not lie evenly, if you don't cut far enough the lap will not be smooth along the top surface. It is difficult because you will be chiselling against the grain of the wood which will tend to tear rather than cut. Using a decent tool you should find that you need only the ball of your hand against the chisel in order to do the job efficiently.

Constructing the Cabinet

All dimensions given in the text and in the diagrams marked with an asterisk (*) are for a 22in. tube receiver. For other sizes see Table 2.

Ready-planed hardwood was used throughout the prototype. No special care was taken in the choice of wood except to make sure that it was not badly warped and that there were no splits in it. Lengths were obtained in all cases slightly longer than needed so that they could be cut so that knots did not appear right at the end of a length or at a joint position. We make no excuse for using Imperial measurements throughout since the vast majority of people aren't equipped with carpenter's rules in metric or metric drill sizes.

Note that although the wood dimensions are given to the nearest half inch a piece of wood nominally $1\frac{1}{2}$ in. x $1\frac{1}{2}$ in. for example will in fact measure some-

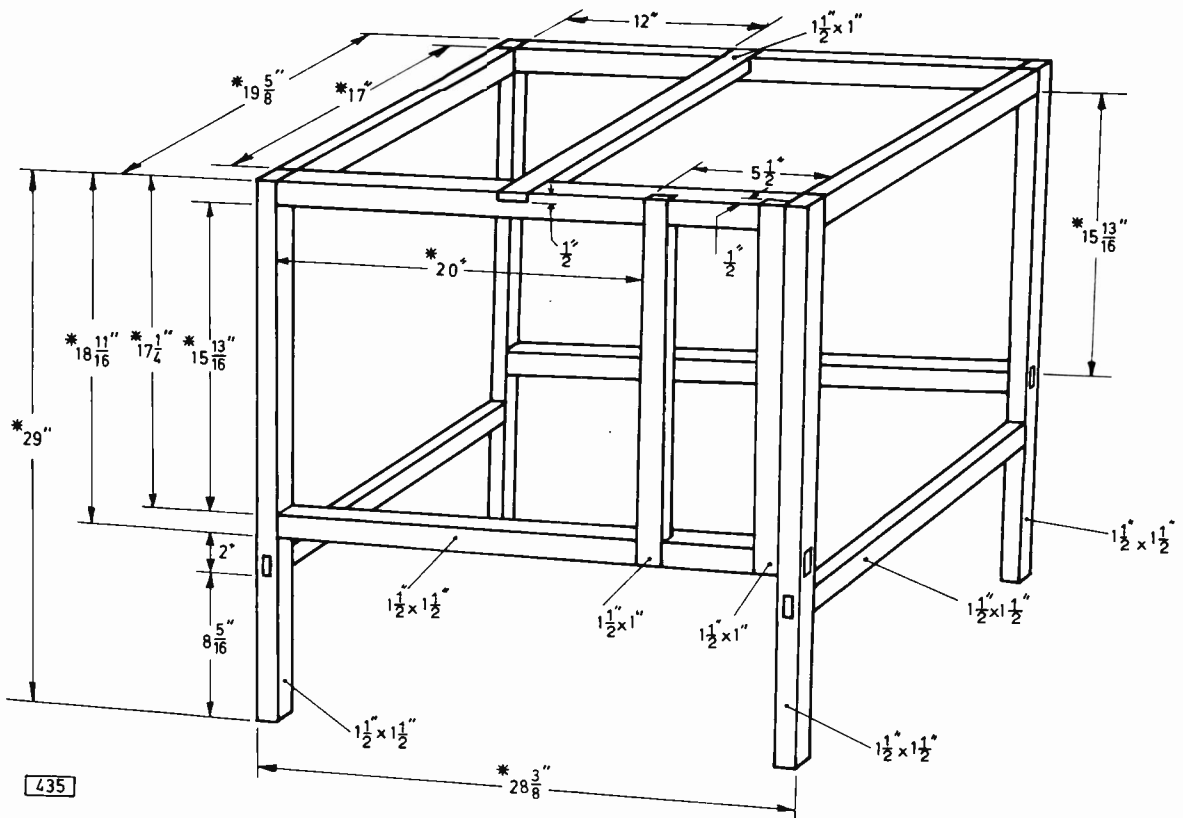


Fig. 7: The main frame of the cabinet. The dimensions given are those for use with a 22in. tube; for modification data for other tube sizes (dimensions marked*) see Table 2. Note that the timber dimensions are nominal: larger widths are forward facing (as shown in Fig. 6) and the actual dimensions (widths) are assumed to be $1\frac{7}{8}$ x $1\frac{7}{8}$ for $1\frac{1}{2}$ x $1\frac{1}{2}$ in. stock.

thing like $1\frac{7}{8}$ in. x $1\frac{7}{8}$ in. because of the surface removal by planing. A rule must be chosen and kept to so that pieces match up correctly: for the prototype the wider dimension—for example $1\frac{7}{8}$ —faces forward and on a front-to-back run of timber this means that the same dimension must be horizontal (see Fig. 6).

The basic frame arrangement of timber in the receiver is shown in Fig. 7. All eight joints at the four top corners are dowel-pin. The lower mating joints are mortise and tenon, the two vertical struts on the front are half-lapped and so is the front-to-back strut across the top of the receiver. These struts perform important functions: the two vertical ones support the forward facing loudspeaker and the control-knob panel—to be described later—and the horizontal strut across the top of the cabinet gives the cladding to be added at the top a very rigid surface so that it neither warps up nor is it easily bent down—even when sitting on the top!

First cut four accurate 29in.* lengths of $1\frac{1}{2}$ x $1\frac{1}{2}$ in. timber for the four verticals. Note the wider dimensions of the wood and mark two of these as “fronts”—one “left front”, one “right front”—and the other two as “rears”—again one “left”, the other “right”. Pencil the markings on the forward-facing sides of each of the pieces and make the markings clear.

On the front left vertical mark off dowelling holes at the top—as already described—on the back and to the right. Move down from the top of the vertical

by $17\frac{1}{4}$ in.* which will be the top of the mortise of the horizontal, lower bar at the front. Measure off a $1\frac{7}{8}$ in. mortise hole left to right through the wood and from the bottom of this mortise move down a further 2in. to locate the *bottom* of the second mortise—in this case for the front-to-back horizontal bar.

Repeat the process for the “rear left” and the other verticals, noting of course the different sides at which the dowel-pin joints are made in each case.

On the four verticals—marked out you can now drill 16 dowel holes (4 on each vertical) and hammer out the eight mortises with a chisel. After this check the dimensions of the cut pieces that you have. If any error does exist don't be afraid to put the piece of timber on one side and start that vertical again—it might well be cheaper in the end.

Accurately cut two pieces of $1\frac{1}{2}$ x $1\frac{1}{2}$ in. stock each of $28\frac{3}{8}$ in.*; identify the standard horizontal and vertical dimensions of each (Fig. 6) and clearly mark the pieces on the forward faces as “front lower horizontal” and “rear lower horizontal”. On the rear piece mark off a tenon $1\frac{7}{8}$ in. from the end at each end (note that the tenons are all vertical) and saw the two tenons.

On the front piece do exactly the same thing and then in addition mark off a half-lap 20in.* from the *end of the left-hand tenon* and on the forward edge of the wood. Make the half-lap $\frac{1}{2}$ in. deep and $1\frac{7}{8}$ in. wide (so as to suit the nominally 1 x $1\frac{1}{2}$ in. vertical

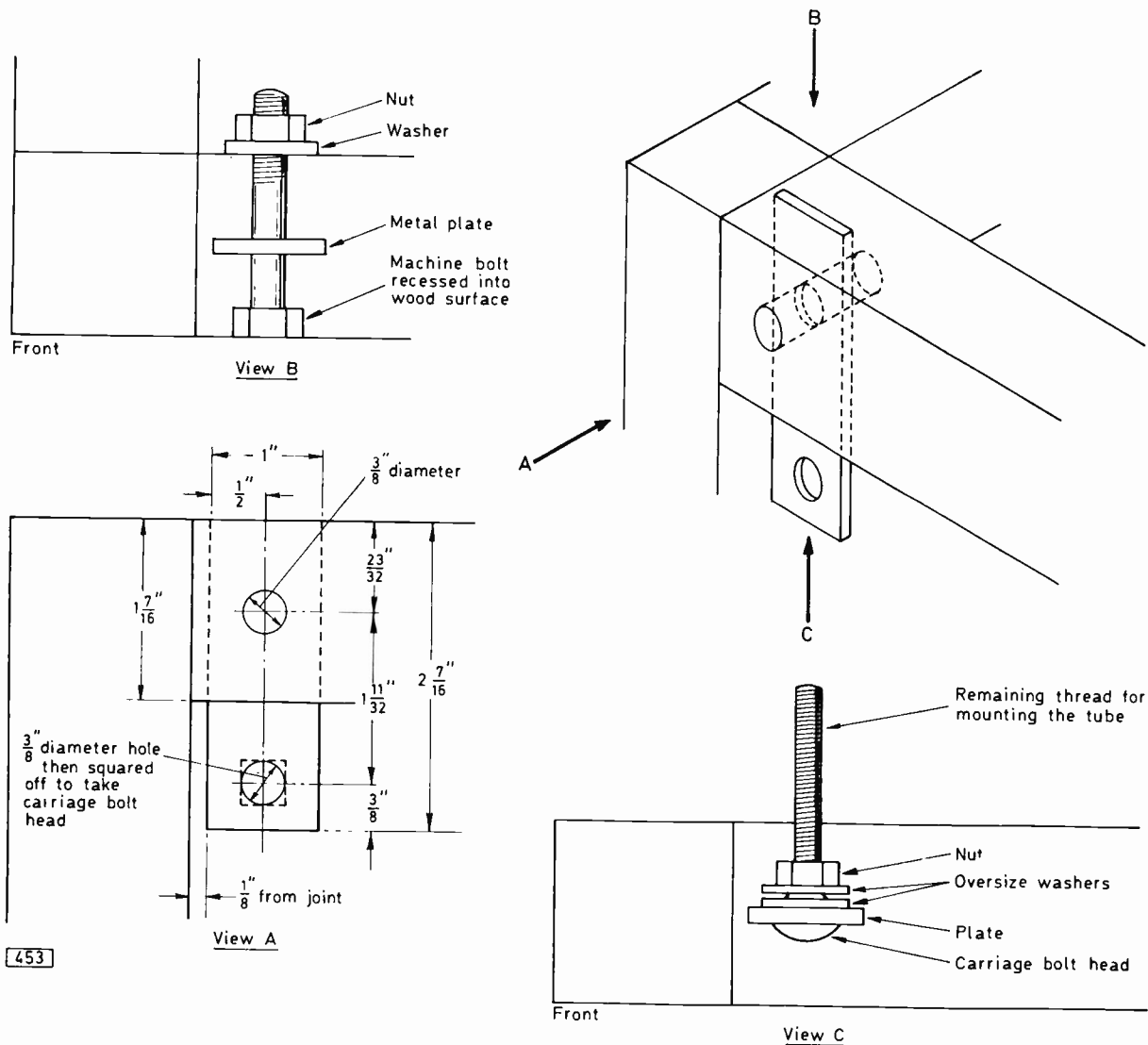


Fig. 8: Tube mounting arrangement: top left-hand corner shown.

struts). Put another half-lap also on the front edge right up to the start of the right-hand tenon—using the same dimensions as before.

Now cut two $1\frac{1}{2} \times 1\frac{1}{2}$ in. lengths of timber of exactly $19\frac{3}{8}$ in.* for the lower side pieces of the frame. Mark these on the top surface as "left side lower" and "right side lower": the $1\frac{1}{16}$ in. dimension will of course be the horizontal side of the timber. Mark off and saw tenons on each end of both pieces of $1\frac{1}{16}$ in. for all.

Move up to the top pieces now. Cut the side pieces first, two lengths of $1\frac{1}{2} \times 1\frac{1}{2}$ in. again each cut to exactly 17 in.*. Mark off and drill dowel holes on the ends of each; again making sure that the horizontal side of the wood is the $1\frac{1}{16}$ in. dimension. Don't forget to clearly mark the pieces as "left side upper" and "right side upper" and as for the other side pieces put your markings on the upper surfaces.

