TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

3'6 (17½ new pence)

FEBRUARY 1971

SIMPLE EHT METER

ALSO:

IMPROVE YOUR TV AUDIO CHANNEL

VIDEO LF RESPONSE • SHF RECEPTION

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

LAWSON TUBES
18 CHURCHDOWN ROAD,
MALVERN, WORCS.
Malvern 2100

2 YEARS' GUARANTEE
FULL TUBE FITTING INSTRUCTIONS

Tubes are despatched passenger train, road or goods taking far too long for customer 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, are direct replacements and guaranteed for two years.*

	Brand New Tubes	Red Label Rebuilt	Carr. Ins.
12–14" mono (M)	£4.10.0	£4. 0.0	10/–
16–17" ,, ,,	£5.19.0	£4.12.6	12/6
19" ,, ,,	£6.19.0	£4.17.6	,,
21" ,, ,,	£7.19.0	£6.10.0	15/–
23" ,, ,,	£9.10.0	£6.12.6	15/–
19" Panorama (P)	£8.10.0	£7. 5.0	15/–
23" Panorama (P)	£11.10.0	£8.19.0	,,
19" Twin Panel (T)	£9.17.6		,,
23" Twin Panel (T)	£13.10.0		,,
20" Panorama (P)	£10.15.0		,,

REBUILT TELEVISION TUBES

STANDARD TYPES:

17"......... £5·00	21"......... £6·00
19"......... £5·50	23"......... £6·50

'PANORAMA' & 'RIMGUARD' TYPES:

19"......... £7·00	23"......... £9·00

TWIN PANEL or BONDED FACE TYPES:

19"......... £7·50	23"......... £9·50

★ Complete new gun fitted to every tube.

★ Two years' guarantee.

★ **Free delivery** by our own transport within 25 miles of London. Over this distance 75p extra for carriage and insurance (Passenger Train).

We have been rebuilding tubes for the past 12 years and can supply any type including 11", 12", 13", 16", etc. and colour tubes. Trade enquiries invited.

N.G.T. ELECTRONICS LTD.,
22 Anerley Station Road,
London, S.E.20
Telephone: 01-778 9178

EX-RENTAL TELEVISIONS

TWO-YEAR GUARANTEE

17" SLIMLINE 405 only
£11 19 0
19" SLIMLINE 405/625
£29 19 0

Carriage and Insurance 30/-
FREE ILLUSTRATED LIST OF TELEVISIONS
17"—19"—21"—23"
WIDE RANGE OF MODELS
DEMONSTRATIONS DAILY

TV TUBES REBUILT GUARANTEED TWO YEARS
14" 79/6, 17" and 19" 119/-, 21" and 23" 129/-. INSUR. CARR. 10/6.

SPEAKERS 10/-, 2½" 8Ω. 4" 10Ω. 3" × 5" 8Ω, 7" × 4" 3Ω. BRAND NEW. P. & P. 2/-.

Transistors: Mullard matched output kit 7/6, OC81D—2 OC81's. P. & P. FREE.

Transistor Radio Cases: 5/- each. Size 9½" × 6½" × 3½". P. & P. 9/6.

Ferrite Rods 3/6: 6" and 7" complete with LW/MW Coils. P. & P. FREE.

STRIP LIGHT TUBES 3/9 each. **PRESS BUTTON SWITCHING UNITS** 4 Banks 3/6; 6 Banks 5/6. P. & P. 1/-.

STEREO RECORD PLAYER CABINET & MATCHING EXTERNAL SPEAKER CABINET £5.19.6

Cloth covered. Two tone Blue/Black. Size 14½" × 24" × 8¾". P. & P. 10/6

DUKE & CO. (LONDON) LTD.

621/3 Romford Road, London, E12 Tel. 01-478 6001/2/3

WILLOW VALE ELECTRONICS

LIMITED

The Service Department Wholesalers

Compare our prices

e.g. NEW **19" C.R.T's** . . . OUR PRICE **£5.19.0** Plus 12/6 carriage

Please note: Components are sold in packs, quantities per pack are shown under each heading. Prices are per piece of each value.

TUBULAR CAPACITORS (3's)

·001	400v.	9d.
·0022	600v.	9d.
·0033	600/1500v.	9d.
·0047	600/1500v.	9d.
·01	400v.	10d.
·022	600v.	11d.
·033	600v.	11d.
·047	600v.	11d.
·1	600v.	1/0d.
·22	600v.	2/0d.
·47	600v.	2/10d.
·01	1000v.	1/1d.
·022	1000v.	1/1d.
·047	1000v.	1/8d.
·1	1000v.	1/8d.
·22	1000v.	2/8d.
·47	1000v.	3/8d.
·001	1500v.	1/6d.

WIRE-WOUND RESISTORS (3's)

10 watt rating, suitable for mains dropper sections.

1	Ohm	1/9d.
10	Ohms	1/9d.
13	,,	1/9d.
25	,,	1/9d.
33	,,	1/9d.
50	,,	1/9d.
87	,,	1/9d.
100	,,	1/9d.
150	,,	1/9d.
220	,,	1/9d.
330	,,	1/9d.
1K	,,	1/9d.
2·2K	,,	1/9d.
3·3K	,,	1/9d.
4·7K	,,	1/9d.

PULSE CERAMICS (3's) 12KV

100pf	22pf	1/1d.
120pf	47pf	1/1d.
180pf	68pf	1/1d.
250pf		1/1d.

Tubular type for use in Scan correction circuits and Line Outputs.

CERAMICS (6's)

500pf	22pf	8d.
680pf	47pf	8d.
820pf	68pf	8d.
1000pf	100pf	8d.
1500pf	120pf	8d.
3000pf	180pf	8d.
5000pf		8d.

BIAS ELECTROLYTICS (3's)

25mfd	25v.	1/6d.
50mfd	25v.	1/8d.
100mfd	25v.	1/11d.
250mfd	25v.	3/0d.
500mfd	25v.	3/8d.
1000mfd	12v.	6/0d.
1000mfd	30v.	5/9d.
2000mfd	25v.	7/0d.
2500mfd	30v.	9/0d.
3000mfd	30v.	9/6d.
5000mfd	30v.	10/0d.
25mfd	50v.	1/8d.
50mfd	50v.	2/0d.
100mfd	50v.	2/6d.
250mfd	50v.	3/8d.
500mfd	50v.	4/6d.
2000mfd	50v.	9/0d.
2500mfd	50v.	10/6d.

SMOOTHING ELECTROLYTICS

Wire ended, 450v. working.

1mfd	1/6d.
2mfd	1/6d.
4mfd	2/3d.
8mfd	2/6d.
16mfd	3/0d.
32mfd	4/6d.
50mfd	5/0d.
8/8mfd	4/0d.
8/16mfd	5/0d.
16/16mfd	5/0d.
16/32mfd	5/0d.
32/32mfd	5/0d.
50/50mfd	8/0d.
50/50/50mfd	10/0d.

CANNED ELECTROLYTICS

100/200mfd	12/6d.
100/400mfd	16/6d.
200/200mfd	16/0d.
200/200/100mfd	18/6d.
200/400/32mfd	18/6d.
100/300/100/16	18/6d.
100/400/32mfd	18/6d.
100/400/64/16	21/0d.

SKELETON PRE-SETS (3's)

25K	Vertical	1/4d.
50K	,,	1/4d.
100K	,,	1/4d.
250K	,,	1/4d.
500K	,,	1/4d.
1 meg	,,	1/4d.
2 meg	,,	1/4d.
500K	Horizontal	1/4d.
680V	,,	1/4d.
1 meg	,,	1/4d.

SUB-MINIATURE ELECTROLYTICS (3's)

1mfd	18v.	1/8d.
2mfd	18v.	1/8d.
4mfd	18v.	1/8d.
5mfd	18v.	1/8d.
8mfd	18v.	1/8d.
10mfd	18v.	1/8d.
16mfd	18v.	1/8d.
25mfd	18v.	1/8d.
32mfd	18v.	1/10d.
50mfd	18v.	1/10d.
100mfd	18v.	1/10d.
200mfd	18v.	2/3d.

THERMISTORS (3's)

Miniature	1/6d.
TH1	2/4d.

RADIO/TV GLASS FUSES

1 amp, 1·5 amp, 2 amp, 3 amp.
Per dozen 3/0d.

MAINS FUSES

2 amp, 3 amp, 5 amp, 13 amp.
Per dozen 5/0d.

TERMINAL STRIPS

2 amp	2/3d.
5 amp.	2/10d.
15 amp	5/9d.

RECTIFIERS

Silicon Mains (3's)

Westinghouse S10AR2	6/6d.
BY127 Mullard	5/3d.
BY105 Mazda	7/0d.
BY327	5/6d.

CONTACT COOLED FULL WAVE

75ma	12/8d.
100ma	13/8d.
150ma	16/8d.

CO-AXIAL PLUGS

Bakelite top	10d.
Egen metal	1/4d.
Single point (car radio)	2/0d.

SLIDER PRE-SETS (3's)

100K	1/6d.
1 Meg	1/6d.
2·2 Meg	1/6d.

JACK PLUGS

Chrome standard	4/0d.
Standard	3/0d.
3·5mm. metal	3/0d.

DIN PLUGS (3's)

3-pin	1/10d.
5-pin	2/2d.
Sockets	1/0d.

DOUBLE DIODE RECTIFIERS (3's)

Bush/Murphy/BRC, etc.
Line/frame timebases etc.

3 leg	6/3d.
4 leg	6/3d.
5 leg	6/3d.

CARBON FILM RESISTORS

½ watt and 1 watt.

The following values are packed in cartons of *six of each value*. Price 2/6d. per carton.

10	ohm	1·2K	150K
12	,,	1·5K	180K
15	,,	1·8K	220K
18	,,	2·2K	270K
22	,,	2·7K	330K
27	,,	3·3K	390K
33	,,	3·9K	430K
39	,,	4·3K	470K
43	,,	4·7K	560K
47	,,	5·6K	680K
56	,,	6·8K	820K
68	,,	8·2K	1M
82	,,	10K	1·2M
100	,,	12K	1·5M
120	,,	15K	1·8M
150	,,	18K	2·2M
180	,,	22K	2·7M
220	,,	27K	3·3M
270	,,	33K	3·9M
330	,,	39K	4·3M
390	,,	43K	4·7M
430	,,	47K	5·6M
470	,,	56K	6·8M
560	,,	68K	8·2M
680	,,	82K	10M
820	,,	100K	12M
1K	,,	120K	15M

All the above values are available in both ½ watt and 1 watt versions.

***Special for Philips TV's:**
8·2M 2-watt, 4/6d. per pack.

VOLUME CONTROLS

Standard spindle with flat.

Double pole switch	4/7d.
Without switch	3/6d.

(One per pack)
5K, 10K, 25K, 50K, 100K, 250K, 500K, 1 meg, 2 meg.

RECORD PLAYER CARTRIDGES

ACOS: GP67/2g.	High gain general purpose Mono	16/8d.
GP91/SC.	Stereo-compatible replacement	22/0d.
GP91/3SC.	High gain version of above	22/0d.
GP94/1SS.	Stereo cartridge	37/9d.

GENERAL PURPOSE REPLACEMENT FOR TC8's etc.

High gain, plenty of output (Jap.)	19/10d.
Stereo version	37/9d.