For the upper horizontals cut off two accurate lengths of $25\frac{1}{2}$ in.* $1\frac{1}{2} \times 1\frac{1}{2}$ in. stock. Here the forward-facing surfaces will be the $1\frac{1}{16}$ in. dimen-

sions. Mark the pieces—on the front surfaces—as "rear upper horizontal" and "front upper horizontal". The rear piece should have dowel holes marked and drilled in each end and 12 in. from the left-hand end put a $\frac{1}{2}$ in. deep, $1\frac{1}{16}$ in. wide half-lap.

For the front piece do exactly the same thing except additionally put half-laps of the same dimensions on the forward-face of the wood at 20 in.* from the left-hand end and fully up to the right-hand end of the piece.

We are now left with only the horizontal and two vertical struts. For the horizontal one cut an accurate $19\frac{3}{8}$ in.* length of $1\frac{1}{2} \times 1$ in. timber and saw out half-laps at each end both of $1\frac{1}{16}$ in. length and $\frac{1}{2}$ in. remaining wood. Note that this is slightly more than half the depth of the stock.

The vertical struts are made in an almost identical manner except that the overall length of the pieces should be $18\frac{1}{8}$ in.* and the half-laps will be $1\frac{1}{16}$ in. long.

Cut off 16 in. lengths of dowel and chamfer and

score each as indicated earlier.

You are now ready to dry assemble the whole frame of the receiver. All the joints should be tight but not impossible to assemble. If there is any excessive tautness on any joint ease it slightly by removing wood from the correct place. Take this process easy—should it be necessary at all—because an almost perfect joint can be easily ruined by pairing off just a little too much wood or removing it from the wrong place. If you are happy with all the joints check with a spirit level that the horizontal surfaces are horizontal—quite obviously the frame must be standing on a flat surface for this check!

Glueing Up

A rather frightening mystique exists among cabinet makers about glue. Each professional seems to have his own recipe continuously bubbling away on a gasring in the corner of his workshop. Fortunately for the home constructor these mysterious processes are no longer essential: a wood glue such as Evostik Resin W can be used with ease and complete confidence.

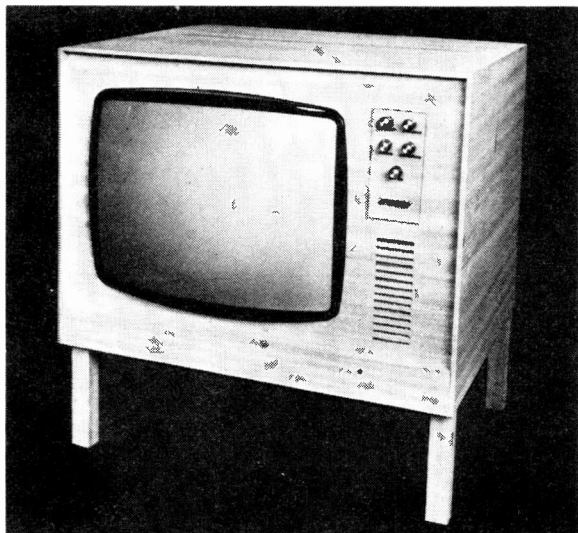
The expert will also insist that the chassis is glued up in sections—a complete left-hand side and then a complete right-hand side, then a period of waiting and a final glueing session with the side pieces and the horizontals between them. The problem as seen by the author is that it is much more difficult to judge the squareness of one section than it is of the whole frame: we therefore suggest one massive glueing operation.

Have ready all the pieces of timber laid out in a reasonable order so that they can be picked out and put in the correct position immediately they are wanted. Also have ready a dozen ten-foot lengths of stout string or cord. We would also suggest that you don't do the glueing on the lounge carpet!

Start on one side frame using an over indulgent amount of glue on each piece of wood. Put glue into the dowel holes until it is almost coming out of the holes and give both the mortise and tenon part of each joint a coating of glue. Very quickly repeat the process on the second side not bothering too much with squaring the first side before moving on.

Then move on to the front and rear horizontals—forgetting the struts for the time being—until the whole frame is standing fairly rigidly by itself. Now square off the sides and the front, easing joints into place so that no gaps are left anywhere. Check horizontals and verticals with your spirit level.

If the assembly has been well made you need do little else: the frame will harden in place by itself in about 24 hours provided it is untouched. If any of the joints are dodgy or try to force themselves apart—particularly the dowel-pin joints if you haven't scored the length of the dowels properly—then the string may be needed to tie up the verticals to one another to keep the whole thing square. Before leaving the work to harden clean off with a rag all the excess glue that can be seen dripping around. Don't be too fussy at this stage because any glue that does harden can always be removed with a knife or even sanded off. Make a final check on the squareness of the frame and leave for 24 hours.



The finished cabinet of the prototype receiver.

When the frame has hardened glue the struts in their correct positions. For a satisfactory result here you will almost certainly have to use a clamp at each end (such as a C clamp if available) or tie the ends up very tightly with string. After the struts have hardened check the surfaces around the joints for smoothness and sandpaper or slightly plane down if necessary so that the top, the sides and the front offer a flat mounting surface for the cladding.

Tube Mounting Points

Considerable thought was given to the question of mounting the tube in the cabinet in a safe and reasonably simple way. The idea is to use the strength of the frame in a way that is most economic.

Figure 8 shows one of the mounting points—the one for the top left-hand corner of the tube. A flat metal plate drilled correctly is inserted through the top timber and bolted up. The bottom hole carries the mounting bolt for the tube. The same system is used at the other three mounting corners of the tube. In each case the plate is mounted so that its centre line is $\frac{3}{8}$ in. away from the nearest vertical (the first strut forms the right-hand vertical). Using 1 in. wide plate this means that the edge of the plate is $\frac{1}{8}$ in. away from the vertical in each case.

Each of the plates in the prototype was of 10 s.w.g. and was in fact copper bar that was redundant from a heavy lightning conductor earthing path. A total length of $9\frac{1}{2}$ in. is needed (4 off $2\frac{1}{16}$ in.). This kind of material can probably be picked up in a local scrap yard for 20 or 30p. With the length cut accurately to $2\frac{1}{16}$ in. (using a hacksaw) two holes are drilled on the centre line, both of $\frac{3}{8}$ in. diameter, one $23/32$ in. from one end and the other $\frac{1}{8}$ in. from the other end. The second hole is then squared off with a needle file to take the shank of a carriage bolt whose shank should also be $\frac{3}{8}$ in. diameter.

Four such carriage bolts will be needed and all should be at least 2 in. in length and *must be threaded right up to the carriage head*. With the bolt in the square hole some of the carriage end will still be visible at the back of the plate. Two oversize flat

Table 2: Dimension Modifications for Tube Sizes other than 22in.

Where the 22in. tube dimension appears as:	replace for 19in. by:	for 25in.	for 26in.
15 $\frac{1}{8}$ "	14 $\frac{1}{2}$ "	17 $\frac{1}{4}$ "	17 $\frac{3}{8}$ "
17	16	19	19
17 $\frac{1}{4}$ "	15 $\frac{3}{8}$ "	18 $\frac{7}{8}$ "	19 $\frac{3}{8}$ "
18 $\frac{1}{4}$ "	17 $\frac{3}{8}$ "	20 $\frac{1}{4}$ "	20 $\frac{3}{8}$ "
19 $\frac{3}{8}$ "	18 $\frac{3}{8}$ "	21 $\frac{3}{8}$ "	21 $\frac{3}{8}$ "
20	17 $\frac{1}{2}$ "	21 $\frac{1}{2}$ "	22 $\frac{7}{8}$ "
28 $\frac{3}{8}$ "	25 $\frac{7}{8}$ "	29 $\frac{3}{8}$ "	31 $\frac{1}{4}$ "
29	27 $\frac{1}{2}$ "	30 $\frac{3}{8}$ "	31 $\frac{3}{8}$ "

All dimensions in inches.

metal washers—see Fig. 8 view C—should cover this up: tighten a nut down on the washers from the back. This provides a fixed mounting point for the tube which can itself be tightened down later with a further nut on to what is then a fixed "stud". This kind of system must be provided to allow some flexibility in the position of the tube and because the front side of the mount will be inaccessible once the front cladding has been attached.

To accommodate the flat strips a rectangular hole must be cut through the horizontal timber in each of the four spots where it is required. If as in the prototype 10 s.w.g. metal is used—we would not advise the use of anything thinner than 14 s.w.g.—these holes can be formed by drilling a line of $\frac{1}{4}$ in. holes along the centre line on the top surface. The hole can then be cleaned up using a flat needle file.

With a $\frac{1}{4}$ in. diameter hole drilled along the centre line position of the strip and half-way down the front-face a machine bolt can be passed through both the wood and the metal strip and a washer and nut used to tighten up and hold the strip in place—see Fig. 8 view B. The heads of the four machine bolts must *not* protrude from the surface. You will therefore have to shape the front ends of the holes to the hexagonal shape of the bolt heads so that the bolts recess themselves into the wood.

Both the machine bolts and the carriage bolts used for the mounting process have $\frac{1}{8}$ in. diameter shafts. We have not quoted a nominal head dimension for the carriage bolt because there appears to be no standard method of doing this while the title of the machine bolt will depend on the thread used and this is unimportant for the project. So take along a rule when you buy the bolts to make sure you are buying what you need.

The mounting lugs with the tube mounting bolts

in position *must* be in place before the outer surface of the receiver is clad. Check that the distances between all the bolts are correct (Table 3).

Convergence Drawer

We will discuss the contents and the make-up of the convergence drawer subsequently but because the drawer forms part of the cabinet we must consider here the front surface of the drawer. In the prototype this was formed with nominal 3 x 1in. stock and the length was cut to just $\frac{1}{8}$ in. shorter than the overall width of the receiver frame (i.e. $28\frac{1}{8}$ "*— $\frac{1}{8}$ in.). This piece of wood should be finished off in the same way that you choose for the rest of the cabinet.

Cabinet Cladding

The prototype receiver was clad using 6mm. hardboard. Four pieces are required: for the top, the two sides and the front of the cabinet—we will discuss the back and the bottom in a future issue.

To make the cabinet appearance more interesting and to match the depth of the convergence drawer front an overhang of 1in. was put on the top and the sides of the cabinet cladding. The side covering was taken down to the lower limit of the convergence drawer front which is also the bottom of the side rails (all dimensions are shown in Table 4).

The prototype was veneered so the cladding was both pinned and glued in place. If you want to avoid veneering—as you will if you have any sense!—the cladding should be either only glued in place or most carefully pinned in just a few selected places as well, the pins being punched below the surface and the small holes filled before staining and polishing.

Because of the overhang the cladding for the front panel is fitted first. This has to be accurately cut for the push-through presentation of the tube face and for the control spindles, loudspeaker, etc. Note that the hardboard for the front panel goes down as far as the bottom of the lower front horizontal timber.

Two masters will be available from the magazine offices to cover the two areas of necessarily accurate cutting because we feel that a full-scale drawing is absolutely essential. The first master is for the tube face cut-out and covers the four tube sizes 19, 22, 25 and 26in., using the top left-hand corner as reference. This is available for 10p. The second master is for the control panel and loudspeaker

Table 3: Tube Mounting Bolt Positions

	19in.	22in.	25in.	26in.
Horizontal distance between bolts	16 $\frac{1}{4}$ "	18 $\frac{3}{8}$ "	20 $\frac{1}{2}$ "	21 $\frac{3}{8}$ "
Vertical distance between bolts	13 $\frac{1}{2}$ "	14 $\frac{1}{4}$ "	16 $\frac{3}{8}$ "	16 $\frac{3}{8}$ "

All dimensions in inches.

Table 4: Hardboard Cladding Dimensions
(allowing for 1in. overhang at front edge of top and sides)

Tube size:	19in.	22in.	25in.	26in.
top:	25 $\frac{7}{8}$ x 19 $\frac{3}{8}$	28 $\frac{3}{8}$ x 20 $\frac{3}{8}$	29 $\frac{1}{2}$ x 22 $\frac{3}{8}$	31 $\frac{1}{4}$ x 22 $\frac{3}{8}$
sides (two required):	19 $\frac{3}{8}$ x 19 $\frac{3}{8}$	20 $\frac{3}{8}$ x 20 $\frac{1}{4}$	22 $\frac{3}{8}$ x 22 $\frac{1}{4}$	22 $\frac{3}{8}$ x 22 $\frac{3}{8}$
front:	25 $\frac{7}{8}$ x 17 $\frac{3}{8}$	28 $\frac{3}{8}$ x 18 $\frac{1}{4}$	29 $\frac{1}{2}$ x 20 $\frac{1}{4}$	31 $\frac{1}{4}$ x 20 $\frac{3}{8}$

All dimensions in inches.

cut-out frets and is again marked for the four tube sizes. This is available from the magazine for 5p.

The masters should be fixed flat on the front panel hardboard—already cut to the right size (Table 4) and the cut-out shapes and control spindle drilling holes etc. marked through.

To cut out the tube face plate shape, a small hole should be drilled in the part of the board that is going to be removed and a pad-saw or key-hole saw used to cut around the marked edge. The accuracy of the cut should be better than $\frac{1}{16}$ in. if it is not to be visible from the front. In order not to tear the hardboard the blade used in the saw should have a large number of teeth per inch. If this isn't available—and they don't seem to be generally—use a hacksaw blade mounted temporarily in the pad-saw handle.

The loudspeaker frets are cut out in the same way: this is an extremely tedious job. The markings given for the tuner control panel apply to one particular unit (Component-Pack No. 15).

Layout Error

The print connection between point 3F (B output) and the junction of L201/D201/Tr207 collector is missing in our illustration of the RGB board layout—Fig. 6, page 449, August issue. We have checked and found that the boards supplied by E. J. Papworth & Son Ltd., also Manor Supplies, are correct; also most of the print patterns sent out to readers for home board construction were corrected. Those making their own boards or obtaining them from any other source should however check this point.

Component-Packs

The following component-packs are now available and readers may care to order them in advance for later complete receiver assembly.

Component-Pack 14

Line output transformer (Mullard AT2055 or equivalent), e.h.t. tripler unit (ITT type TS25—version to have 18in. e.h.t. lead with other leads 12in.) and focus assembly (Erie focus potentiometer with suitable Pressac connectors supplied).

Supplier: Forgestone Components, Low Street, Ketteringham, Wymondham, Norfolk.
Price: £9.60 including post and packing.

Line output transformers as wound for the prototype are available from E. J. Papworth & Son Ltd., 80 Merton High Street, London SW19 at £5.25 including post and packing.

Manor Supplies can supply Mullard line output transformers and e.h.t. triplers (mainly Mullard type LP1174-10 which are suitable except that the mounting leads are rather shorter). Present prices: transformer £3.25, tripler £4.75, 25p post and packing. Check monthly adverts for latest prices.

Component-Pack 15

Varactor tuner control unit. The front panel master layout now available (see earlier in article) is based on the use of this particular tuner control

panel which incorporates switches and potentiometers for controlling the varactor tuner to be recommended for use with this receiver. It is essential therefore to obtain this control panel before cutting the receiver front panel if the recommended tuner is going to be used.

Supplier: Manor Supplies, 64 Golders Manor Drive, London NW11 (mail order address).
Price: £2.05 including post and packing.

When ordering Component-Pack No. 15 readers should state on the order that the unit is the one intended for use with the TELEVISION Colour Receiver: although the price is the same this is not the same unit as the one (see *Renovating the Rentals* this month) sold by Manor Supplies to replace conventional u.h.f. push-button assemblies when converting a receiver to use a varactor (varicap) tuner unit.

RECEIVER-MONITOR CONVERSION

—continued from page 555

through. A single-edged razor is suitable for this purpose. The circuitry of the set used (Philips Style 70 chassis) is shown in Fig. 2. S6 and S7 are part of the 405-625 system switch. Note that on this chassis the video input to the pentode is the same on both systems, i.e. the bias on the output valve is not varied from one standard to the other. The signal is direct coupled on 405 and a.c. coupled via C249 on 625 with d.c. restoration by means of X205. The connections carrying video signals should be of screened cable, earthed at one end only to save earth loop problems.

Setting up is quite easy. Using a scope, adjust VR2 to give the required output level across 75 Ω . Then couple this to the input, observe the picture and adjust VR1 to give a correctly contrasted picture. An alternative method would be to apply a 1V signal to the input, adjust VR1, then adjust the output to suit.

The output obtained from the set and circuit used is suitable for driving other monitors or mixing in a small CCTV studio or feeding to a videotape recorder. The input will accept a videotape recorder output or the output from a CCTV camera.

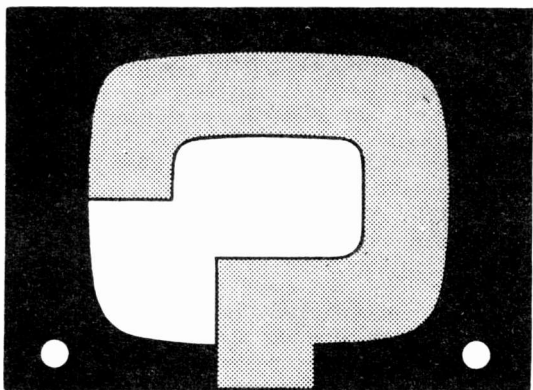
Power for the circuit can be taken from the transistor u.h.f. tuner (on 625 only) or from the h.t. line via a suitable potential divider.

CIRCUIT NOTES

—continued from page 550

PAL V switch is tapped from the junction of resistors R178/R179 and fed to the demodulator i.c.

VT113 provides the colour-killer action. On monochrome there is no ident signal (since there are no bursts). As its emitter is connected direct to the 25V rail VT113 conducts, shorting the base of VT114 to the positive rail. This action ensures that VT114 remains cut off so that its collector is at chassis potential and there is no turn-on bias for the chrominance channel. On colour the ident signal appears at VT112 collector, is rectified by W109 and smoothed by R176 and C164, producing a positive bias that cuts VT113 off (its base is then at approximately 26V). VT114 operates as already indicated and the squarewave output is smoothed by R180 and C166 and fed via R181 as the turn-on bias to the chrominance channel.



BUSH TV148U

The picture and sound break up to give what can only be described as a pulsating movement—this trouble is experienced on u.h.f. only. If the push-button of the channel that has been selected is pressed hard the trouble clears. A camera change or loud passage will start the trouble off again.—A. J. Sprout (Enfield).

The symptoms described could be the result of a defect in the a.g.c. line—possibly a faulty anti-lockout diode 2MR5 (type MIS). If mechanical pressure cures the fault, however, it is likely to have a mechanical origin. Check by disturbance the plugs and sockets taking the i.f. signal from the u.h.f. tuner to the v.h.f. tuner and remake as necessary. Also check the clearance between the vanes of the u.h.f. tuner gang.

EKCO T433

The trouble is distorted sound on 625 lines. The EH90 sound detector has been replaced with a new one but this has only slightly improved matters.—T. Anson (Bognor).

Try adjusting the EH90 oscillator coil L28 which is below and slightly to the left of the EH90. If this does not put matters right check the screen and cathode voltages on 625 and check resistor values as necessary.

DEFIANT 9A61U

The fault with this set is no e.h.t. There is a faint line whistle which can be varied by adjusting the line hold control. I have tried all the usual cures—the valves, boost capacitor, width circuit and line output pentode screen components. The oscillator stage appears to be in order. A new line output transformer has been tried but the symptoms remain the same. Have you any further suggestions? — T. Byford (Southend).

On several occasions we have found the contacts between the line output transformer and the panel above it to be at fault and we suggest you check this possibility first. Then if necessary obtain a replacement L620 line output stage h.t. feed coil: shorted turns in this can result in non-operation when under load.

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by a 10p postal order (made out to IPC Magazines Ltd.), the query coupon from page 571 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.

ULTRA V1781

The field linearity is poor on this set, the picture being stretched at the top with the bottom half closed up leaving four inches of blank screen. The 30PL13 field timebase valve and its cathode components have been replaced but the fault is still present.—F. Goodwin (Hampstead).

It is our custom on these old Ultra sets to replace a number of small capacitors in the field timebase as a matter of routine. We suggest you replace C104 (0.02 μ F) and C103 (0.03 μ F) associated with the linearity network and C99 (0.1 μ F—coupling) and C103 (0.05 μ F—field charging) on pin 9 (triode anode) of the 30PL13. Then if necessary check the values of the resistors in the linearity circuit—R121 180k Ω , R123 180k Ω and R129 82k Ω .

BUSH TV77

The sound and picture are good except for triggering over picture verticals after a few minutes. This distortion of the picture moves up and down, sometimes becoming almost stationary.—T. Cadmuth (Bradford).

Line triggering displacement can occur if the aerial is receiving reflected signal(s) which would appear on the screen as ghosting; check this first. If this is not the cause of the trouble observe the sides and bottom closely to see if there is any sign of ripples and rhythmic rise and fall to denote poor smoothing. This would call for a check of the h.t. electrolytics. Then if necessary check the flywheel line sync discriminator diodes.

ULTRA 6618

The fault on this set (BRC 850 dual-standard chassis) is that the sound keeps going off. It can be brought back by operating the light switch in the room—or in almost any other part of the house. All likely valves have been changed and the channel selector switch checked.—T. Cradock (Morpeth).

There are two 0.02 μ F coupling capacitors (C65 and C66) in the vicinity of the audio valve (PCL86—the capacitors are connected to pins 1 and 9). Either of these capacitors could be faulty.

STELLA ST1017U

On switching on everything lights up and seems to be in order with perfect sound but the screen in daylight is blank. On switching off a bright spot appears, so the e.h.t. is present. In the dark, shadows can be discerned on the screen with the brightness control advanced.—T. Murray (Gloucester).

You will have to check the tube base voltages. First the heater voltage, across pins 1 and 8: this should be about 6.3V (a.c.). If it is a lot less suspect a partially shorted heater in which case sharply tapping the tube neck may clear the trouble for a short time. Next check the first anode voltage at pin 3: this should be well over 300V. If low check the value of the focus control R713 (2M Ω) and the boost line decoupler C609. The grid voltage (pins 2 and 6) should vary from very little at minimum brilliance to about 150V at maximum brilliance. If this voltage is low and remains so check the feed resistor R212 (68k Ω) from the h.t. line to the brilliance control and the decoupler C704 connected to the slider of the brilliance control. The cathode voltage (pin 7) should be around 140V. If high check the video amplifier valve V608 (EF80) which is d.c. coupled to the tube in this chassis.

INVICTA 7120

The width is excessive and the width control has no effect. This preset control has been checked and found to be in order. Voltages read normally but the line output valve appears to be overheating slightly with excessive screen current.—G. Dawkins (Liverpool).

The voltage dependent resistor (VDR1, type E298/ED/A265) in series with the width control should be checked: a 100k Ω resistor bridged across it should restore width control action if it has gone open-circuit.

PYE 81

On switching on after the set has been off for several hours all one gets is a blank raster. An unstable picture appears after about half an hour and normal results come after a further 15 minutes. If the set is switched on when it has been off for only a short time the picture and sound come on much sooner.—R. Hale (Bristol).

Your instability is probably in the cascode i.f. stage VT2 and VT3. Suspect especially the i.t. supply decoupler C15, VT2 base decoupler C16 and VT3 emitter decoupler C19.

PHILIPS G20T230A

The problem is a white bar about 3in. wide across the screen (it is not as bright as the picture). The bar moves upwards when the set is warming up and tends to move downwards when the set has reached its normal operating temperature. There also seems to be louder than normal hum.—R. Foster (Hendon).

The symptoms suggest that the main smoothing electrolytics on the right-hand side are faulty. We often find however that it is not the electrolytics themselves that are causing the trouble but the bonding between the cans and chassis: improve the contact if possible or provide alternative leads to chassis.

ALBA T1095

The contrast control has no effect and if the brightness control is advanced the picture enlarges and then disappears. The picture is also of increased size.—R. Tapforth (Gloucester).

The increased picture size and blooming are due to the inability of the e.h.t. rectifier to supply sufficient beam current for the c.r.t. The DY87 should therefore be checked, then if necessary the other valves in the line output stage, the PY800 and PL36. For the inoperative contrast control we suggest you check the clamp diode in the a.g.c. circuit (X401 type OA81 or OA91) and then if necessary the value of the 2.7M Ω resistor R462 connected to the slider of the contrast control.