SERVISOL AND ELECTROLUBE PRODUCTS (Nett trade)

Servisol aerosol can	12/6d. nett
Electrolube 2AX aerosol	14/0d. nett
Servisol Freezit	9/6d. nett
Electrolube No. 1 Snorkel	18/0d. nett
Electrolube 2GX Grease	8/4d. nett
Servisol Aero-Clene for tape heads	10/6d. nett
Servisol Aero-Duster	10/6d. nett

REPLACEMENT STYLI

TC8	4/6d.
GC8	4/6d.

REBUILT AND NEW TUBES—*TWO YEARS' GUARANTEE*

REBUILT	BRAND NEW	A FEW SAMPLE TYPES, REMEMBER WE STOCK EVERY TUBE
17" @ £4 14 6	£5 10 0	CME1702, AW43-80, CRM173, MW43-80, MW43-69*, CRM172*, AW43-88, AW43-89, CME1705, CME1703, C17AF, C17SM, etc.
19" @ £4 17 6	£5 19 0	CME1903, CME1902, CME1901, AW47-90, AW47-91, A47-14W, C19AH, C19AF, C19A.
21" @ £7 5 0	£8 10 0	CME2101, AW53-88, AW53-89, CRM211*, CRM212*, MW53-20*, MW53-80*.
23" @ £7 5 0	£8 19 0	CME2303, CME2301, AW59-90, AW59-91.

COLOUR TUBES IN STOCK. PRICES ON APPLICATION — ALL PRICES ARE NETT — *NEW ONLY. NO REBUILDS

TWIN PANELS 19" CME1906 / A47-13W £10 1 0 — 23" CME2306 / A59/13W £16 1 0

EVERY TUBE IN STOCK INCLUDING 12", 16" PORTABLES, PANORAMA & RIMGUARDS. TERMS: CASH WITH ORDER. CARRIAGE ANYWHERE IN GT. BRITAIN 12/6 per Tube

HOT-LINE ORDERS Tel: 01-567 5400/2971 TRADE ONLY

e.g. New VALVES . . . **33⅓** plus **13%** plus quantity discounts **6%**

RADIO AND TELEVISION VALVES SMALL SELECTION

British made valves normally supplied. EVERY TYPE IN STOCK

DY86/7	10/–	EY86/7	10/–	PCL86	11/4
DY802	9/1	EZ80	10/10	PD500	31/7
EABC80	12/8	EZ81	8/2	PFL200	15/9
EB91	8/2	EZ90	9/3	PL36	16/4
EBC90	10/10	GZ34	13/7	PL81	13/7
EBF80	10/10	GY501	15/9	PL81A	14/6
EBF89	10/10	PC86	14/6	PL82	10/10
ECC81	10/0	PC88	14/6	PL83	13/8
ECC82	10/0	PC97	10/10	PL84	12/8
ECC83	10/0	PC900	12/8	PL302	13/7
ECC804	15/4	PCC84	10/0	PL504	20/–
ECH81	14/6	PCC88	16/8	PL508	20/4
ECH84	12/8	PCC89	13/7	PL509	31/7
ECL80	9/6	PCC189	13/7	PY33	12/2
ECL82	12/8	PCC806	15/9	PY81	10/10
ECL83	13/4	PCF80	11/4	PY800	10/10
ECL84	11/4	PCF86	13/7	PY801	10/10
ECL86	12/8	PCF87	18/1	PY82	8/4
EF80	9/6	PCF801	13/7	PY83	13/7
EF85	12/8	PCF802	13/7	PY500	20/4
EF86	16/4	PCF805	14/11	UABC80	13/7
EF89	10/10	PCF806	13/7	UCH81	13/7
EF183	12/8	PCF808	14/11	UCL82	12/8
EF184	12/8	PCL82	11/4	UCL83	14/6
EH90	13/7	PCL83	13/4	UL41	14/6
EL34	10/0	PCL84	13/7	UL84	12/8
EY51	13/7	PCL85	13/7	UY85	9/0

ALL MAZDA/BRIMAR TYPES IN STOCK.

TRADE & SERVICE ENGINEERS ONLY SUPPLIED
Cash with order. 10% MAY BE DEDUCTED FROM THE ADVERTISED PRICES EXCEPT FOR NETT ITEMS, C.O.D., OR TUBES

All orders must exceed £5 in value otherwise postage and packing will be charged at 5/0d. per invoice. Components must be ordered in multiples as packed.

COMPREHENSIVE CATALOGUE listing valves, tubes, L.O.P.T.'s components, transistors, including HUGE VALVE EQUIVALENTS LIST. 2/6 in loose stamps, please.

L.O.P.T.'s

LINE OUTPUT TRANSFORMERS

ALL MAKES SUPPLIED

EXCHANGE UNITS AND NEW REPLACEMENTS

EVERY MAKE SUPPLIED
(EXCEPT MURPHY OIL-FILLED)

REWIND SERVICE FOR OBSOLETE MODELS

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and at 42 WEST END STREET, SOMERSET 045-84 2597

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12"—£4-0-0 17"—£4-5-0 19" TWIN PANEL £9-10-0

14"—£4-0-0 19"—£6-0-0 21" MONO £6-10-0

23" MONO £6-10-0 23" TWIN PANEL £10-0-0

ANY TYPE OF NEW TUBE SUPPLIED . . . PRICES ON APPLICATION

CARRIAGE ON ALL TUBES 12/6 EACH

TELEVISION VALVES:—

DY86	6/–	ECL80	7/–	GY501	15/-	PCC89	10/6	PCF802	9/9	PD500	29/–	PL802	16/6	PY801	9/6	6CD6G	24/–	30FL1	15/–
DY87	6/6	EF80	4/9	GZ32	10/-	PCC189	10/6	PCF806	13/–	PFL200	14/–	PY32	10/9	R19	7/9	6F23	16/–	30L15	17/–
DY802	12/6	EF85	6/6	KT61	22/6	PCF80	6/9	PCH200	12/6	PL36	10/9	PY33	10/9	U25	15/6	6P25	22/6	30L17	17/–
EB91	3/–	EF91	3/6	PC86	11/6	PCF86	9/–	PCL82	7/9	PL81	9/6	PY81	15/9	U26	15/6	6X4	4/6	30P4	22/6
ECC81	6/–	EF183	6/6	PC88	11/6	PCF200	16/–	PCL83	10/3	PL82	8/6	PY82	5/3	U191	13/9	10F1	14/9	30P19	15/–
ECC82	5/9	EF184	7/–	PC97	8/9	PCF201	15/6	PCL84	8/6	PL84	7/–	PY83	7/–	U801	23/6	30C15	15/–	30PL1	16/–
ECC83	6/3	EY51	7/6	PC900	8/6	PCF800	15/–	PCL85	9/3	PL508	29/–	PY500	18/6	UU8	21/–	30C17	16/–	30PL13	18/6
ECC85	5/–	EY86	7/–	PCC84	6/6	PCF801	9/9	PCL86	9/3	PL509	29/–	PY800	9/6	6/30L2	15/-	30F5	17/–	30PL14	15/–
																		35W4	4/6
																		50C5	6/3
																		50CD6G	31/–

Postage per valve first class 9d. Orders over £5 post free.

TELEVISION TRANSISTORS:—

2N698	8/6	2S034	12/6	AF178	9/6	BC107	2/6	BC116	8/–	BC154	7/6	BF154	8/–	BF180	7/6	BFY50	4/6	BZY88 Series	3/6
2N3703	2/6	AC127	5/–	AF180	10/6	BC108	2/6	BC118	7/6	BC187	5/6	BF158	6/–	BF181	7/6	BFY51	4/–		
2N3705	3/–	AC128	5/–	AF186	8/–	BC113	5/–	BC134	7/6	BD124	12/6	BF167	5/–	BF184	5/–	BY100	3/6	OA47	2/–
2N3710	2/6	AC153	4/–	BA102	5/–	BC115	6/6	BC148	2/6	BF115	5/–	BF173	6/–	BF194	3/6	BY126	3/–	OA79	2/–
																		OA90	2/–
																		OA91	1/6
																		OC202	12/6

Postage free on all Transistors.

ALL VALVES AND TRANSISTORS BRAND NEW AND FULLY GUARANTEED.

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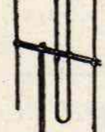

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TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 21 No 4
ISSUE 244

FEBRUARY 1971

WHAT'S IT ALL ABOUT?

Two items recently seen in print, although from very dissimilar sources and setting up two independent trains of thought, converged (of course!) at one point in the editorial brooding process, leaving a rather nagging problem.

In *Wireless World* the editor reminded us of the staggering fact that of the radio frequency spectrum up to 1,000MHz more than 500MHz is occupied by TV broadcasting! Following a discourse on frequency allocations he sets the problem of *"How, for example, to weigh 8MHz-worth of Coronation Street against 8MHz-worth of ambulance radio communication?"* In short TV takes the lion's share of the most useful part of the r.f. spectrum, but is this justified?

In the London *Evening Standard* critic Milton Shulman erupted on the TV programme fare offered over the Christmas holiday, establishing an *"electronic holiday camp mood"* and an atmosphere of *"gluttonous festivity and complacent euphoria." "For four days"* he wrote *"an illusion is created that Britain has been released from the rest of the world and, like some vast balloon, is suspended in a vacuum of festive bonhomie unconcerned and unconnected with the cares and troubles of mankind."*

He grumbled that current affairs programmes were banished, news coverage shrunk and that for 11 days we were denied *Nationwide, 24 Hours, World in Action*, etc. *"Television"* he concluded *"ever more preoccupied with the glib and superficial aspects of mass taste, is letting the nation down."*

Much of TV *is* of course glib and superficial, but the danger of an advocate overstating his case is to create a backlash. Mr. Shulman's tirade served principally to convey the impression that he must be desperately sad and out of touch with the rest of us ordinary, frivolous beings. For to be honest how many viewers *wanted* depth coverage of depressing world events (which we get all through the rest of the year) during a holiday break? What is wrong with lightening the gloom?

And this is where our two isolated trains of thought come together. *What is television for?* To entertain purely and simply or to inform and educate? To form a social service giving a measure of escapism in one's leisure hours, or as a cultural uplift. And once its role in society is decided does it justify its enormous appetite for spectrum space? Let us know what you think.

W. N. STEVENS—*Editor*

THIS MONTH

THE NEXT ISSUE DATED MARCH WILL BE PUBLISHED MARCH 8

TELETOPICS

FIRST QUARTER-INCH VTR SYSTEM

A new self-contained videotape recording-playback system, the Akai VT100, has been introduced by The Rank Organisation (Rank Audio Visual, Audio Products Division, PO Box 70, Great West Road, Brentford, Middlesex). The key unit in the system is a ¼in. videotape recorder which is smaller than most portable typewriters and is able to both record and playback using its own batteries. The complete system with camera, clip-on monitor and batteries weighs less than 24lb. and can be used slung over the shoulder and under both indoor and outdoor conditions. The system can also be operated from the mains or a 12V car battery. The complete system costs £568 while a spool of tape with 20 minutes playing time costs £4. The package includes a 4:1 zoom lens camera with built-in microphone and through-the-lens viewfinder, 3in. monitor which clips on to the recorder, two rechargeable batteries and a charger unit which can be used to recharge the batteries or operate the machine from the mains—or do both simultaneously. As the system is not intended for domestic use it is not subject to purchase tax.

LATEST UHF TRANSMISSIONS

BBC-1 is now being transmitted from **Sudbury** on channel 51 (horizontal polarisation, aerial group B), **Durris** (Kincardineshire) on channel 22 (horizontal polarisation, aerial group A), **Hemel Hempstead** on channel 51 (vertical polarisation, aerial group B), **Pendle Forest** (Lancashire) on channel 22 (vertical polarisation, aerial group A) and **Tunbridge Wells** on channel 51 (vertical polarisation, aerial group B). BBC-2 transmissions have started from **Fenham** (Newcastle upon Tyne) on channel 27 (vertical polarisation, aerial group A) and **Londonderry** on channel 44 (vertical polarisation, aerial group B).

SMALL MONITOR TUBE

Brimar have introduced a new 1in. instrument tube, type D3-130GH, for such applications as data processing equipment display, sync pulse and dot pattern generator monitoring, frequency drift indicators and modulation monitors. The D3-130GH low-voltage, general purpose oscilloscope type tube features low cost, small spot size, freedom from trapezium distortion, good focus uniformity, high sensitivity so that it is suitable for operation with transistor circuits and operation with an e.h.t. as low as 500V so that power supplies can be kept relatively simple. Focusing and deflection are electrostatic and the maximum overall length is 103·2mm. with a minimum useful screen diameter of 27mm. The maximum diameter is 33·3mm. and the base type B13B. Further details from Thorn Radio Valves and Tubes Ltd., 7 Soho Square, London W1V 6DN.

ITV—1971

The ITA's annual handbook, *ITV 1971—Guide to Independent Television*, is now available at bookshops and bookstalls or from Independent Television Publications Ltd., 247 Tottenham Court Road, London W1P OAU. The theme this year is "do you want to be a television expert?", one of the main objectives being to answer as many as possible of the television questions viewers are likely to ask. The 240 pages—with lashings of colour—provide comprehensive information on all aspects of ITV from engineering developments to advertising control. But at 15/-d. (75p) inflation seems to have caught up with it: last year's handbook sold at 10/6d.

UHF FIELD EFFECT TRANSISTOR

An f.e.t. intended for use as a u.h.f. amplifier or mixer has been introduced by Siliconix Ltd. (Saunders Way, Sketty, Swansea). The type E300 is an epoxy-encapsulated low-cost version of the 2N5397, costing 15/6d. for a single device—reducing to 7/-d. for large quantities. The power gain at 450MHz in the common-gate mode is 12dB, with a noise figure of 4dB. The noise figure can be reduced at the expense of power gain.

VIDICONS FOR EXPERIMENTERS

We understand from the EMI Electronic Tube Division (Hayes, Middlesex) that the prices of their vidicons for the experimenter have been reduced as follows:

9677Amateur, Low-grade tube for experiments, £12
10667M, Integral-mesh tube, £10.

RTS MEETINGS

Amongst technical subjects to be dealt with at forthcoming meetings of the Royal Television Society are *Colour EVR* on February 18, *Recent Developments in Colour Tubes* on March 4, *Low-light TV* on March 18 and *New Techniques in Video Mixing* on April 15. These meetings will be held in the Conference Suite, ITA, 70 Brompton Road, London, SW3, commencing at 7 p.m. Non-members of the Society are admitted to meetings on presentation of a signed ticket obtainable from any member or from the Society at 166 Shaftesbury Avenue, London, WC2H 8JH.

SET NEWS

Two new colour sets have been announced. From **Pye** comes the CT79 26in. model at £349. This is fitted with their 691 single-standard chassis. From **B and O** comes the Beovision 2600 Colour K, a single-standard 22in. model at £359 with teak finish and £364 with rosewood finish. The set features external loudspeaker and tape recorder sockets and twin loudspeakers, one at each side of the screen. Deliveries of Japanese-made PAL-standard **Hitachi** colour receivers are expected to start early in April.

The **Thorn** videocassette equipment mentioned last month is due to be introduced during the first half of 1972.

Mitsubishi in Japan have announced that they have had to cut back colour set production by some 20% because of mounting stocks. About 40% of Japanese households are now equipped with colour sets. If this means that the colour set market in Japan has reached some sort of saturation point at current prices, we can expect to see increased export efforts.

Meanwhile colour set deliveries in the UK remained in November at almost the high level attained in October, according to BREMA. The figure was 55,000, bringing the total at that date for 1970 to 417,000. Monochrome set deliveries during November fell away to 149,000.

IMPORT ESTIMATES

Speaking at the November meeting of the East Midlands Radio Industries Club, Dennis Swannack, general sales manager of Radio and Allied (Sobell-GEC), gave figures indicating the growing penetration of the UK TV set market by imports from the Far East and Europe. Comparing the first nine months of 1970 with the same period in 1969, he said that monochrome imports had increased from 13,000 to 73,000 while colour imports had increased from 1,500 to 12,000. Whilst the totals are not great, he felt that the percentage increases were significant. The figure for portable monochrome TV set imports from Japan during the first half of 1970 was 19,500, an increase of more than six times over 1969.

NEW PRODUCTS

J-Beam Aerials Ltd. (Rothersthorpe Crescent Northampton) have redesigned their Logbeam log-periodic u.h.f. aerial. In log-periodic aerials the elements are mounted alternately on two booms which are insulated from each other, the output being taken from across the ends of the two booms. J-Beam point out that field tests have shown that under adverse weather or atmospheric conditions moisture, snow or soot can build up on the aerial upsetting the insulation between the booms and thus causing a deterioration in performance. The solution adopted with the redesigned Logbeam aerial is to increase the separation between the booms, and the new aerial has been given a triangular shape. The suggested retail price is £4 10s. An improvement in maintaining the gain of the aerial throughout its bandwidth is also claimed for the new design.

The first of a new series of integrated circuits for use in TV sets has been announced by Mullard Ltd. This, the TBA550, replaces the previous TAA700 as a central signal processing device providing video preamplification, field and line sync pulse separation with flywheel line discriminator action, and a.g.c. potentials for the i.f. and tuner stages.

A new pocket-size multimeter, the Multimetrix MX209A, has been introduced by ITT-Metrix and is available through ITT Electronic Services, Edinburgh Way, Harlow, Essex. The meter has a total of twenty nine ranges, selected by a thumb selector, and an extensive range of accessories is available including voltage dividers, a.c. and d.c. high-voltage probes, d.c. shunts and an ohmmeter adaptor.

Olson Electronics Ltd. (Factory 8, 5-7 Long Street, London, E2) have introduced a crosshatch and dot generator at £36. The output is at r.f. on 405 or 625 lines, continuously variable from channel 6-13 in the v.h.f. band and 29-43 in the u.h.f. band. The crosshatch pattern is adjustable from 5 to 25 lines by means of front panel vertical and horizontal controls. A further switch gives blank raster, crosshatch or dots.

The new Shibaden SV-700ED videotape recorder has been introduced by General Video Systems Ltd. (61-63 Watford Way, Hendon, London NW4 3AX). This is a modified version of the SV-700 series equipped with an electronic editing system which enables intermittent recording or the insertion of other material into a prerecorded programme to be undertaken. Other features are still framing and an automatic gain control system.

The first of a new range of solid-state oscilloscopes has been introduced by Metronic Ltd., Birchen Napps Platt, Nr. Sevenoaks, Kent. The MSB100 is a single-beam instrument with rectangular c.r.t. giving a display area of 5×4cm. The vertical amplifier response is d.c. to 4·5MHz at 100mV/cm., and an f.e.t. input stage is used. The timebase is calibrated from 10msec/cm. to 100msec/cm. in six steps with a 15:1 variable control for manual setting. Synchronisation is automatic with a screen deflection greater than 1cm. Price is £56.

ADM Business Systems Ltd. (64-66 King Street, London, W6) are marketing a new Toshiba portable CCTV system which costs £235 and comprises a mini camera (type 2A) with tripod, interphone, 5in. monitor and 10 metres of cable. In the on position the equipment can be used continuously whilst in the stand-by position the equipment will automatically become operational for 40 seconds after the call button on the interphone or monitor is pressed.

A convergence generator has been introduced by Gifkins Electronics (Egerton Works, Egerton Street, Salford 3, Lancs) which provides crosshatch, grey-scale and 75% peak white outputs in the v.h.f. channels D – I (8MHz spacing) and the u.h.f. channels 21 – 68. A 2V composite video output is also provided.

The DTV Group Ltd. (126 Hamilton Road, West Norwood, London SE27) has introduced a range of microresistors with dimensions of approximately 3·3mm.×2·2mm. and resistance values in the range 51Ω to 100kΩ. The tolerance is 5%, wattage rating $\frac{1}{16}$W and maximum voltage 100V. They are constructed from metal glaze resistor paste, ceramic bases, solder metal plated copper wires and insulating colour-code paint.

Specification details of over 140 EMI photomultiplier tubes are contained in a new 64-page publication available from the Electronic Tube Division of EMI Electronics Ltd., Hayes, Middlesex. General information on the selection and use of photomultiplier tubes is also given.

BUILD THIS

SIMPLE EHT METER

E. TRUNDLE

In these days of solid-state circuitry and semiconductor e.h.t. rectifiers—especially in colour receivers—haphazard spark testing for e.h.t. is definitely out and an accurate and safe method of checking the e.h.t. voltage is indispensable. Commercial instruments are costly so it was decided to try to evolve a cheaper alternative. The design finally produced can be made for less than half the cost of its commercial equivalent. It is important however that the constructional details given below are *strictly adhered to,* especially the multiplier column, if the finished instrument is to be safe at its working voltage.

Multiplier Column

Three resistors are used in the multiplier column, enclosed in a 7 × $\frac{3}{4}$in. plastic water pipe and impregnated with paraffin wax. The construction is illustrated in Fig. 1. First obtain a $\frac{3}{4}$in. diameter disc of thin plastic or perspex and drill a small central hole in it. Take a top cap from an old valve such as an EY86-7 or DY86-7 and place this on top of the plastic disc. Then pass the lead from one of the resistors through the hole in the disc and solder it to the top cap, making a nice rounded joint as shown in the diagram.

Cut the resistor leads to $\frac{1}{4}$in. at the resistor junctions, then wrap them together with tinned copper wire and solder as shown in the insert in Fig. 1. It is important to avoid sharp points on these solder joints in order to prevent corona discharge. When the three resistors have been joined together in this way roll the string of resistors carefully between boards to ensure accurate mechanical alignment. Wipe the resistors down with a cloth soaked in lighter fuel and take care not to touch them again as you insert the string of resistors down through the column. Cement the plastic disc to the top of the plastic pipe and the metal top cap to the disc with Araldite. When these joints are hard the process of impregnation can begin.

Melt the paraffin wax (candle grease will *not* do) and gently heat to drive off air and moisture. Allow the paraffin to cool until comfortable to touch and then pour carefully into the pipe at the same time ensuring that the resistors are central within the pipe. As the wax contracts as it cools, impregnation should be done in four stages. Finally fill flush to the end and leave to solidify.

Final Assembly

The meter housing used is available from Radiospares through dealers and comes with one black and one red terminal. Remove the red one and enlarge the hole to a diameter of $\frac{3}{4}$in. (this is most easily done by drilling a circle of small holes, breaking the circle out and cleaning up with a half-round file). The column should be a tight fit in the hole. Push it through so that 1$\frac{1}{2}$in. protrudes into the meter housing and cement the case to the column with Araldite.