FERGUSON 3703

The fault with this set (Thorn 3000 chassis) appears to be in the convergence system. Figures on monochrome are outlined by a red or green ghosting effect which is worst at the top and bottom of the picture, tapering in towards the centre of the screen where for about an inch conditions are correct. The effect on colour is the same. Straight vertical lines take on an X shape, the top showing red and green at each side but converging correctly at the centre. The set operates perfectly when switched on from cold, the above fault developing after about twenty minutes.—J. Atkinson (Hornchurch).

Check the 50 Ω R-G amplitude control R719 which with the convergence board down is the second control up in the second row from the left. Then if necessary check the associated components W705 (type OA91—omitted on later boards) and the non-polarised electrolytic C706 (150 μ F).

EKCO TCG316

I obtained one of these old "de-luxe" models recently and after resetting most of the preset controls and making one or two valve replacements get quite reasonable results. There are, however, a couple of points on which I would welcome your comments. First there is a switch-off spot I would like to eliminate. Secondly the flyback lines can be seen on a blank raster.—F. Barker (Finchley).

Switch-off spot suppression is not really necessary on this chassis as the e.h.t. is moderate and the Metro-sil fitted discharges the c.r.t. The presence of flyback lines denotes faulty flyback suppression. In these old Ekco chassis a suppression pulse is taken from the field blocking oscillator circuit via an 0.001 μ F capacitor to the first anode of the tube. It is usually this coupling capacitor which is at fault.

BUSH TV118

The picture quality, contrast and brightness vary with changes in the scene: also it is several minutes before the picture comes on.—C. Graham (Lincoln).

The trouble is probably due to a changed value resistor in the PCF80 video amplifier circuit and we suggest you check the anode load resistor R34 (10k Ω) and cathode bias stabilising resistor R31 (33k Ω). If these are in order check the EF184 vision i.f. amplifier and the EF85 common i.f. amplifier valves.

VALVES

SAME DAY SERVICE
NEW! TESTED! GUARANTEED!
SETS IR5, IS5, IT4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94.
Set of 4 for £112, DAF96, DF96, DK96, DL96, 4 for £155.

IR5	28	30C15	58	EAF42	50	EM80	38	PCF808	68	U801	80
IS5	22	30C17	76	FB91	10	EM81	38	PCL82	30	UABC80	32
IT4	16	30C18	58	FBC33	40	EM84	32	PCL83	57	UAF42	50
3S4	26	30F5	64	FBC41	54	EM87	50	PCL84	34	UBC41	45
3V4	47	30F11	65	FBC41	30	EY51	36	PCL85	38	UBF80	34
5U4G	31	30F112	69	FBC90	22	EY85	29	PCL86	38	UHF89	32
5V4G	35	30F114	68	FBE80	32	FY87	29	PCL88	65	UCC84	32
5Y3GT	34	30I1	29	EBF83	29	EZ40	43	PCL800	75	UCC85	35
5Z4G	35	30L15	70	EBF89	29	EZ41	43	PCL805	38	UCC80	32
6/30L2	54	30L17	67	ECC81	17	LZ80	22	PEN44	77	UCH42	58
6AL5	11	30P4	65	FCC82	20	EZ81	23	PEN36C	70	UCH81	32
6AM6	13	30P12	69	FCC83	35	EZ90	25	PFI200	52	UCI82	32
6A05	22	30P19	65	LCC85	34	GZ30	34	PL36	49	UCL83	55
6A16	20	30P11	60	FCC804	54	GZ32	40	PI81	44	UF41	52
6A16	20	30P113	89	ICF80	31	GZ34	48	PI81A	47	UF89	30
6B46	20	30P114	65	ECCF82	26	K741	31	PL82	31	UL41	53
6BE6	21	35V6GT	45	FCH35	55	K761	55	PL83	33	UL84	30
6B16	41	35W4	25	ECH42	59	K166	78	PL84	30	UM84	22
6BW7	53	35Z4GT	25	FCH81	29	LN319	63	PL500	63	UY41	39
6F14	40	50C D6G	68	FCH83	40	LN329	72	PL504	63	UY85	25
6F23	68	AC/V P2	77	1CH84	36	LN339	63	PM84	33	VP4B	77
6F25	55	B349	65	1CL80	35	N78	87	PX25	95	W77	43
6J7G	24	B729	62	ECL82	31	P61	40	PY32	52	Z77	22
6K7G	12	CCH35	67	FCL86	35	PABC80	34	PY33	32	AC107	17
6K8G	17	CY31	30	F139	38	PC86	47	PY81	25	AC127	18
6Q7G	35	DAF91	22	FF41	60	PC88	47	PY82	25	AD140	37
6SN7GT	30	DAF96	36	1FR0	23	PC96	42	PY83	32	AF115	20
6V6G	28	DF91	16	1FR5	28	PC97	36	PY88	33	AF125	17
6V6GT	28	DF96	36	EF86	30	PC900	29	PY800	34	AF116	20
6X4	23	DH77	20	EF89	26	PCC84	29	PY801	34	AF117	20
6X5GT	28	DK32	33	EF91	13	PCC85	23	R19	30	AF125	17
10P13	53	DK91	28	EF92	27	PCC88	38	R20	56	AF127	17
12AH8	295	DK92	50	EF98	65	PCC89	45	U25	64	OC26	25
12AT7	17	DK96	45	EF183	28	PCC189	48	U26	56	OC44	12
12AU7	20	DL35	40	EF184	31	PCC805	56	U47	64	OC45	12
12AX7	22	DL92	26	EH90	34	PCF80	28	U49	56	OC71	12
19RG6G	80	DL94	47	EL33	55	PCF82	33	U52	31	OC72	12
20F2	67	DL96	38	EL34	45	PCF86	46	U78	24	OC75	12
20P3	75	DY86	24	EL41	54	PCF800	58	U191	59	OC81	12
25L6GT	19	DY87	24	EL84	23	PCF801	28	U193	42	OC81D	12
25U4GT	57	DY802	33	EL90	26	PCF802	40	U251	64	OC82	12
30C1	28	EABC80	32	EL500	62	PCF805	58	U301	38	OC82D	12
						PCF806	56	U329	66	OC170	23

READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441.

Minimum post/packing on 1 valve 7p., on each additional valve, (3p. per. valve extra)

Any parcel insured against damage in transit 3p extra.

FERGUSON 3617

This set is fitted with the Thorn 850 dual-standard chassis. The line hold control has to be carefully adjusted to get any sort of picture and even then a band slips across the screen distorting the picture. When I manage to lock the picture for a few seconds there is a smudgy effect and adjustment of the contrast control seems to make matters worse. The valves on the i.f. board, also the line oscillator and field timebase valves, have been replaced but the condition is the same. Both 625 and 405 are affected in this way.—A. Kemp (Manchester).

We suggest you check the resistors in the PCL84 video amplifier stage where you will almost certainly find that at least R24 (47kΩ) the bias stabilising resistor has changed value. Some of the other resistors could also be outside their tolerance range. Change all discoloured resistors and make sure that all voltages are correct. Also check R38 (43kΩ) the upper resistor of the potential divider feeding the screen grid of the sync separator. The tuner feed resistors R168/R169/R170 near the mains fuse may also be defective.

COSSOR CT1922A

There was total field collapse on this model. The PCL85 field timebase valve and its cathode components, also the height circuit resistors, have all been checked or replaced but the problem remains. On switching on there is a flashover between pins 6 (pentode anode) and 5 of the PCL85. While testing with a bulb and battery for short-circuits there was a weak flashover between pins 6 and 5 of the PCL85 when I checked from the scan coils to chassis.—R. Hinchcliff (West Drayton).

The symptoms indicate that there is an open-circuit in the field scan coils. This causes high voltages at pin 6 of the PCL85 and consequently the flashovers.

EKCO T536

On 625 lines part of the picture moves from right to left when the picture is bright, e.g. a white sky. Also I get four pictures: the fault only lasts about three seconds and appears to be affected by the white sky. On 405 lines there is a slight move from left to right.—G. Hemmings (Spalding).

The preset contrast controls appear to be set too high. Reduce the settings so as to read 2.9V on 625 and 1.6V on 405, measured across the vision detector load resistor R20.

GEC 2015

The height and vertical linearity controls have been set to their extreme limits and the PCL85 field timebase valve and its pentode cathode components replaced but there is still lack of height at both top and bottom, showing at the bottom as a 3in. black margin.—T. Brown (Dunstable).

We suspect that the 2.7MΩ resistor from the boost rail to the height control has increased in value. This resistor is near one corner of the timebase panel. The voltage at the h.t. end of the height control should be 110V and on 405 lines the triode anode voltage of the PCL85 (pin 1) should be 50V.

TV'S 19" NOW £11.95

TWO YEARS GUARANTEE ALL MODELS

405/625: 19" £25.95, 23" £35.95

FREE CATALOGUE

 DAILY DEMONSTRATIONS FOR PERSONAL SHOPPERS
carr. £1.95


COMPONENTS

MUST BE CLEARED

Transistor Radio Cases: 25p each. Size 9½" x 6½" x 3½". Post 15p.

Speakers: 35p. 2½" 8Ω. Brand new. Post 15p.

Press Button Switching Units 4 Banks 25p 6 Banks 35p P. & P. 5p.

Precision Tape Motors: £1.95, 200/250V. Famous German manufacturer. Post 20p.

Transistor Gang Condensers: 20p. Miniature AM. Post free.

Modern Gang Condensers: 30p. AM/FM or AM only 20p. Post 10p.

Record Player Cabinets: £3.75. Designed for the modern auto-changer size 17 x 15 x 7½ PP 55p.

Valve ELL80 50p.

Posts: 25p each. Post 5p. D/SW 500/500 KΩ. D/SW 500/100 KΩ. D/SW 1 meg./100 KΩ. S/SW 500/500 KΩ. S/SW 500/1 meg.

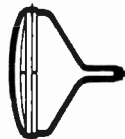
COLOUR TV'S

25" £185.00

19" £145.00

A selection of recent years models. U.K. manufacture.

Regret personal shoppers only.

 TV TUBES REBUILT
GUARANTEED 2 YEARS


17" & 19" £5.95;

21" & 23" £6.95

Exchange Bowls carr. 55p.

DUKE & CO. (LONDON) LTD.

621/3 ROMFORD ROAD, MANOR PARK, E.12

Phone 01-478 6001-2-3

Stamp for Free List

PYE 13

If the brightness control is turned farther than about half way the picture expands and the screen darkens. The c.r.t. seems to be all right, with plenty of contrast.—G. Moore (Cafford).

The e.h.t. regulation is poor so the DY87 e.h.t. rectifier should be checked. If the picture is small when visible however suspect the PL36 line output valve instead.

BUSH TV141U

On 625 lines there is a continuous buzz on sound which can be reduced by turning the contrast down—this, however, spoils an otherwise good picture.—J. T. Durban (Leeds).

The most likely cause of the trouble is inadequate a.g.c. at the common i.f. stage 2V1 and this could well be due to a weak EF184 in the final i.f. stage position (2V3). Check this valve and also the EF183 (2V1). Then check the setting of the f.m. detector balance control 2RV2 and the detector diodes 2MR2 and 2MR3.

DECCA DR1

There is lack of both height and width although the picture is a lot larger on 625 lines. The line output stage valves and transformer have been replaced without effecting a cure.—S. Halloran (Swansea).

There is clearly something in the boost circuit reducing the supply to the height and "set boost" (width) controls. The latter control—R171 $1M\Omega$ should be checked for correct value, also the $470k\Omega$ resistor R170 in series with it. If these are OK check the other components in the line output valve grid circuit—R169 ($1M\Omega$), R146 ($2.2M\Omega$) and the v.d.r.

QUERIES COUPON

This coupon is available until October 16 1972 and must accompany all Queries sent in accordance with the notice on page 568. Don't forget the 10p postal order!

TELEVISION OCTOBER 1972

TEST CASE

118

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.

? The fault on a Philips Model 23TG173A was lack of raster accompanied by a line whistle of abnormal loudness from the line output transformer. The line whistle appeared to be of the correct frequency and by removing the aerial (to remove the sync pulses) and adjusting the line hold control the whistle was found to change normally in pitch, proving at least that the line oscillator was delivering drive and that its frequency could be regulated in the correct manner.