Wire the end multiplier resistor to the positive terminal of the meter and connect the meter negative terminal to the black terminal on the case. The soldered joints here must be very carefully made because any open-circuit will raise the whole instrument to the full e.h.t. potential. The 1MΩ 1W resistor connected across the movement is there to prevent the full e.h.t. voltage appearing across any break that may occur inside the meter movement.

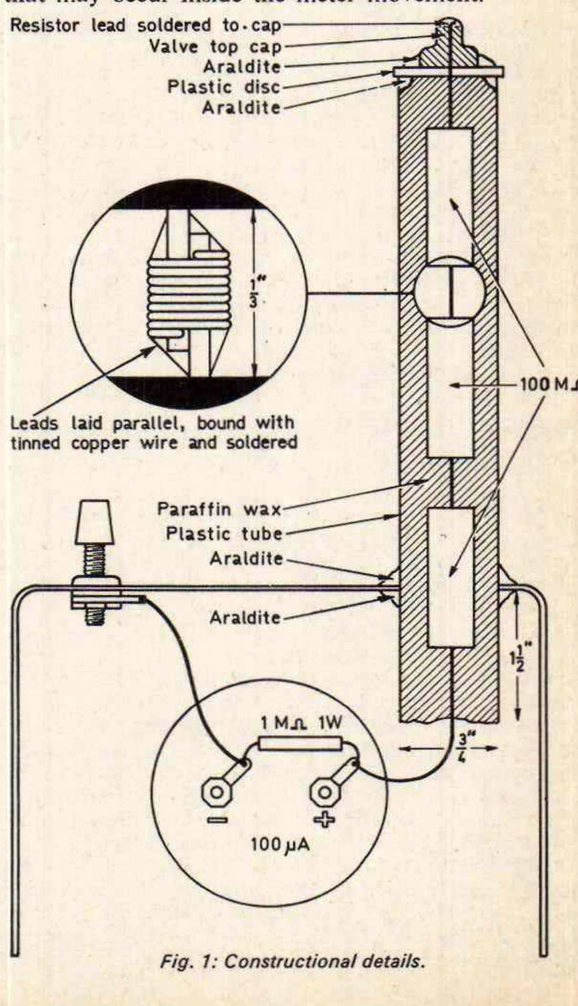

Fig. 1: Constructional details.

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CY31	7/-	ECH81	10/3	EM71	12/6	PCF80	10/3	QQVO2-6	42/-	UY85	6/9	6AT6	9/-	6F5	8/-	6SN7GT	6/-	12K7GT	7/-	30PL14	17/-
DAF91	8/3	ECH83	8/-	EM80	8/-	PCF82	10/6	QQV03-10	25/-	U25	15/-	6AU6	5/9	6F6G	5/-	6SQ7	8/-	12Q7G	5/-	35A3	10/-
DAF96	8/3	ECH84	9/6	EM81	8/6	PCF84	9/6	QVO3-12	13/-	U26	15/-	6AV6	6/-	6F11	6/6	6SR7	7/6	12SC7	5/-	35A5	11/-
DF91	9/-	ECL80	8/-	EM84	7/6	PCF86	12/3	R19	13/-	U191	14/6	6BA6	9/6	6F12	4/6	6T8	6/6	12SG7	7/-	35B5	13/-
DF96	9/-	ECL82	9/9	EM87	11/-	PCF200/1	16/3	R20	15/-	U193	8/3	6BE6	12/-	6F13	7/-	6U4GT	12/6	12SH7	5/-	35C5	7/-
DK91	11/6	ECL83	11/6	EN91	6/6	PCF801	12/3	SU2150A	15/-	U301	17/-	6BH6	8/6	6F14	12/-	6U8	7/-	12SJ7	5/-	35D5	13/-
DK96	11/6	ECL86	9/9	EY51	8/-	PCF802	12/3	TT21	48/-	W729	11/-	6BJ6	8/6	6F15	11/-	6V6GT	6/6	12SK7	8/-	35L6GT	9/6
DL92	7/6	ECL L800	30/-	EY80	9/-	PCF805	13/-	TT22	50/-	Z759	24/6	6BK7A	10/-	6F18	8/-	6X4	5/-	12SL7GT	8/-	35W4	5/-
DL94	7/6	EF39	10/6	EY81	8/-	PCF806	12/3	U18/20	13/6	OA2	6/6	6BL8	7/-	6F22	6/6	6X5GT	5/6	12SN7GT	8/-	35Z3	11/-
DL96	9/3	EF80	8/-	EY83	11/-	PCF808	13/6	U20	13/6	OA3	9/-	6BN5	8/6	6F23	15/6	6X8	11/-	12SQ7	8/-	35Z4G	5/-
DM70	6/6	EF83	10/-	EY86	8/-	PCH200	14/-	U25	15/-	OB2	6/6	6BN6	8/-	6F24	13/6	6Y6G	12/-	12SR7	6/6	35Z5GT	7/6
DY86/7	8/-	EF85	8/3	EY87	8/6	PCL82	10/3	U26	15/-	OB3	10/-	6BQ5	5/-	6F25	15/-	7Y4	12/-	14S7	16/-	50A5	18/-
DY802	8/6	EF86	13/3	EY88	8/6	PCL83	12/3	U31	9/-	OC3	7/-	6BR7	15/-	6F26	7/-	9BW6	8/6	20D1	9/-	50B5	7/-
E55L	55/-	EF89	8/-	EZ35	5/6	PCL84	10/3	U37	30/-	OD3	6/6	6BR8	19/-	6F28	14/-	10C2	10/-	20L1	20/-	50C5	7/-
E88CC	8/-	EF91	8/6	EZ40	9/-	PCL85	10/6	U50	6/-	3Q4	8/-	6BW6	16/6	6F29	6/6	10D1	8/-	20P1	10/-	50L6GT	8/-
E130L	90/-	EF92	10/-	EZ41	9/-	PCL86	10/3	U52	6/-	3S4	7/-	6BW7	13/9	6F30	7/-	10D2	8/-	20P3	12/-	83A1	18/-
E180F	19/-	EF93	9/6	EZ80	5/6	PD500	30/6	U76	5/-	3V4	8/-	6BX6	5/-	6J4	9/6	10F1	18/-	20P4	20/-	85A2	7/6
EABC80	10/6	EF94	15/6	EZ81	5/6	PFL200	14/9	U78	5/-	5R4GY	11/-	6BZ6	6/6	6J5GT	6/-	10F9	10/-	20P5	20/-	90AV	48/-
EAF42	10/-	EF95	12/6	EZ90	5/-	PL36	12/9	U191	15/-	5U4G	6/-	6C4	6/-	6J7	8/6	10F18	8/-	25C5	9/-	90C1	12/-
EBC33	11/-	EF183	11/3	G810C	100/-	PL38	18/-	U201	7/-	5U4GB	7/6	6C5GT	7/-	6K6GT	10/-	10L1	8/-	25L6GT	7/6	90CV	25/-
EBC41	9/6	EF184	7/-	GY501	16/-	PL81	10/3	U281	8/-	5V4G	8/-	6CD6G	28/-	6K7	6/6	10LD11	11/-	25Z4G	6/-	807	9/6
EBC81	6/6	E280F	42/-	GZ30	7/6	PL81A	12/6	U282	8/-	5Y3GT	6/-	6CA4	5/6	6K8G	6/-	10P13	11/-	25Z6GT	10/-	811A	30/-
EBC90	9/6	EF800	20/-	GZ31	6/-	PL82	7/3	U301	11/6	5Z3	9/-	6CA7	10/6	6K23	10/-	10P14	20/-	30A5	8/-	812A	65/-
EBF80	8/-	EF804	20/-	GZ32	9/6	PL83	10/3	U403	10/-	5Z4GT	8/-	6CBC	5/6	6K25	15/-	12AB5	10/-	30AE3	8/-	813	75/-
EBF83	8/-	EF811	15/-	GZ33	16/-	PL84	8/3	U404	7/6	6/30L2	15/-	6CD6GA	23/-	6L6GT	9/-	12AC6	7/6	30C15	15/-	866A	14/-
EBF89	8/-	EL34	10/6	GZ34	11/-	PL500	16/6	U801	20/-	6AB4	6/6	6CG7	9/-	6L7	6/6	12AD6	7/6	30C17	16/-	5642	12/-
EB91	5/3	EL36	9/6	HK90	6/6	PL504	17/-	UABC80	10/6	6AF4A	9/6	6CH6	11/-	6L18	6/-	12A15	8/-	30C18	15/-	6080	27/6
EC53	10/-	EL41	11/-	HL92	7/-	PL505	29/-	UBF89	8/-	6AG7	7/6	6CL6	10/-	6LD20	6/6	12AQ5	8/-	30F5	17/-	6146	30/-
EC86	12/-	EL42	11/6	HL94	8/-	PL508	20/-	UBC41	9/9	6AH6	10/-	6CW4	12/6	6N7GT	7/-	12AT6	5/-	30FL1	15/-	6146B	47/6
EC88	12/-	EL81	10/-	KT66	27/6	PL509	30/9	UCC85	9/3	6AJ8	5/9	6CY5	8/-	6P1	12/-	12AU6	15/-	30FL2	18/6	6267	6/6
EC90	6/-	EL83	8/3	KT88	33/-	PL802	17/3	UCH42	13/9	6AK5	6/-	6CY7	12/-	6P25	21/-	12AV6	6/-	30FL13	10/-	6360	25/-
EC92	6/6	EL85	8/6	N78	21/-	PL805	17/3	UCH81	10/9	6AK6	11/6	6D3	8/-	6P28	12/6	12AV7	9/-	30FL14	15/6	6939	42/-
EC93	9/6	EL86	8/6	PABC80	8/-	PY33	12/6	UCL82	10/3	6AL3	8/6	6DC6	13/6	6Q7	7/6	12AX7	6/-	30L1	7/-	7199	15/-
ECC81	8/-	EL90	6/6	PC86/8	10/3	PY80	6/6	UCL83	12/3	6AL5	3/3	6DK6	8/6	6R7G	7/-	12AY7	13/6	30L15	17/-	7360	36/-
ECC82/3	8/6	EL91	5/-	PC95	7/3	PY81	8/3	UF41/2	11/-	6AM5	5/-	6DQ6B	12/-	6S2	8/-	12B4A	10/-	30L17	17/-	7586	25/-
ECC84/5	8/6	EL95	7/-	PC97	8/3	PY800	8/3	UF80/5	7/6	6AM6	4/6	6DS4	15/-	6S4A	11/-	12BA6	6/6	30P12	16/-	9002	6/6
ECC88	11/-	EL360	23/-	PCC84	9/3	PY801	8/3	UF89	8/3	6AQ5	6/6	6EA8	11/-	6SA7	7/6	12BA7	6/6			9003	10/-
E88CC	12/6					PY82	7/-			6AQ6	10/-										

SEMICONDUCTORS

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2N388A	12/6	2N2193A	10/-	2N3055	15/-	2N3854	5/6	2N5176	9/-	40315	9/6	AF106	8/6	BC117	7/9	BCY54	6/6	BF238	6/6	BSX20	3/6
2N404	4/6	2N2194A	4/6	2N3133	6/-	2N384A	5/6	2N5232A	6/-	40316	12/6	AF114	5/-	BC118	6/6	BCY58	4/6	BF257	9/6	BSX21	7/6
2N696	4/-	2N2217	5/6	2N3134	6/-	2N3855	5/6	2N5245	12/6	40317	9/6	AF115	6/-	BC121	4/-	BCY59	4/6	BF22A	9/6	BSX26	9/-
2N697	4/-	2N2218	6/6	2N3135	5/-	2N3855A	6/-	2N5246	12/6	40319	18/6	AF116	5/-	BC122	4/-	BCY60	19/6	BFX12	4/6	BSX27	9/6
2N698	5/-	2N2219	6/6	2N3136	5/-	2N3856	6/-	2N5249	13/6	40320	9/6	AF117	5/-	BC125	11/-	BYC70	4/-	BFX13	4/6	BSX28	6/6
2N699	12/6	2N2220	5/-	2N3340	19/6	2N3856A	7/-	2N5249A	13/6	40323	8/6	AF118	12/-	BC126	11/-	BCY71	8/6	BFX29	7/-	BSX60	16/6
2N706	2/6	2N2221	5/-	2N3349	26/-	2N3858	5/-	2N5265	65/-	40324	11/6	AF119	4/-	BC134	11/6	BCY72	3/6	BFX43	7/6	BSX61	12/6
2N706A	2/6	2N2222	6/-	2N3390	7/6	2N3858A	6/-	2N5266	55/-	40326	19/6	AF124	4/6	BC140	7/6	BYZ10	5/6	BFX44	7/6	BSX76	4/6
2N708	3/-	2N2287	21/6	2N3391	4/-	2N3859	5/6	2N5267	52/6	40329	7/-	AF125	4/-	BC147	3/6	BCZ11	7/6	BFX68	13/6	BSX77	5/6
2N709	12/6	2N2297	6/-	2N3391A	6/-	2N3859A	6/6	2N5305	7/6	40344	7/-	AF126	4/-	BC148	3/-	BD116	22/6	BFX84	6/-	BSX78	5/6
2N718	5/-	2N2368	3/6	2N3392	4/-	2N3860	6/-	2N5306	8/-	40347	8/6	AF127	3/6	BC149	3/6	BD121	13/-	BFX85	7/-	BSY10	5/6
2N718A	6/-	2N2369	3/6	2N3393	4/-	2N3866	30/-	2N5307	7/6	40348	12/6	AF139	7/6	BC152	3/6	BD123	16/6	BFX86	6/-	BSY11	5/6
2N726	6/-	2N2369A	4/-	2N3394	4/-	2N3877	8/-	2N5308	7/6	40360	11/-	AF178	9/-	BC157	4/-	BD124	12/-	BFX87	6/-	BSY24	3/-
2N727	6/-	2N2410	8/6	2N3402	4/6	2N3877A	8/-	2N5309	12/6	40361	12/6	AF179	9/-	BC158	3/6	BD131	19/6	BFX88	5/-	BSY25	3/-
2N914	3/6	2N2483	5/6	2N3403	4/6	2N3900	7/6	2N5310	8/6	40362	13/6	AF180	10/6	BC159	4/-	BD132	19/6	BFX89	12/6	BSY26	3/6
2N916	3/6	2N2484	6/6	2N3404	7/6	2N3900A	8/-	2N5354	5/6	40370	7/6	AF181	8/6	BC160	12/6	BDY10	27/6	BFY10	6/6	BSY27	3/6
2N918	6/-	2N2539	4/6	2N3405	9/-	2N3901	19/6	2N5355	5/6	40406	14/6	AF186	13/4	BC167	3/-	BDY11	37/6	BFY11	8/6	BSY28	3/6
2N929	4/6	2N2540	4/6	2N3414	5/6	2N3903	7/-	2N5356	6/6	40408	12/6	AF239	8/6	BC168B	2/9	BDY17	37/6	BFY17	4/6	BSY29	3/6
2N930	5/6	2N2613	7/-	2N3415	5/6	2N3904	7/-	2N5365	9/6	40467	16/6	AF279	9/6	BC168C	3/-	BDY18	49/6	BFY18	6/6	BSY32	5/-
2N987	10/6	2N2614	6/-	2N3416	7/6	2N3905	7/6	2N5366	6/6	40467A	14/6	AF280	12/6	BC169B	2/9	BDY19	62/6	BFY19	6/6	BSY36	5/-
2N1131	5/6	2N2646	11/6	2N3417	7/6	2N3906	7/6	2N5367	11/6	40468A	14/6	AFZ11	6/6	BC169C	3/-	BDY20	30/6	BFY20	12/6	BSY37	5/-
2N1132	6/6	2N2696	6/6	2N3439	26/-	2N4058	5/6	2N5457	7/6	AC107	6/-	ASY26	5/-	BC170	3/6	BDY38	19/6	BFY21	8/6	BSY38	4/6
2N1302	3/6	2N2711	6/-	2N3440	19/6	2N4059	5/-	2S005	15/-	AC117	12/-	ASY27	7/6	BC171	3/6	BDY60	36/-	BFY24	9/-	BSY39	4/6
2N1303	3/6	2N2712	6/-	2N3570	17/6	2N4060	5/-	2S020	37/6	AC126	4/-	ASY28	5/6	BC172	3/6	BDY61	36/-	BFY25	5/-	BSY40	6/6
2N1304	4/6	2N2713	5/6	2N3572	17/6	2N4061	4/6	2S102	6/6	AC127	5/-	ASY29	5/6	BC175	5/6	BDY62	27/6	BFY26	4/-	BSY51	6/6
2N1305	4/6	2N2714	6/-	2N3605	5/6	2N4062	4/6	2S103	6/6	AC128	4/-	ASY36	5/-	BC182	4/6	BF115	5/-	BFY29	10/-	BSY52	6/6
2N1306	5/-	2N2865	12/6	2N3606	5/6	2N4244	9/6	2S104	6/6	AC154	4/6	ASY50	5/-	BC183	4/6	BF117	9/6	BFY30	10/-	BSY53	7/6
2N1307	5/-	2N2904	7/-	2N3607	4/6	2N4245	8/6	2S501	5/6	AC176	5/-	ASY51	6/6	BC184	4/6	BF163	7/-	BFY41	10/-	BSY54	8/-
2N1308	6/-	2N2904A	8/-	2N3662	7/6	2N4254	8/6	2S502	5/6	AC187	12/6	ASY53	5/-	BC182L	4/-	BF167	5/-	BFY43	12/6	BSY56	18/-
2N1309	6/-	2N2905	8/-	2N3663	7/6	2N4255	8/6	2S503	5/6	AC188	7/6	ASY54	5/-	BC183L	3/6	BF173	6/6	BFY50	4/6	BSY78	9/6
2N1507	5/6	2N2905A	9/-	2N3702	3/6	2N4284	3/6	3N83	37/6	ACY17	5/6	ASY62	5/-	BC184L	4/-	BF177	6/6	BFY51	4/6	BSY79	9/-
2N1613	5/-	2N2906	6/-	2N3703	4/6	2N4285	3/6	3N128	18/6	ACY18	5/-	ASY63	3/6	BC187	5/8	BF178	7/-	BFY52	4/6	BSY82	10/6
2N1631	8/6	2N2906A	6/6	2N3704	4/6	2N4286	3/6	3N140	19/6	ACY19	5/-	ASY72	5/-	BC212L	4/6	BF179	14/6	BFY53	4/6	BSY90	11/6
2N1632	8/6	2N2907	8/-	2N3705	4/-	2N4287	3/6	3N141	19/6	ACY20	5/-	ASY83	5/-	BC213L	5/4	BF180	7/-	BFY56A	11/6	BSY95A	2/6
2N1637	8/6	2N29023	3/6	2N3706	4/6	2N4288	3/6	3N142	19/6	ACT21	5/-	ASY86	6/6	BCY10	5/6	BF181	6/6	BFY75	6/-	BSW41	8/6
2N1638	7/6	2N2924	3/6	2N3707	4/-	2N4289	3/6	3N143	17/6	ACY22	4/-	ASZ20	7/6	BCY12	5/6	BF184	5/-	BFY76	8/6	BSW70	5/6
2N1639	7/6	2N2925	3/6	2N3708	3/6	2N4290	3/6	3N152	22/6	ACY28	4/-	ASZ21	8/6	BCY30	5/6	BF185	8/6	BFY77	11/6	D16P1	7/6
2N1701	32/6	2N2926		2N3709	3/6	2N4291	3/6	R.C.A.:		ACY40	4/-	AUY10	30/-	BCY31	5/6	BF194	4/6	BFY90	13/6	D16P2	8/-
2N1711	5/-	Green	2/9	2N3710	4/-	2N4292	2/6	40050	13/6	ACY41	5/-	BC107	3/-	BCY32	7/6	BF195	5/6	BFW58	5/6	D16P3	7/6
2N1889	6/6	Yellow	2/6	2N3711	4/-	2N5027	10/6	40250	10/-	ACY44	8/-	BC108	3/-	BCY33	4/-	BF196	8/6	BFW59	5/-	D16P4	8/-
2N1893	8/6	Orange	2/6	2N3713	30/-	2N5028	11/6	40251	19/6	AD140	8/-	BC109	3/-	BCY34	4/6	BF197	6/4	BFW60	5/-	GET102	6/-
2N2147	14/6	2N3011	6/-	2N3714	35/-	2N5029	9/6	40309	8/-	AD149	11/6	BC113	5/6	BCY38	4/6	BF198	8/6	BPX25	37/-	GET113	4/-
2N2148	12/6	2N3014	6/6	2N3819	7/-	2N5030	8/6	40310	11/6	AD150	12/6	BC114	7/6	BCY39	8/6	BF200	7/4	BPX29	36/-	GET114	4/-
2N2160	11/6	2N3053	5/6	2N3823	22/6	2N5172	3/-	40311	9/6	AD161	7/6	BC115	6/6	BCY40	7/6	BF224	6/-	BPY10	29/-	GET118	4/-
2N2193	9/6	2N3054	11/-	2N3826	6/-	2N5174	10/6	40312	12/6	AD162	7/6	BC116	12/6	BCY42	3/-	BF225	6/-	BSX19	3/6	GET119	4/-
						2N5175	10/6	40314	9/6			BC116A	7/6	BCY43	3/-	BF237	6/6			GET120	10/6

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The MR31 meter used is scaled 0-10 and 0-3: the lower 0-3 scale should be used and this will read directly in tens of kilovolts.

If the reader has sufficient confidence the meter scale can be given a legend (kV × 10) and a red line drawn on the 25kV mark.

The leads for use with the meter should be about 2ft. long. Careful attention must be paid to the termination of the earth lead (one spade terminal, one crocodile clip) as a break here will have dire results! The e.h.t. lead can be made of stout coaxial cable with the braid and outer covering removed. Choose a coaxial cable with stranded centre conductor and thick plastic insulation. A hook made from a paper clip terminates the c.r.t. end of this lead and hooks under the claw in the "flower" e.h.t. connector of the set under test. A rubber or plastic top-cap connector of the type used on DY87 valves may be connected to the meter end of the e.h.t. cable where it will push firmly on to the column top cap.