Further tests indicated lack of e.h.t. voltage and only very mild pulse voltage at the anode of the DY87 e.h.t. rectifier. Also that the heater of the rectifier was unlit. As an internal short in the rectifier can sometimes cause this symptom the anode was disconnected but the pulse suppression remained.

By removing the top cap connector of the PY800 efficiency diode a slight increase in e.h.t. rectifier anode pulse potential was noticed. The technician then performed two tests, the first of which was negative, and then replaced one component to cure

the fault.

What tests were these and which components if in trouble would be likely to cause the symptoms described? See next month's TELEVISION for the answer and for a further item in the Test Case series.

SOLUTION TO TEST CASE 117

Page 523 (last month)

The nature of the interference dot display on the screen can indicate to the experienced technician the source of the discharge responsible for it.

When the discharge is anywhere in the pulse producing components—such as the line output transformer—it invariably occurs during the flyback period when the pulse voltage peaks. This gives rise to a uniform column of dots or dashes—often towards the left-hand side of the screen—because the discharges, which are radiated and then picked up by the aerial, occur at approximately the same instant during each line cycle.

When the interference is in the form of random white dots all over the screen however one can be pretty sure that the discharge is on the d.c. side of the e.h.t. system. It will be recalled that the effect occurred only when the tube beam current was increased by advancing either the brightness or contrast control. There are two main causes of this type of trouble, a short somewhere in the tube or poor connection between the external conductive tube coating and the earthing spring or clip pressing against it. The latter proved to be the case with the set concerned and was put right by simply increasing the tension of the spring so that it pressed harder against the conductive coating.

TELEVISION CLASSIFIED ADVERTISEMENTS

The pre-paid rate for classified advertisements is 5p a word (minimum 12 words), box number 10p extra. Semi-display setting £3 per single column inch. All cheques, postal orders, etc., to be made payable to TELEVISION and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post*. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, TELEVISION IPC Magazines Ltd., Fleetway House, Farringdon Street, London, EC4A 4AD, for insertion in the next available issue.

EDUCATIONAL



COLOUR TELEVISION TRAINING

11 WEEKS' COURSE for men with Mono experience. Shorter appreciation courses by arrangement. Hours 10 a.m. to 1 p.m. Monday to Friday. Next course commences September. Prospectus from: London Electronics College, Dept. C/10, 20 Penywern Road, London, SW5 9SU. Tel. 01-373 8721.

TRAIN FOR SUCCESS WITH ICS

Study at home for a progressive post in Radio, TV and Electronics. Expert tuition for City & Guilds (Telecoms Techn's Cert. and Radio Amateurs') R.T.E.B., etc. Many non-exam courses incl. Colour TV Servicing, Numerical control & Computers. Also self-build kit courses—valve and transistor.

Write for **FREE prospectus** and find out how ICS can help you in your career.

ICS, DEPT. 560, INTERTEXT HOUSE, STEWARTS ROAD, LONDON SW8 4UJ.

BECOME "technically qualified" in your spare time. Home study courses in Radio, TV, Servicing and Maintenance; RTEB, City & Guilds, etc. Informative **FREE** guide—Chambers College (Dept. R.105), Aldermaston Court, Reading RG7 4PF.

ENGINEERS—get a technical certificate. Postal courses in Engineering, Electronics, Radio, TV, Computers, Draughtsmanship, Building, etc. **FREE** book from: BIET (Dept. H.6), Aldermaston Court, Reading RG7 4PF. Accredited by CACC.

SITUATIONS VACANT

TELEVISION SERVICING INSTRUCTOR

required to teach Theory and Practice of Mono & Colour TV on a 16 months day course. Salary according to qualifications and experience. 30-hour week Mon. to Fri.

Apply: Principal, London Electronics College, 20 Penywern Road, London SW5 9SU.

£2500 career Yours in 6 weeks?

Yes. That's all the time it takes ACT to turn a person with the aptitude into a qualified Computer Programmer. Able to hold down a responsible, well-paid job in the world of computers. And our own exclusive appointments agency will introduce you to all the right connections. **FREE**. We've already trained vast numbers of people; pointed them in the direction of success and life-long security. Write or phone **TODAY** for **FREE** details without obligation.

ACADEMY OF COMPUTER TRAINING.
M61, Oxford House
9-15, Oxford Street, W.1
Telephone: 01-734 2874
127, The Piazza, Dept. M61,
Piccadilly Plaza, Manchester 1.
Telephone: 061-236 2935

AERIALS

Direct from the Manufacturers

U.H.F. AERIALS

EASY ASSEMBLY KITS

10 Element **SAVE 40%**
£1.25 (normal retail price)

14 Element **£1.50** 18 Element **£1.75**

Mast clamp optional extra
Ready assembled add 20p
allow 32 1/2 p. carriage and packing.
Please state which channels or group.

TRADE SUPPLIED, SEND FOR LIST

APEX AERIALS (T.V.)

ALBAN WORKS, MARY ST.
JOHNSTONE, RENFREWSHII E

U.H.F. TELEVISION AERIALS: Genuine Multielement "Colorseeker" Kits: New Design: Perfect Monochrome/Colour 10 Element—£1.65: 18 Element—£3.10 including carriage: Alternatively, S.a.e. for lists. D.B. Aerials Co., 2 Robert Street, Newport-on-Tay, Fife DD6 8BL.

CUT PRICE UHF AERIALS

10 element UHF Ae, with grid reflector and tilt clamp, completely assembled, state Ch. group, £1.15. Chimney lash kits for 1"-1 1/4" poles, 75p. 6' 1" masts, 50p. Aerialite low-loss coax, 8p/yd. Aerialite std. coax, 4p/yd. Coax plugs (all metal), 5p each. P&P on aerials, 37 1/2 p. accessories, 15p. All items complete with instructions. Please send s.a.e. for complete list of aerials accessories all at drastically reduced prices. **HANDLEY AERIALS**, 39 Alkincoats Road, Colne, Lancs. BB8 9QQ.

BAINES for High Frequency Aerials. Multibeams by J. Beam
MBM 10, £2.20; MBM 18, £2.90;
MBM 30, £3.90; MBM 46, £6.00;
2MBM 46, £15.20; 4MBM 46, £33.00;
Log Periodic, £5.25; UHF Diplexers, £1.00.
Pre-Amplifiers
Masthead, £7.00; Colourbooster, £3.88;
Wideband Masthead, £9.50; VHF Co-ax, 5p; UHF, 9p.
Accessories: SAE for full details.
Please state channels on all orders.
R. BAINES, 11 Dale Crescent, Tupton, Chesterfield, S42 6DR.

GENUINE FULL SIZE 18 element TV aerial

as used by leading TV companies

FOR ONLY **£1.99**
+ 35p cart



ITV BBC 1/2 Black/White and Colour Guaranteed Perfect Pictures. Save ££s. We supply this genuine U.H.F. aerial for only £1.99, can be fitted outside or inside. Quality made, technically advanced design. Precision grid reflector eliminates ghosting. Complete with clamp, instructions, advice.
Money Back Guarantee. Wall/Caravan Bracket 25p. Low Loss Cable 10p per yard. Plug 8p & **FREE** with order maps & channel reference of all Radio and TV Transmitters

Send direct to Dept. P.T.10,
219 Mansfield Rd., Nottingham
IMPERIAL TRADING (AERIALS) LTD.
the quality Aerial Specialists

SERVICE SHEETS

SERVICE SHEETS. Radio, TV, etc. 8,000 models. List 10p. S.A.E. enquiries. **TELRAY**, 11 Maudland Bank, Preston.

SERVICE SHEETS, 35p, plus stamped addressed envelope. Mail order only. **LESMAR**, 15 Conholt Road, Andover, Hants.

RADIO, TELEVISION and Tape Recorders, 50 mixed odd sheets, 50p, also large stock of obsolete and current valves. **John Gilbert Television**, 1b Shepherds Bush Road, London, W.6. 01-743 8441. S.a.e. enquiries.

★ SERVICE SHEETS • MANUALS • BOOKS ★

SERVICE SHEETS OVER 12,000 SERVICE SHEETS AND MANUALS IN STOCK ON RADIOS, TV's, RPLAYERS AND T.RECORDERS, ETC..
30p + Postage PLEASE ENCLOSE S.A.E. WITH ENQUIRIES... **SERVICE SHEET Catalogue 20p.**

NEW BOOKS & PUBLICATIONS	PRICE + P.&P.
1. COLOUR TELEVISION SERVICING by G.J. King. 332 pages	£4.40
2. COLOUR TELEVISION PICTURE FAULTS by K.J. Bohlman. Illustrated in Colour	£2.50
3. MAZDA BOOK OF PAL RECEIVER SERVICING by D.J.Seal. FS.ERT.MRTS. 288 pages	£3.50
4. TELEVISION SERVICING HANDBOOK by G.J. King. 358 pages	£3.80
5. T.V. FAULT FINDING BOOK by Data Publications Ltd. 405/625 Edition. 124 pages	£0.50
7. HOW TO RECEIVE FOREIGN TV PROGRAMMES ON YOUR SET by W.J. West	£0.33
10. UNDERSTANDING TELEVISION by J.R. Davies. 512 pages	£2.10
11. PRACTICAL TELEVISION CIRCUITS by R.F. Sreer. 376 pages	£1.80
12. TELEVISION ENGINEER'S POCKET BOOK by J.P. Hawker. 304 pages	£1.40
13. COLOUR RECEIVER TECHNIQUES by T.D.Towers, MBE, MA, BSc, MIEE, AMIERE. 96 pages	£1.75
14. COLOUR TELEVISION by P.S.Camt. Volume 1. NTSC System, Principles. 502 pages	£5.00
15. COLOUR TELEVISION by P.S.Camt. Volume 2. PAL, SECAM and other systems, 276 pages	£3.75
93. COLOUR TELEVISION WITH PARTICULAR REFERENCE TO THE PAL SYSTEM by G.N.Patchett	£3.00
94. PAL-D COLOUR RECEIVER: QUESTIONS & ANSWERS by K.J. Bohlman, AM, Inst. E.	£0.60
95. TELEVISION SERVICING by G.N. Patchett, Vol.1. Principles. Video & Sound, IFS	£0.75
96. TELEVISION SERVICING by G.N. Patchett, Vol.2. C.R.T. Sync.Seps. Time-Bose	£0.75
97. TELEVISION SERVICING by G.N. Patchett, Vol.3. Limiters, A.G.C. Flywheel Sync.	£0.55
98. TELEVISION SERVICING by G.N. Patchett, Vol.4. Practical Servicing & Fault-Finding	£0.75

Send S.A.E. for Free LISTS of Practical and Technical Books on Radio & Television now available to

★ BELL'S TELEVISION SERVICES ★

Albert Place, Harrogate, Yorks. Tel. 0423-86844

SERVICE SHEET SERVICE

Our stocks now cover over 10,000 makes and models, 1972 list covering Mono & Colour T.V., Radio, Tape Record Players.

Price 25p PLUS S.A.E.

SERVICE SHEETS

Price 30p plus large S.A.E.
Manuals for MANY MAKES

Enquiries welcome but please, a STAMPED ADDRESSED ENVELOPE. Always state make, model number and whether TV, Radio, etc.

NEW SERVICE SHEETS, Magazines, Books, Newsletter, S.A.E. bring you full details plus FREE SAMPLE.

MAIL ORDER ONLY

A.L.S., 21c, Dryden Chambers,
119 Oxford Street, London,
W1R 1PB.

SERVICE SHEETS

(1925-1972) for Radios, Televisions, Transistors, Radiograms, Car Radios, Tape Recorders, Record Players, etc.
By return post with

FREE FAULT FINDING GUIDE

PRICES FROM 5p

Over 8,000 models available.
Catalogue 13p.

Please send stamped addressed envelope with all orders and enquiries.

Hamilton Radio

47 Bohemia Road, St. Leonards,
Sussex. Telephone Hastings 29066.

LARGE SUPPLIER of SERVICE SHEETS

(TV, RADIO, TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS)

Only 40p each.

PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES AND ORDERS.

Otherwise cannot be attended to.

(Uncrossed P.O.'s please, original returned if service sheets not available)

C. CARANNA 71 BEAUFORT PARK, LONDON, N.W.11

We have the largest supplies of Service Sheets (strictly by return of post). Please state make and model number alternative.

Free TV fault tracing chart or TV list on request with order.

MAIL ORDER ONLY
or Phone 01-458 4882.

SETS & COMPONENTS

BARGAIN TV's

EX RENTAL. SLIM LINE.

23in. 3 Channel with U.H.F. Tuned	£10.00
23in. 2 Channel	£6.50
19in. 3 Channel with U.H.F. Tuner	£8.50
19in. 2 Channel	£1.50
17in. 2 Channel	50p
All sets complete. Callers only.	

EDWARDS & SON

103 Goldhawk Rd., London, W.12
Phone: 743-6996

150 NEW Capacitors/Resistors/Silicon Diodes. Electrolytic. Mica, Ceramic. Carbon. Oxide etc. £1 Post Free. Whitsam Electrical, 33 Drayton Green Road, London, W.13.

WITWORTH Transformers

LINE OUT-PUT TRANSFORMERS
Manufacturers of the largest range in the country. All makes supplied.

SPECIAL
L.O.P. Transformer as specified for "Television" Colour Set only
£3.20. P. & P. 20p.

E.H.T. Tripler
£5.00. P. & P. 20p.

BAIRD, BUSH, G.E.C., PHILIPS

Replacement types ex-stock.
For "By-return" service, contact your nearest Depot:

London: 01-948 3702
Tidman Mail Order Ltd., Dept. PT.
236 Sandycroft Road, Richmond,
Surrey, TW9 2EQ.

Birmingham: 021-643 2148
Hamond Components.
89 Meriden Street,
Birmingham 5.

Valves, Tubes, Condensers, Resistors, Rectifiers and Frame out-put Transformers also stocked.

CALLERS WELCOME

TESTED TOP 20 TV VALVES FROM 10p. PL504, 17½p. New PL508's, 45p. Individually boxed, p & p 4p per valve, 12 or over 2½p, over £3 free. Resistors and capacitors by leading manufacturers at competitive prices. Stockists of "THE WONDER LEAD" colour C.R.T. tester. Send for leaflet. Trade enquiries welcomed. S.a.e for new free list. L. & D. Components Ltd., 71 Westbury Avenue, Wood Green N22 6SA. 01-888 2701.

FORGESTONE COMPONENTS

Ketteringham, Wymondham, Norfolk.

For new **COLOUR** components. Including scans, converge, LOPTS, delays, VDRs, shields, coils, Varicap tuners, etc.

Quality parts at competitive prices.

Supplier of component packs for the **TELEVISION** colour receiver.

Large s.a.e. and 2 x 3p stamps
FOR NEW 1972 CATALOGUE

TELEVISION'S Colour Receiver
Epoxy Glass P.C.B.'s, drilled and tinned
DECODER, £2.00; I.F. STRIP, £2.00;
BLANK PANELS, £1.00.

Remaining boards available when published.

Cash with Order

ELECTRONIC DESIGN SERVICES LTD.
Bolholt Works, Walshaw Road, Bury, Lancs.

TELEVISION

ALL Sets complete with UHF.
Tuners 19" Pye's BBC-2, £7.

23" Pye's BBC-2, £9.

Other makes in stock. All Sets re-polished. All Sets untested.

SLIMLINE TELEVISION,
58 Harpur Street, Bedford.

SETS & COMPONENTS (continued)

For quality Hi-Fi Equipment, records and Colour Television
Visit

HANSPAL'S AUDIONICS

488 Lady Margaret, Southall.
01-578 2258.
54 St. Anns Road, Harrow.
01-863 3400.

Marantz, Pioneer, Sansui, Akai, Rotel, Nikko, Lux, Telefunken, Sony, Sanyo, Lux, Tandberg, Hitachi, Grundig, Scandyna, KEF, TEAC, National Quad, etc., etc.

Telefunken, Hitachi, Sony and Grundig Colour T.V. Always in stock.

Up to 5 years Colour Tube guaranteed and 1 year Free Servicing and Labour. Late evening: Thursday until 7.00 p.m.

(Southall)

Friday until 7.00 p.m.

(Harrow)

EXCELLENT CREDIT FACILITIES

25" D/STD. COLOUR TVs. All makes available. 19"/23" BBC2 TVs from £5. Smith Switchmaster Mk III reconditioned decimalized meters, perfect working order, 10 for £20 delivered. Sample meter send £2.50 c.w.o. Ring Mr. Kent, Bradford (0274) 665670. Thornbury Trade Disposals, 1043 Leeds Road, Bradford 3.

T.V. BARGAINS

Complete but untested TVs. 19 in. 405 lines, £5, 19 in. dual standard, E.G., Ekco 402, Sobell, 1000 series, Thorn 850 etc., £8 (less U.H.F. tuner). 19 in. dual standard with U.H.F. tuner, £12. Carriage and packing, £1.50. Lists, S.A.E. Personal callers welcome.

LINAVAL RADIO LIMITED

48 Hoe Street, London, E.17
01-520 7546

WANTED

CASH PAID for New Valves. Payment by return. **WILLOW VALE ELECTRONICS**, 4 The Broadway, Hanwell, London, W.7. 01-567 5400/2971.

TOP PRICES PAID
for new valves, popular
TV & Radio Types

KENSINGTON SUPPLIES
(A), 367 Kensington Street
Bradford 8, Yorks

SERVICE SHEETS purchased. **HAMILTON RADIO**, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 29066.

NEW BVA valves of popular types. PCL805, PY800/1, etc. Cash waiting. Bearman, 6 Potters Road, New Barnet. 449/1934-5.

WANTED. **NEWNES** Radio and Television Servicing, 1963-64 volume. Buy or swap.—Tele: Stevenage (STD 0438) 55808.

WANTED: B.R.C. 2000 colour series convergence board. State price and condition. Harris, 59 Highbanks Close, Welling, Kent.

FOR SALE

25" COLOUR TV cabinet with base, teak finish. Not drilled for switch units, £25.00. Fulmer 2525, evenings.

MULLARD valve tester with cards and manual-Avo testmeter, offers. Price, 2 Bourne Close, Bicester, Oxon.

MISCELLANEOUS

START your own business making television aerials. Large quantity assembled and unassembled aerials. Components, aluminium, elements, booms, £250. Box 101.

RECORD T.V. SOUND

using our loudspeaker isolating transformer.

Provides safe connection for recorders. Hi-Fi equipment, or extension speakers. £1 post free. Instructions included

CROWBOROUGH ELECTRONICS (T), Eridge Road, Crowborough, Sussex.

CHROMASONIC ELECTRONICS is well and living at 56 Fortis Green Road, London N10 3HN, 40-page illustrated catalogue, 20p post free.

COLOUR — COLOUR — COLOUR

19" and 26" Colour Televisions, from £125. in working order. Various non-working sets available.

Delivery can be arranged.

S.A.E. Details.

T.E.S.T.

P.O. Box 1, Kirkham, Preston, PR4 2RS.

**rebuilt T.V. tubes
for men of vision**

Current types

17"	£4.00	21"	£5.00
19"	£4.00	23"	£5.00

Panorama & Rimguard types

19"	£6.00	23"	£8.00
-----	-------	-----	-------

Twin panel

19"	£7.50
-----	-------

Cash or P.O. with order, no C.O.D. Carriage 50p in England, Scotland, Wales. Add 75p for carriage Northern Ireland. For all enquiries please send S.A.E. Each tube fitted with new electron gun assembly. Fully guaranteed for two years against any fault except breakage.

k.s.f. ltd.

Providence Mills, Viaduct St., Stanningly, Nr. Leeds, Yorks. Tel. Pudsey 78177

PRACTICAL WIRELESS

20p every month
- for
constructional
articles
on audio units
and hi-fi
systems!

You get detailed diagrams and instructions for building units and complete systems. Stereo tuners, amplifiers, mixers, FM receivers, transistor radios and intercoms are just some of the more obvious projects included month by month. But you will also find a wealth of interesting ideas for simplified units such as an alternative to an a.f. signal source, an FET receiver, and many ingenious pieces of testing equipment, and ideas, too, for making useful electronic devices for the home.

IMPOSSIBLE-TO-GET COMPONENTS?

There really are no such things! Sometimes the price is daunting but then you don't have to buy. **FREE** quotation on all your requirements, whatever the quantity, whatever the item. Full consultancy service also available for one off constructions, installations, equipment tests, etc., etc.

EAST CORNWALL COMPONENTS P.O. BOX No. 4 SALTASH, CORNWALL

SOUTHERN VALVE CO. 44 Earls Court Road, KENSINGTON, W.8

SPECIALISTS IN QUALITY VALVES MAINLY FROM BRITISH MANUFACTURERS: GENUINE VALUE IN BEST COMPONENTS AND FINEST VALUE AT LOWEST POSSIBLE TRADE PRICE

All new and boxed, Mullard wherever possible. Lists see. Mail order only

AZ31	65p	EY51	50p	PCL86	37p	UY85	36p	30FL1	60p
DY86/7	37p	EY86/7	37p	PD500	£1-25	U25	65p	30FL2	60p
DY802	45p	EZ40/1	37p	PFL200	62p	U26	60p	30FL12	75p
EB91	15p	EZ80	45p	PL36	52p	U191	65p	30L1	35p
ECC81	37p	EZ81	30p	PL38	75p	U193	35p	30L15	75p
ECC82	30p	GY501	80p	PL81	46p	U251	62p	30L17	75p
ECC83	42p	GZ30/2	55p	PL81A	50p	U301	75p	30P12	70p
ECC85	40p	GZ34	55p	PL82	40p	U329	62p	30P19	70p
ECC88	50p	N37	75p	PL83	50p	U404	50p	30PL1	60p
ECH42	70p	N78	£1-50	PL84	55p	U801	90p	30PL13	75p
ECH81	37p	PC86	50p	PL500	65p	W729	50p	30PL14	75p
ECH84	55p	PC88	50p	PL504	65p	Y3	42p	30PL15	75p
ECL80	40p	PC97	40p	PL508	75p	5Z4	50p	30P4MR	95p
ECL82	50p	PC900	50p	PL509	£1-25	6/30L2	60p	35W4	45p
ECL83	57p	PCC84	35p	PL802	62p	6AT6	45p	50C5	42p
ECL86	52p	PCC85	40p	PL805	85p	6BW7	60p	50CD6G	—
EF80	27p	PCC88	70p	PY32	55p	6CD6G	90p	—	£1-60
EF85	40p	PCC89	52p	PY33	55p	6F24/5	62p	ETC., ETC.	—
EF86	65p	PCC189	55p	PY81	35p	6F28	48p	Sorry no	—
EF89	35p	PCF80(L)	32p	PY88	40p	6K7/8	40p	X78/X79	—
EF91	50p	PCF80(S)	40p	PY800	35p	6V6	47p	All in stock	—
EF93	45p	PCF82	55p	PY801	35p	6X4	30p	at moment.	—
EF94	50p	PCF86	52p	PY500	75p	6X5	40p	SAE for	—
EF95	60p	PCF200	50p	R19	70p	9D7	48p	Transistor	—
EF183	37p	PCF201	50p	UBC41	50p	10C2	87p	lists etc.	—
EF184	37p	PCF801	50p	UBF89	40p	10F1	50p	Post 3p	—
EH90	45p	PCF802	50p	UCC85	50p	10P13	80p	per valve.	—
EL34	57p	PCF805	50p	UCH42	50p	12BA6	45p	ALL new	—
EL41	50p	PCF806	60p	UCH81	55p	20L1	85p	and boxed.	—
EL42	50p	PCF808	60p	UCL82	51p	20P3	90p	ALSO	—
EL84	35p	PCH200	60p	UCL83	61p	20P4	90p	COM-	—
EL86	50p	PCL82	37p	UF41	52p	20P5	95p	PONENT	—
EL90/1	45p	PCL83	35p	UF85	37p	30C1	40p	LISTS	—
EL95	45p	PCL83S	50p	UF89	41p	30C15	70p		—
EM34	£1-00	PCL84	37p	UL41	57p	30C17	75p		—
EM80/1	57p	PCL85	45p	UL84	60p	30C18	50p		—
EM84/7	65p	PCL805	45p	UY41	35p	30F5	70p		—

Tel.: 440/8641 (office)