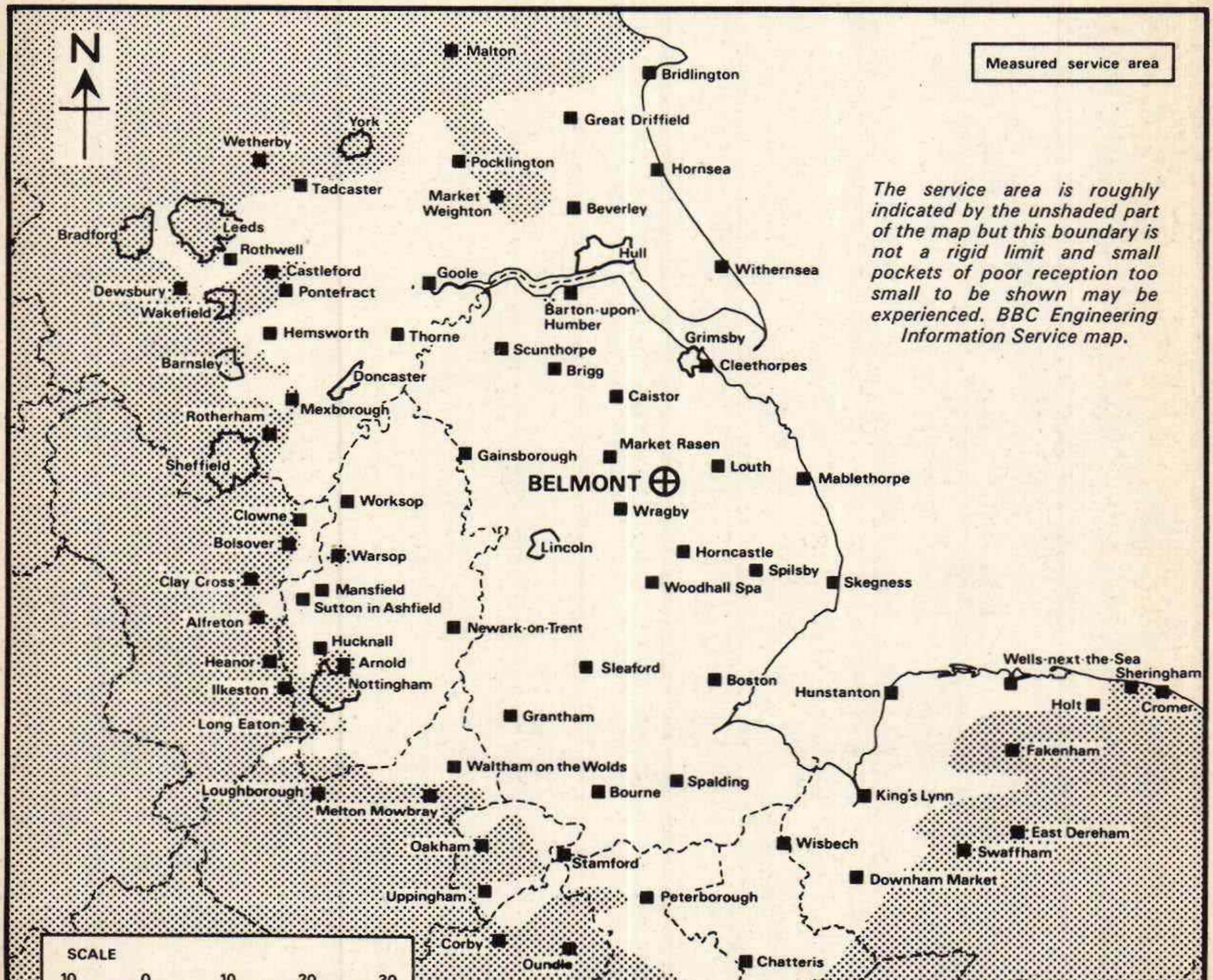
The unit is accurate to within 5% with the specified components so that calibration is not necessary. When using the instrument avoid coming into contact with any part of the multiplier column and wait until the meter has sunk to zero before disconnecting first the e.h.t. lead and then the earth lead.

Components Required

3 100MΩ 5% 1W resistors (type 3954 obtainable from Welwyn Electric, Bedlington, Northumberland, at 18/9d. each—delivery at present seven weeks)
1 1MΩ 1W resistor
100μA meter type MR31 (Radiospares)
Medium size meter desk stand (Radiospares)
7×¾in. plastic water pipe
¼lb. pure paraffin wax (obtainable from most chemists)
Araldite, small piece of ⅛in. plastic or perspex, top cap from an old e.h.t. rectifier valve and materials for test leads as specified in the text above. ■

BELMONT UHF SERVICES

Channels: BBC-1 22, BBC-2 28, ITV 25; horizontal polarisation; aerial group A; max. vision e.r.p. 500kW.



SHF TV RECEPTION

MULLARD have recently released information on the research they are at present carrying out on s.h.f. (i.e. 3000-30.000MHz, 3-30GHz or 10-1 cm.) television reception. At these frequencies reception is of course possible only from local line-of-sight transmitters or via satellites, but it is thought that part of Band VI (11.7-12.7GHz) will in the near future be allocated for television broadcasting. Reception at these frequencies presents entirely new problems. It is unlikely that these will have to be faced in the home market for many years however, the main scope for broadcasting at these frequencies in the near future being via satellite to large land areas. The Indian government for example is due to carry out experiments in conjunction with a NASA applications technology satellite in 1973.

FM Video

Mullard have been studying the general problems and the development of suitable converters to enable standard sets to receive s.h.f. transmissions. One conclusion they have come to is the advantage of using f.m. instead of a.m. for the video signal. With f.m. the transmitter power can be significantly reduced, the receiving aerial made smaller, the converter noise factor and local oscillator stability requirements relaxed and, of greatest importance, better co-channel performance obtained. The converter is more complex and costly however, having not only to convert the incoming signal from s.h.f. to u.h.f. but also to demodulate it and then remodulate in order to provide a signal which can be fed to the aerial socket of a standard receiver.

Converter Problems

It might seem that the complexity of the converter could be reduced by arranging for it to provide channel selection and demodulation so that its output could be fed to the receiver at video frequency. This however would necessitate modification to existing receivers and there could be hum and isolation difficulties with a.c./d.c. models.

The need to be able to use the converter to feed the aerial socket of a standard receiver thus inevitably increases the complexity of the converter in both circuit configuration and the type of components it is necessary to use. One approach which allows some conventional TV components to be used is to convert the s.h.f. carrier to v.h.f. so that existing commercially available devices can be used in the limiting and demodulation stages. If however in doing this the frequency conversion is made in one step to say 35MHz, the image frequency will be only about 70MHz from the wanted s.h.f. signal.

Experimental Converters

In an experimental converter which has been demonstrated at the Mullard Research Laboratories the image rejection problem was solved by using a double superhet circuit: the s.h.f. is stepped down to u.h.f. and then to v.h.f. before being passed to the limiter and demodulator stages, the resultant demodulated signal being used to amplitude modulate a new u.h.f. carrier which can then be fed to the aerial socket of a standard u.h.f. receiver. The basic arrangement is shown in Fig. 1 in block diagram form.

Preliminary work at the Laboratories has included the construction for experimental purposes of tri-plate and microstrip mixer-amplifiers consisting of a Schottky-barrier diode balanced ring mixer followed by a low-noise u.h.f. transistor amplifier. For the tri-plate mixer-amplifier the overall conversion gain was about 6dB and the noise factor less than 13dB over the 750-900MHz region, indicating the feasibility of a stripline device to cover the complete 450-900MHz range.

Local Oscillator

In early experiments a klystron local oscillator was used and drift was not a serious problem with this. A klystron however is out of the question for a commercially marketable converter, and attention was turned to solid-state devices such as the Gunn oscillator which can produce directly the few milliwatts of oscillator power required. Attractive though this is, the Gunn oscillator has a temperature stability which at present falls short of the requirements, even on f.m. (For a.m. the temperature stability requirement is very severe, being better than one part in 10^5 over a range possibly as great as 80°C.) An obvious approach to this problem is to introduce temperature compensation and a.f.c., and experiments along these lines are being undertaken. There is of course also the possibility of making improvements in the Gunn oscillator itself. ■

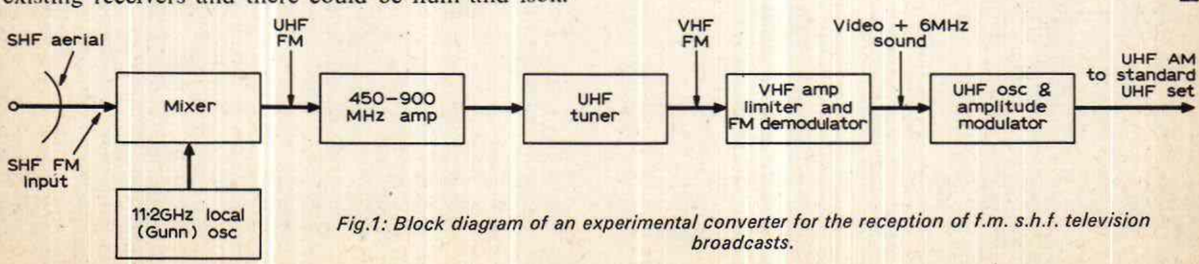


Fig.1: Block diagram of an experimental converter for the reception of f.m. s.h.f. television broadcasts.

S. GEORGE

VIDEO LF RESPONSE

So much emphasis is placed—rightly—on the importance of ensuring adequate h.f. response in video stages that the almost equally vital need to maintain correct l.f. video response down to d.c. tends to be overlooked. Good h.f. response provides fine detail resolution while correct l.f. and d.c. amplification ensure that the more slowly changing and large picture areas will be reproduced at correct amplitude, free from shading and streaking. Excessive l.f. amplification is equally as unwanted as inadequate response, since it means that on a picture set for best overall contrast the fine resolution will be reproduced at a paler contrast level than the low frequencies—and furthermore aircraft flutter will be accentuated.

Ideally the video response should, as with a.f. amplifiers, be reasonably level over the entire operational range but in addition with negligible or frequency-proportional phase change. As however the frequency range of a video amplifier is so many times that of an a.f. amplifier its response linearity cannot be expected to approach that of a.f. circuits.

First we shall consider what constitutes l.f., m.f. and h.f. in the video sense. There are no accepted set figures for these broad classifications since they vary with individual receivers and circuits. However, the following points indicate the factors determining the limits. Medium frequencies are those at which the reactance of the load shunting capacitance is too high to produce any noticeable effect on the load impedance while the reactances of the various coupling and decoupling capacitors are so low as to be negligible. High frequencies are those at which the reactance of the load shunting capacitance becomes comparable to or even lower than the resistive load, reducing the latter's effective value. Low frequencies are those at which the coupling or decoupling capacitors offer a comparatively high reactance. This causes signal loss since the reactance of a coupler attenuates the signal because of the signal developed across it while in the case of a decoupler offering a high reactance there is loss through the negative feedback it effectively introduces.

Now the higher the capacitance value of a capacitor the lower is its reactance. Thus to maintain l.f. response capacitors must generally be of high value. This is particularly so in two applications, for signal feed in solid-state circuits where the low input impedance of transistors otherwise results in heavy l.f. attenuation across the coupling capacitor's reactance, and secondly for valve cathode or transistor emitter decoupling capacitors since the biasing resistors used in these positions are of necessity low in value.

Whether a video output stage is fed from the vision detector, from a video phase-splitter or from a preamplifier, the coupling on 625 lines usually consists of a simple *RC* combination. Now a series *RC* combination will form—in conjunction with the input impedance of the stage—a signal potential divider, with only the signal developed across the resistor of the *RC* combination being usable. The video frequencies extend to 3MHz on 405 and to 5·5MHz on 625, and the proportion of the signal developed across the reactance of the coupling capacitor will naturally markedly increase towards the lower frequencies with a consequent reduction in the signal available across the resistor.

Capacitive Reactance

Capacitive reactance (Xc) simply means the opposition or impedance offered by a capacitor to an a.c. signal. This impedance varies with capacitor size and the frequency of the signal. The formula for determining its value is $1/(2\pi fC)$, where f is the frequency in Hz, C the capacitance in Farads and π is of course approximately 3·14. A more useful form however is $10^6/(2\pi fC)$ where C is in microfarads.

Capacitive reactance *decreases* in direct proportion to *increase* in applied frequency and *increase* in capacitance value. Thus if the reactance of a capacitor at a particular frequency is known it is a matter of simple proportion to find its reactance at any other frequency—or the reactance of an easily comparable size capacitor to the first frequency. For example a 2μF capacitor has an Xc of 1,592Ω at 50 Hz. Thus by proportion a 100μF electrolytic will have a reactance of 1/50th of this or approximately 32Ω at 50 Hz, while a 1μF capacitor has a reactance of 3,184Ω. And while an 0·1μF capacitor has a reactance of 31,840Ω at 50 Hz a 1μF capacitor has as we have seen a reactance of 3,184Ω at this frequency. At the top end of the video range the reactance of capacitors of value of the order of microfarads falls to only a fraction of an ohm. Clearly this widely varying reactance value will have a vital effect at low frequencies in video circuits.

LF Attenuation

As previously mentioned cathode and emitter decoupling capacitors must be especially large since to be at all effective they must have a reactance well below that of the resistor they shunt. Calculations in this part of the circuit are complicated by the fact that the designer may want to incorporate a limited degree of negative feedback to offset any unwanted increase in gain at very low frequencies approaching d.c. The likelihood of an increase in gain at very low frequencies arises because although the video load consists of the anode or collector components at medium and high frequencies, at low frequencies the reactance of the main h.t. smoothing capacitors rises to an appreciable value and in consequence the "top" of the video load is no longer earthed to these signals. The resistance of the h.t. supply is then to some extent in series with the video load, increasing its value. The overall video circuit design and the component values used must therefore be arranged so as to offset any such rise at very low frequencies, thereby preserving a generally linear response down to d.c.

In many designs this is achieved by a double cathode decoupling arrangement in which two series-connected resistors provide the required bias for the stage and are shunted by a small to medium-size capacitor to provide m.f. and h.f. decoupling while in addition one of the resistors is decoupled by a high-value electrolytic to bypass low frequencies: the l.f. signal developed across the other resistor provides the required degree of negative feedback at l.f. A typical example of this arrangement is shown in Fig. 1 and is used in a Pye range of hybrid models. R7 and R8 provide the bias required and R7 is shunted by an $0{\cdot}01\mu$F capacitor to provide h.f. decoupling. An $0{\cdot}01\mu$F capacitor has a reactance of $7{\cdot}95\Omega$ at 2MHz and by proportion of $15{,}900\Omega$ at 1kHz, so clearly it is only effective at above 2MHz when shunted across the 18Ω resistor R7 which thus provides negative feedback at medium to low frequencies. The 200μF electrolytic shunted across the 56Ω resistor R8 has on the other hand a reactance of only $15{\cdot}92\Omega$ at 50Hz and so provides a good measure of decoupling down to this low frequency. There will however be negative feedback

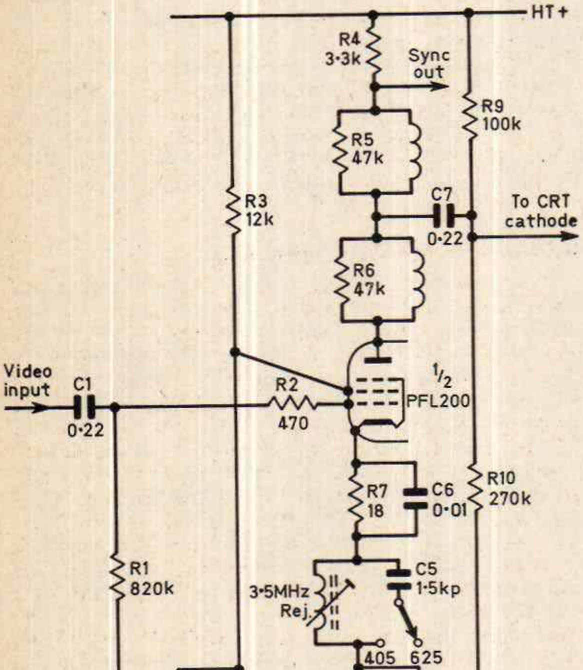


Fig. 1: Typical dual-standard video output stage. The l.f response is attenuated by the partial decoupling of the cathode resistor R7 and, at the screen, the small-value electrolytic C2.

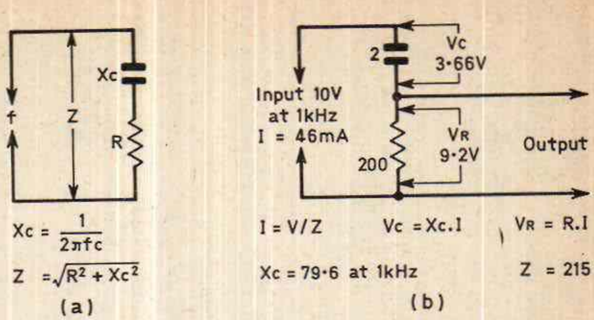


Fig. 2: (a) Calculation of series circuit impedance. (b) Practical example showing individual voltages developed for a 10V input at 1kHz. Xc and Z in ohms.

at very low frequencies.

Some l.f. attenuation is also introduced in this circuit at the screen grid of the pentode, as the electrolytic decoupler at this point is only 4μF and thus has considerable reactance at l.f. The 5kpF capacitor in parallel with it is to ensure adequate h.f. decoupling since the self-inductance of the electrolytic could possibly resonate at a high video frequency and function as a rejector tuned circuit.

Effect of RC Coupling

There are two other *RC* combinations which provide a degree of l.f. attenuation in this circuit—C1 and R1 in the grid circuit and C7 plus the parallel combination of R9 and R10 in the output circuit. The junction of R9 and R10 provides the fixed d.c. potential for the c.r.t cathode, brilliance control being effected by varying the c.r.t. grid voltage. R9 and R10 are in series so far as the d.c. drain is concerned but are virtually in parallel to the signal since the h.t. rail is earth to all but the lowest frequency video signals. The combination of C7, R9 and R10 attenuates the lower frequencies to a greater extent than the combination of C1, R1, for although both coupling capacitors are $0{\cdot}22\mu$F the combination in the output circuit has a lower total resistive value so that the signal loss across C7 is greater at l.f. than that across C1.

Unlike two resistors in series, or two capacitors for that matter, which develop a signal or voltage across each according to their relative values, the total impedance *Z* of a series *RC* circuit must be determined vectorially since resistance and reactance are electrically at right angles. This makes computation rather more involved but does not alter the basic fact that the rising reactance of a capacitor at l.f. reduces the usable signal developed across the associated resistor of an *RC* combination. Fig. 2 shows how reactance and resistance are added in a series arrangement to give their total impedance for any particular frequency. Note that due to their quadrature relationship the sum of the individual capacitor and resistor voltages exceeds the applied potential.

Fig. 3 shows the use of this series *RC* arrangement as the input signal feed to the video output stage in three modern receivers. It will be seen that the lower the stage input impedance (which for valves at l.f. equals the grid resistor value) the higher the value of capacitor needed to maintain l.f. gain. The Bush example (a) with a grid resistor of 270kΩ has

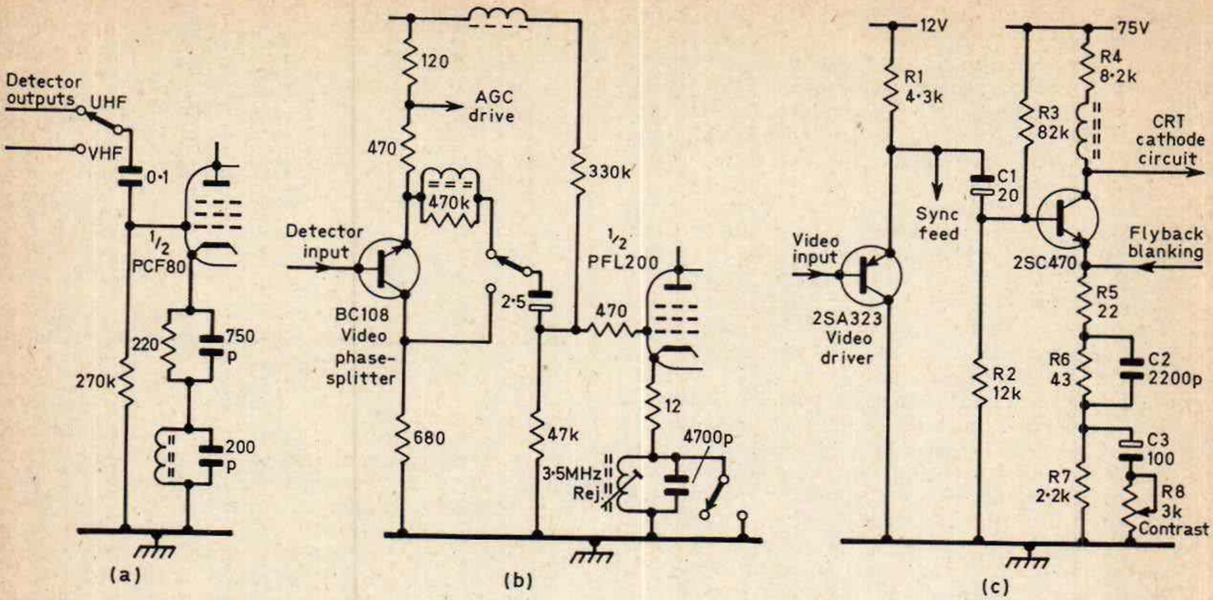


Fig. 3: Typical RC video input coupling circuits, (a) Bush, (b) Pye and (c) Sony. As only the signal developed across the resistor is amplified, the rising reactance of the capacitor at the lower frequencies leads to l.f. attenuation. Capacitor values are therefore large for circuits with a low input impedance.

an 0·1μF coupling capacitor, the Pye example (b) with a 47kΩ grid resistor has a 2·5μF coupling electrolytic, while in the Sony transistor circuit, with a 12kΩ base-emitter resistor which is in effect shunted as far as a.c. signals are concerned by the 82kΩ base to supply rail bias resistor and the input impedance of the transistor, the signal is coupled by a 20μF electrolytic. The emitter circuit of this transistor is noteworthy, incorporating a three-tier resistive arrangement. R5, being without decoupling, introduces slight negative feedback at all frequencies, R6 gives some negative feedback at m.f. and l.f. while R8 varies both gain and l.f. compensation.

Tailoring the Response

In valve video amplifiers it is common to use the cathode and/or screen circuits to tailor the response at l.f. Cathode decoupling is necessary since the signal developed across a cathode resistor follows the grid signal in phase and if completely undecoupled would result in the net grid input equalling Vg – Vk. Partial cathode decoupling, with careful choice of split resistor values, is usually employed to attenuate the l.f. response to the required extent while leaving the vital h.f. response unimpaired.

Where the video amplifier valve screen grid is fed via a resistor—the usual practice—the input at the control grid will result in an amplified but opposite phase signal appearing at the screen. As the anode current is determined by both the control and screen grid potentials, unless the screen grid is completely decoupled there will as a result be negative feedback and consequently a reduction in gain. Naturally the higher the value of the screen resistor the larger the screen grid voltage variations will be and therefore the greater the attenuation introduced. For effective operation the screen grid decoupling capacitor must be sufficiently large to "absorb" these signal voltage variations. Viewed from this angle it is easy to see why a larger capacitor is necessary to absorb l.f. than h.f. variations: the duration of voltage changes—rises or falls—persists for a longer period at l.f., thus increasing the net charge or discharge per half-cycle. In many designs, as in Fig. 4(b), the screen grid is only partially decoupled, by a small to medium size capacitor which although offering a low impedance path to h.f. signals is largely ineffective as an l.f. decoupler when its reactance rises to a substantial value, giving l.f. attenuation through negative feedback action.

Screen-Anode Combinations

Some models take this idea a step further and take the screen grid supply from a point in the anode circuit of the pentode instead of from the h.t. rail, as in the case of the two examples in Fig. 4. In the Philips circuit the single cathode resistor is fully decoupled by a 250μF electrolytic while the screen is supplied from the junction of R1, R2 and R3 in the anode circuit and decoupled by the 20μF electrolytic C1. At high and medium frequencies C1 earths both the screen grid and the resistive junction in the anode load so that R3 in series with the parallel combination of R4 and L1 constitute the video load. At low frequencies however the reactance of C1 rises to an appreciable figure. R1 and R2 then become to some extent part of the video load, increasing the gain, while as the screen grid is no longer fully decoupled there is screen grid negative feedback and thus a tendency for the gain to fall. These two actions are not completely in opposition however and their combined effect as determined by the individual component values used tailors the l.f. response exactly as required by the designer.

The KB/RGD circuit, Fig. 4(b), is rather more involved. Let us first look at the cathode circuit. On 405 the cathode bias is developed across R6 and

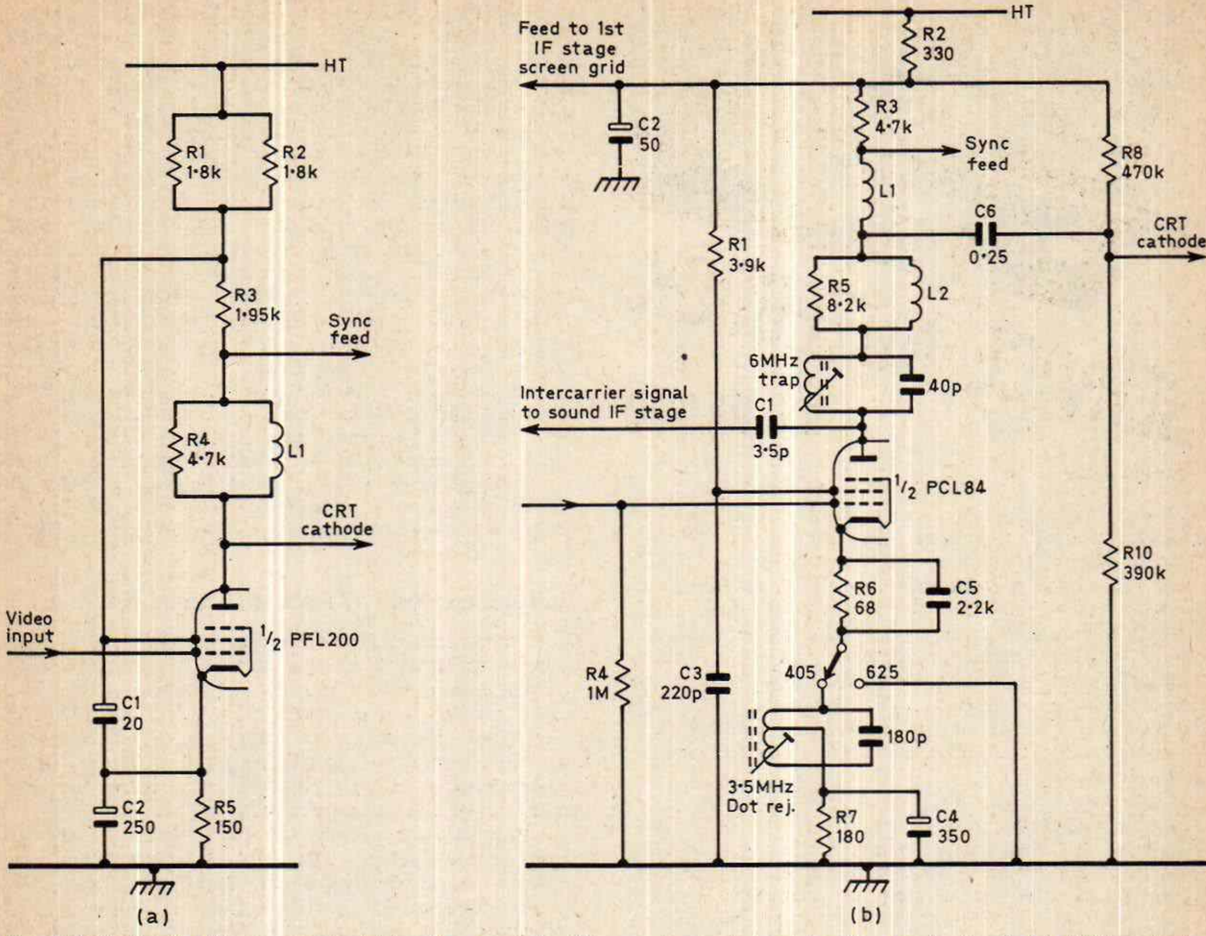


Fig. 4: Tailoring the l.f. response by taking the screen feed from a decoupled point in the anode circuit. (a) Philips circuit, (b) KB-RGD circuit.

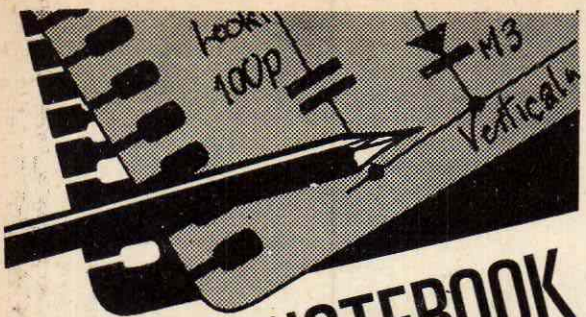
R7, the latter being fully decoupled by a 350μF electrolytic C4. On system change to 625 R7, C4 and the 3·5MHz dot rejector circuit are shorted out to leave only R6, 68Ω, in circuit. The resulting bias reduction is necessary to adjust for the change from a positive-going direct-coupled video input on 405 to an a.c. feed on 625 since the latter requires that the valve is biased for class A operation (in the Philips circuit the 625-line a.c. coupled signal is d.c. restored at the grid, so that no change in biasing between systems is necessary). On both systems in the KB/RGD circuit there is considerable negative feedback developed across R6 at low frequencies.

The first point to note in the screen grid circuit is that the decoupler is only 220pF, so clearly negative feedback will develop here at a comparatively high frequency. The second point to note is that the screen grid supply is taken from the junction of R1 and R3 in the anode circuit and is decoupled by C2, 50μF. This capacitor fully decouples the junction of R2 and R3 down to low frequencies so that R3 and L1 form the main load components. When however at very low frequencies the reactance of C2 rises to an appreciable figure R2 is no longer fully decoupled and forms part of the video load and also varies the screen grid voltage in similar phase. In addition the voltage at the junction of R8 and R10, which forms a d.c. potential divider for the c.r.t. cathode, is varied. The total net effect of this is that the response is shaped as required over the entire l.f. end of the video range.

Servicing and Experimenting

As well as maintaining gain and stability the decoupling components in these video circuits also fulfil a vital role in response shaping. When defective therefore they must be replaced by exact equivalents.

Experimenting on an old test receiver to see the effects that different capacitor values produce on the l.f. response gives real insight into video stage operation and underlines the importance of circuit impedance when choosing component values. To demonstrate the action of circuits such as those shown in Fig. 4, insert a resistor of a few hundred ohms between the top of the video load and h.t., decouple the junction to chassis with an electrolytic, and feed the screen grid from this point instead of from the h.t. line. Then ring the changes on decoupling component values while leaving the actual video load unchanged. ■



SERVICE NOTEBOOK

G. R. WILDING

No Raster

THERE was no raster but normal sound on an elderly Decca 17in. model. Naturally our first move was to check for e.h.t. and by holding the blade of a wooden-handled screwdriver close to the EY86 anode we were able to draw a sizeable blue corona even without removing the top-cap insulator. The rectifier's cathode appeared to be glowing normally and by transferring the screwdriver blade close to the valvebase we obtained good thin sparks. So it appeared that e.h.t. was being rectified and was plentiful. (Rectifiers can develop anode-cathode shorts.)

Our next move was to short-circuit the c.r.t. cathode and grid, pins 6 and 7 on the B8H base, to see if that restored a raster. On these bases the grid is also connected to pin 2 but it is more convenient and safer momentarily to short pins 6 and 7 when making this test: it avoids risk of shorting an h.t. carrying pin to either or both of the heater pins 1 and 8.

There was still no raster so it appeared that there was either no first anode voltage or an internal disconnection inside the tube. We were just about to check for the former when after wiping the c.r.t. neck we realised that the cathode was not glowing. Now a complete short across a tube heater is very rare so we next checked to see if any other valves were failing to warm-up, indicating a partial short across the heater chain due to a valve's heater-cathode breakdown. All the valves were normally lit however and remained so even after removing the c.r.t. base. It was obvious therefore that the short-circuit was only across the c.r.t. supply.

On unhinging the chassis and tracing the course of the brown (unearthed) c.r.t. heater lead we found that its insulation had been pierced at one spot by an earthed sharp-pointed soldered joint on a valve-holder. Wrapping a little insulation tape round the damaged area and rerouting the lead restored a normal picture.

Ragged Verticals

THERE were ragged verticals on a 23in. RGD receiver unless the fine tuner was adjusted "spot-on" and as the line hold was edgey the impression was of line sync trouble. After a few moments we noticed that the picture width was intermittently varying by a $\frac{1}{2}$in. or so. Replacing the PL36 and PY801 failed to effect a cure but on replacing the DY86 e.h.t. rectifier we obtained constant width with complete freedom from the ragged verticals and with normal line lock.

While it is easy to appreciate that an intermittent fault in this rectifier—such as a partial heater short-circuit—can vary the width by varying the load imposed on the line output stage it is rather more difficult to see how it can affect the line generator. The reason is that in modern sets with flywheel line sync a reference pulse is taken from the line transformer and fed to the flywheel sync discriminator along with the sync pulses. Thus intermittent faults in the line output stage must produce some effect on the discriminator d.c. output.

The three- or four-stick e.h.t. units used in BRC receivers can produce somewhat similar symptoms when defective—mainly only at high brilliance levels—and in extreme cases can make it appear that there are two pictures displaced sideways by about an eighth of an inch. The best cure with defects in these e.h.t. triplers or quadruplers is complete replacement of the unit.

Failure to Lock: Thorn 950 Chassis

THE picture modulation fluctuated wildly across the screen of one of these models and it was impossible to lock the picture although adjustment of the line hold control would momentarily "run through" the correct frequency. Fortunately an accompanying high hum level gave away the cause by