TELEVISION TUBE SHOP

BRAND NEW TUBES AT REDUCED PRICES

A28-14W (A28-13W)	£12-75
A31-18W	£12-50
A47-11W	£9-95
A47-13W	£12-50
A47-14W	£8-25
A47-26W	£10-75
A50-120WR	£12-50
A59-11W	£12-95
A59-13W	£13-50*
A59-15W	£9-95
A59-16W	£13-50*
A59-23W	£14-75
A61-120WR	£16-50
AW-21-11	£7-00*
AW36-21, 36-80	£5-75
AW43-80	£6-95
AW43-88, 43-89	£6-75
AW47-90, 47-91	£7-50
AW53-80	£7-50*
AW53-88, 53-89	£8-25
AW59-90, 59-91	£9-00
C17LM, 17PM, 17SM	£6-50
CME1201	£12-50
CME1402	£5-75
CME1601	£10-50
CME1602	£12-00
CME1702, 1703	£6-75
CME1705	£7-75
CME1713/A44-120	£14-50
CME1901, 1903	£7-50
CME1906	£12-50
CME1908	£7-75
CME2013	£12-50
CME2101, 2104	£8-25
CME2301, 2302, 2303	£9-00
CME2305	£14-75
CME2306	£13-50*
CME2308	£9-95
CME2413R	£16-50
CRM93, 124	£5-50*
CRM141, CRM142	£5-50
CRM171, CRM172	£6-50
CRM211, CRM212	£7-50*
MW36-24, 36-44	£5-50
MW43-69	£6-75
MW43-80	£6-75
MW53-20, 53-80	£7-50
TSD217, TSD282	£14-00†
13BP4 (Crystal 13)	£14-00†
190AB4	£9-25
230DB4	£11-25

†Rebuilt tubes also, at £7-00 plus bulb

*These types are FULLY rebuilt. ALL TUBES ARE TESTED AND GUARANTEED FOR 12 MONTHS ADD 75p FOR CARRIAGE AND INSURANCE

COLOUR TUBES

19 in. and 22 in. having slight marks or scratches at £35 each
New R.C.A. A49-15X £35
New R.C.A. Scan Coils, Convergents, Yokes, and Blue Lateral, complete £5 per set.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD, LONDON, S.W.11. 228 6859
WE GIVE GREEN SHIELD STAMPS

PHILIP H. BEARMAN

(VALVE SPECIALISTS)

NEW valves by Mullard, Telefunken, etc.

BY RETURN POST, TRADE PRICES. LISTS.

DY86/7	40p	PC86/88	72p	PCL805(Q)	54p	U193	47p	30L17	86p
DY802	42p	PC97	42p	PCL86	63p	U251	62p	30P12	90p
EB91	22p	PCF80	50p	PL36	83p	6/30L2	86p	30PL1	66p
ECC81	42p	PCF86	60p	PL81	75p	6BW7	78p	30P4MR	95p
ECC82	42p	PCF801	59p	PL84	62p	6CD6G	90p	30P19	83p
ECL80	47p	PCF802	59p	PL500&50486p	6F23	90p	30PL13	95p	
EF80	39p	PCF805	83p	PY81	47p	6F28	71p	30PL14	95p
EF183	54p	PCF808	80p	PY800	47p	20L1	90p	etc., etc.	—
EF184	54p	PCL82	48p	PY801	47p	20P4	90p	Note.	—
EH90	51p	PCL83	61p	U25	91p	30C15	86p	BY100/127	—
EH51	60p	PCL84	57p	U26	91p	30FL1/2	62p	equiv. with	—
EY86/7	40p	PCL85/805	63p	U191	86p	30L15	91p	res. 15p	—

POST FREE OVER £2, BELOW add 3p per valve

Large PCF80 30p. See separate component and transistor lists.

Sorry no X78 or X79

6 POTTERS ROAD, NEW BARNET, HERTS.

(ADJACENT TO POST OFFICE)

(Suppliers to H.M. Govt., etc.)

Tel: 449/1934 and 1935.

PHILIP H. BEARMAN,

Suppliers to H. M. Government

LARGE STOCKS BY LEADING BRITISH AND FOREIGN MANUFACTURERS
TUBES GUARANTEED 2 YEARS, COLOUR 4 YEARS! ALL EX STOCK

Every tube tested before it leaves our premises. Open Saturday mornings

FOR EXAMPLE:

		Cgs.
CME1702, AW43-80, CRM173, MW43-80, MW43-69*, CRM172, AW43-88, AW43-89, CME1705, CME1703, C17AF	17"	£5-87p 55p
CME1903, CME1902, CME1901, AW47-90, AW47-91, A47-14W, C19AH	19"	£6-87p 60p
CME2101, AW53-88, AW53-89, CRM211, CRM212, MW53-20, MW53-80, CME2104	21"	£7-87p 65p
CME2303, CME2301, AW59-90, AW59-91	23"	£9-50p 65p

* Rebuilds only usually

COLOUR TUBES

4 YEAR GUARANTEE

19" A49.11X, A49.120X	£49-00	plus £1 carriage
22" A55.141X, A56.120X	£53-00	plus £1 carriage
25" A63.11X, A63.200X	£57-00	plus £1 carriage
26" A67.120X, A66.120X	£59-00	plus £1 carriage

All prices net trade, old glass not required.

We endeavour to maintain prices but all are subject to alteration without notice

A LEADING NAME IN
NEW
VALVES AND TUBES
(*ONE YEAR GUARANTEE)

*TSD282	11"	£12-50
A28-14W (Mullard)	11"	£11-00
MW31-74	12"	£3-00
TSD290/CME1201	12"	£9-80
*13BP4	13"	£14-00
MW36/24 & 44	14"	£4-75
CME1601	16"	£7-50
CME1602	16"	£10-00
CME1906	19"	£11-00
A47-13W		
A47-11W & 26W	19"	£8-50
A50-120W	20"	£10-50
CME2306	23"	£15-00
A59-13W		
A59-11W & 25W	23"	£11-50
CME2413	24"	£13-00
CME2501		£17-00

Rebuilt CME 1903 £5-50, CME 2303 £7-50

Plus carriage, but if sea journey, 50p extra

6 POTTERS ROAD, NEW BARNET, HERTS. TEL: 01-449/1934 (Robophone) and 449/1935
All enquiries welcomed, all prices NET trade

REBUILT COLOUR TUBES

19"	£22.50	22"	£25.00
25"	£27.00	26"	£28.00

Exchange prices: Tubes supplied without exchange glass at extra cost, subject to availability.

Colour Tubes demonstrated to callers.

Carriage extra all types.

New RCA Type A49-15X: £30.00

Full range of rebuilt mono tubes available, Standard, Rimband and Twin Panel

- * Complete new gun fitted to every tube.
- * 2 years' guarantee monochrome, 1 year colour.
- * 15 years' experience in tube rebuilding.
- * Trade enquiries welcomed.

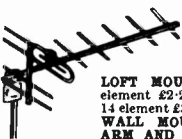
N.G.T. ELECTRONICS LTD.
(Nu Gun Teletubes)

22-24, Anerley Station Road,
London S.E.20.

Telephone: 01-778 9178.

U.H.F. TV AERIALS

Suitable for Colour and Monochrome Reception



All U.H.F. aerials now fitted with tilting bracket and 4 element reflector.

LOFT MOUNTING ARRAYS. 7 element £2-25. 11 element £2-75. 14 element £3-25. 18 element £3-75.
WALL MOUNTING c/w WALL ARM AND BRACKET. 7 element £3-25. 11 element £3-75. 14 element £4-25. 18 element £4-75.
CHIMNEY MOUNTING ARRAYS c/w MAST AND LASHING KIT. 7 element £4. 11 element £4-50. 14 element £4-75. 18 element £5-25.
MAST MOUNTING arrays only 7 element £2-25. 11 element £2-75. 14 element £3-25. 18 element £3-75. Complete assembly instructions with every aerial.
LOW LOSS coaxial cable 9p yd. **KING TELEBOOSTERS** from £3-75. **LABGEAR** all band V.H.F.-U.H.F.-F.M. radio mains operated preamps £7-50. State clearly channel number required on all orders. P.p. on all aerials 50p. Accs. 13p. C.W.O. Min. C.O.D. charge 25p.

BBC-TV-FM AERIALS

BBC (band 1) Wall 8/D £2. **LOFT** inverted 'T' £1-25. **EXTERNAL 'H'** array only £3. **ITV** (band 3) 5 element loft array £2-50. 7 element £3. **COMBINED BBC-TV** loft 1+5 £2-75. 1+7 £3-50. **WALL AND CHIMNEY UNITS ALSO AVAILABLE.** Pre-amps from £3-75. **COMBINED U.H.F.-V.H.F. aerials** 1+5+9 £4. 1+5+14 £4-50. 1+7+14 £5. **FM RADIO** loft 8/D £1. 3 element £3-25. 4 element £3-50. Standard coaxial plugs 9p. Coaxial cable 5p yd. Outlet box 30p. P.p. all aerials 50p. Accs. 30p. C.W.O. Min. C.O.D. charge 25p. Send 5p for fully illustrated lists.

CALLERS WELCOMED

OPEN ALL DAY SATURDAY

K.V.A. ELECTRONICS

40-41 Monarch Parade
London Road, Mitcham, Surrey
01-648 4884

COLOUR TELEVISION RECEIVER

(as published in P.T.—April issue)

Component Pack No. 1 (Semi-conductors, Resistors, Thermistor and Capacitors) £7-63 inc. P. & P.

Component Pack No. 4 (Semi-conductors, Resistors, Capacitors) £7-50 inc. P. & P.

Component Pack No. 8 (Semi-conductors, Resistors, Capacitors) £6-05 with Silicon Grease, £5.85 without Grease, inc. P. & P.

All the items supplied are as specified or acceptable equivalents and will fit the recommended P.C. Boards.

We also stock a vast range of Semi-conductors, Capacitors, Resistors, Thermistors, V.D.R.S., Potentiometers and Associate Electronic Components.

Send 10p for Transistor Price List.

A. MARSHALL & SON LTD

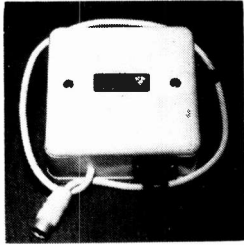
28 CRICKLEWOOD BROADWAY

LONDON, NW2

TEL. 01-452 0161

TELEX 21492

THE NEW UM4 "COLOURBOOSTER" UHF/625 LINE



**CAN PRODUCE
REMARKABLE
IMPROVEMENTS IN
COLOUR AND
PICTURE QUALITY
IN FRINGE OR
DIFFICULT AREAS
WITH SIGNIFICANT
REDUCTION IN
NOISE (SNOW).**

**HIGH GAIN—VERY LOW NOISE
FITTED FLY LEAD—INSTALLED IN SECONDS
HIGHEST QUALITY COMPONENTS
IVORY PLASTIC CASE 3½ x 3½ x 1½ CORK BASE
CHANNELS: Group A, Red code 21-33
Group B, Yellow code 39-51
Group C-D, Green code 52-68**

EQUALLY SUITABLE FOR BLACK AND WHITE

**Also the M4 DUAL BAND VHF UNIT
BOOSTS ALL BAND III and ANY SPECIFIED
BAND I CHANNEL SIMULTANEOUSLY
NOMINAL GAIN 16-18 DB BOTH BANDS**

PRICES BOTH TYPES:

**£3.75 Battery model or £5.87 Self-contained mains version
Postage and Packing 13p**

**TRANSISTOR DEVICES LIMITED
6 ORCHARD GARDENS, TEIGNMOUTH, DEVON
Telephone: Teignmouth 4757**

AERIAL BOOSTERS

We make four types of Aerial Boosters, L45 625 U.H.F., L12 V.H.F. TV, L11 V.H.F. Radio, L10 M/W & S/W. Price L45, L12 and L11 £2.95, L10 £2.45.

VALVE BARGAINS

Any 5—45p, 10—70p:
EC82, ECL80, EF80, EF85, EF183, EF184, EF88, EF91, EF86, PCC84, PCC89, PC97, PCF80, PCF86, PCL82, PCL83, PCL84, PCL85, PL36, PY33, PY82, PY800, PY801, 30L15, 30C15, 6-30L2.

POST AND PACKING: Under £1, 5p. Over £1, 10p. S.A.E. for leaflets on all items. Money back guarantee if not completely satisfied.

VELGO ELECTRONICS

62B Bridge Street, Ramsbottom, Bury, Lancs.

RENOVATE THE COLOUR RENTALS DECCA CTV19 (as featured in "Television")

- ★ NON-WORKERS TESTED TUBE £80
- ★ WORKERS FROM £110
- ★ VISIT OUR SHOWROOM AND
PICK YOUR SET
- ★ CASH AND COLLECT

**SECONDHAND COLOUR
TOWERTON WORKS
OXFORD ROAD
STOKENCHURCH
BUCKS**

(End of M40)

(024-026) Radnage 3321

COLOUR, UHF AND TELEVISION SPARES

"TELEVISION" Colour set parts, available from us. Save £££. Call, phone, or write for up to date information.

PRINTED CIRCUIT BOARDS, T.B., £1.25, Decoder £1.25, I.F. amp £1.25 p.p. 25p, R.G.B. 65p p.p. 15p, E.H.T. Tripler £4.75 p.p. 15p, Mullard AT2055 LOPT £3.25 p.p. 25p, DL1 £1.95, DL20 £3.50 p.p. 25p, Crystal 75p p.p. 5p, FX2249, 5 for 40p p.p. 5p, Luminance Delay Line 90p p.p. 15p, B9D valve bases 2 for 20p p.p. 5p.

SPECIAL OFFER surplus/incomplete G.E.C. colour decoder panels incl. DL20, crystal & approx. 50% of resistors. Conds., diodes, transist., etc. for "Television" decoder £5.50 p.p. 30p. Plessey scan coils £5.75 p.p. 35p. Convergence coils £3.80 p.p. 25p. Blue lateral £1.25 p.p. 9p, or Complete Set £10 p.p. 35p. **MULLARD AT 1027** type scan coils & convergence £5.25 p.p. 35p. Integrated transistorised decoder unit including Circuits £1.25 p.p. 10p. New colour list available.

PHILIPS G6 decoder panel incl. DL1E crystal, etc. £6.50 p.p. 30p. **VARICAP/VARACTOR ELC 1043** UHF tuner (for "Television" colour receiver) £4.50 p.p. 25p. Varicap push-button control unit £1.90 p.p. 15p. VHF Varicap tuners for band 1 & 3 £2.85. Varicap tuners salvaged £1.50 p.p. 25p.

UHF 625 conversion kits and tuners available at reduced prices. Lists available.

UHF tuners, transistd. £2.85; incl. s/m drive, indicator £3.85; push-button £6.25. UHF/VHF transistd. basic tuner, latest type, incl. circuit £3.95. Cyldon valve type £1.50 p.p. 25p.

MURPHY 600/700 series UHF conversion kits in cabinet plinth assembly, can be used as separate UHF receiver £7.50 p.p. 50p.

SOBELL/GEC Dual 405/625 IF amp and o/p chassis incl. circuit £1.50 p.p. 30p. **PHILIPS 625 P/C** IF panel incl. circuit £1 p.p. 25p.

TV SIGNAL BOOSTERS. Latest **PYE/LABGEAR** all station UHF/VHF transistd. 3 outlet Amplifier £6.50 p.p. 25p.

FIREBALL TUNERS Ferg., HMV, Marconi. New £1.90 p.p. 25p. **PUSH BUTTON** Plessey, Ekco, Ferranti £1 p.p. 25p.

TURRET TUNERS. KB "Featherlight VC11, Philips 170 series, GEC 2010 £2.50. AB Dual Standard Suitable Ferguson, Baird, KB, etc. 75p, Cyldon C 75p, Pye 110/510-Pam, Invicta, Miniature, incremental £2.50, Peto Scott 960, Cossor 1964, Decca 95/606

£1.50 p.p. 25p.

LINE OUTPUT TRANSFORMERS. Popular types available, brand new replacements, fully guar. A selection which can be supplied p.p. 25p. C.O.D. 25p.

MURPHY 849 to 939, 153 to 2149 ... £4.50

PHILIPS 1768/2168, 1796/2196 ... £4.50

PHILIPS 17TG/100 Range ... £3.90

STELLA 1011/1029 ... £4.00

PHILIPS 19TG111/12 ... £4.50

PHILIPS 19TG121 to 156 ... £4.50

PHILIPS 19TG170, 210 series ... £4.50

BUSH TV92, 93, 105 to 178 ... £4.50

Ekco 221 to 394, FERRANTI 1001 to 1065 ... £3.90

Ekco, FERRANTI 418, 1093 etc. ... £3.90

DECCA DR 95, 101/606, DRI, 2, 3, 121, 122, 123 ... £4.25

FERG 305 to 436, 606 to 727 ... £3.90

FERG, HMV, MARCONI, ULTRA, PHILCO 3600, 2600, 4600, 6600, 1100 series, Jellypot ... £3.75

KB RV20, SV20, VCI to VC11 ... £4.00

MARCONI VT157 to 172 ... £3.90

GEC 302 to 346, £2.50, 448 to 452 ... £3.25

GEC 454 6, 2000 series ... £4.50

HMV 1865/9, 1870/6, 1910/1924 ... £3.90

PYE 17/21, 17/S, 110 to 510 700, 830, 1, 2, 3, 11U to 48 ... £3.90

PAM, INVICTA equiv. LOPTS to above PYE ... £3.90

SOBELL, McMICHAEL TPS 173, 180, T23, 24, 178, 278 ... £2.50

SC24, 270, MP17, 18, M72, M74, M247 ... £2.50

TPS 781, 279, SC34, 370, MP27, M75, 76, 93, T25, 280, TPS710 ... £3.25

195, 282 to 288, 762, 763 ... £3.25

SOBELL 196/7 1000 series ... £4.50

ULTRA 1770 to 2834 ... £3.90

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

SPECIAL OFFERS

BUSH TV53/86 ... £1.75

BUSH TV95/99 ... £2.50

BUSH 141, 148, 15KV ... £2.50

EKCO 407/417 ... £2.50

FERR. 1084/1092 ... £2.50

FERG. 506 to 546 ... £1.50

HMV 1890 to 1896 ... £1.50

MURPHY 149, 159, 15KV ... £2.50

P/SCOTT 1419 to 1725, 733 to 738 ... £1.75

REG. 10-6, 10-17 ... £2.50

REG. 191, 192, 17-18 ... £2.50

RGD 519 606, 610, 612, 619, 620, 711 ... £2.50

PHILCO 1010/21 ... £2.25

LOPT Inserts p.p. 15p ... £1.75

ALBA 655, 656 ... £1.75

COSSOR 933/950 ... £1.75

KB NF70, OV30, PV40, PVP20, QV10, 20, 30 ... £1.75

KB/RGD VCII Featherlight ... £2.50

KB/RGD VC1-9 ... £1.75

PHILCO 1030/60 ... £1.75

PHILIPS 17TG100 range ... £1.75

RGD 590 to 619 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

REG 10-4, 10-12 ... £1.75

Practical TV 625 Receiver

Integrated push button transistorised tuner ... £4.90 p.p. 25p

Transistorised IF panel ... £4.75 p.p. 25p

850 line output transformer ... £3.75 p.p. 25p

850 field output transformer ... £1.62 p.p. 15p

850 scan coils ... £3.90 p.p. 25p

(p.p. on complete set of 5 items 50p)

THORN 850 Time Base Panel, Dual Standard £1 p.p. 30p.

THORN 850 Mains Droppers 25p, p.p. 10p (state approx. values).

CALLERS WELCOME AT SHOP PREMISES

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

FREE!

Over 150 ways to engineer a better future

HIGHER PAY

A BETTER JOB

SECURITY

find out how in just 2 minutes

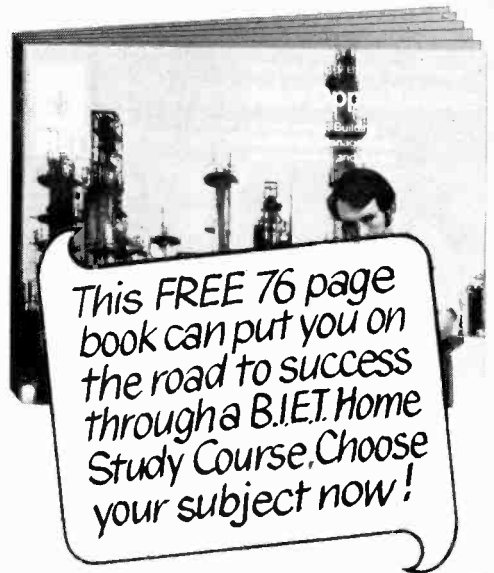
That's how long it will take you to fill in the coupon below. Mail it to B.I.E.T. and we'll send you full details and a free book. B.I.E.T. has successfully trained *thousands* of men at home - equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost B.I.E.T. Home Study Course gets results fast - makes learning easier and something to look forward to. There are no books to buy and you can pay-as-you-learn. Why not do the thing that really interests you? Without losing a day's pay, you could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). No obligation and nobody will call on you . . . but it could be the best thing you ever did.

Others have done it, so can you

"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained - a view echoed by two colleagues who recently commenced the course".—Student D.I.B., Yorks.
 "Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects".—Student J.A.O. Dublin.
 "My training with B.I.E.T. quickly changed my earning capacity and, in the next few years, my earnings increased fourfold".—Student C.C.P., Bucks.

FIND OUT FOR YOURSELF

These letters - and there are many more on file at Aldermaston Court - speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help you. Write to B.I.E.T. Dept, B36, Aldermaston Court, Reading RG7 4PF



MECHANICAL A.M.S.E. (Mech.) Boiler Inspection & Operation C & G Eng. Crafts C & G Fabrication Diesel Eng. Eng. Inspection Eng. Metallurgy Inst. Eng. & Tech. Inst. Motor Ind. Maintenance Eng. Mechanical Eng. Sheet Metal Work Welding	Man. Prod.—cont. Salesmanship Storekeeping Work Study Works Management DRAUGHTSMANSHIP A.M.I.E.D. Design of Elec. Machines Die & Press Tool Design Electrical Draughtsmanship Gen. Draughtsmanship Jig & Tool Design Technical Drawing	Constructional-cont. Building Drawing Building Foreman Carpentry & Join. Civil & Municipal Engineering Constructional Engineering Construction Surveyors Institute Clerk of Works Council Eng. Geology Health Eng. Heat & Vent. Hydraulics Inst. of Builders Inst. Clerk of Works Inst. Works & Highway Supers. Painting & Dec. Public Hygiene Road Engineering Structural Eng. Surveying
ELECTRICAL & ELECTRONIC A.M.S.E. (Elec.) C & G Elec. Eng. C & G Elec. Inst. C & G Elec. Tech. Computer Elect. Elec. Maths Elec. Science Electronic Eng. Electrical Eng. Install. & Wiring Meters & Measuring Instruments	RADIO & TELE-COMMUNICATIONS Colour TV C & G Radio/TV/ Electronics C & G Telecomm. Tech. Prac. Radio & Elec. (with kit) Radio Amateurs Exam. Radio Servicing & Repairs Radio & TV Eng. Transistor Course TV Main. & Serv.	GENERAL Agricultural Eng. Council of Eng. Inst. Farm Science General Education Gen. Plastics Fract. Slide Rule Pure & Applied Maths Refrigeration Rubber Technology Sales Engineers Tech. Report Writing Timber Trade University Ent.
MANAGEMENT & PRODUCTION Automatic Control Computer Prog. Electronic Data Processing Estimating Foremanship Inst. Cost & Works Accountants Inst. Marketing Management Metrication Motor Trade Man. Network Planning Numerical Control Operational Research Personnel Man. Planning Eng. Production Eng. Quality Control	AUTO & AERO Aero Eng. A.M.I.M.I. A.R.B. Cert. Auto Engineering Auto Repair C & G Auto. Eng. Garage Management MAA/IMI Diploma Motor Vehicle Mechanics	G.C.E. 58 'O' & 'A' LEVELS SUBJECTS Over 10,000 group passes
<p><i>Coaching for many major exams. including HNC, ONC, C & G, etc.</i></p>		

POST TODAY FOR A BETTER TOMORROW

To B.I.E.T., Dept. B36, Aldermaston Court, Reading RG7 4PF

B36



NAME _____
Block Capitals Please
ADDRESS _____

SUBJECT OF INTEREST _____

AGE _____

Accredited by the Council for the Accreditation of Correspondence Colleges.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY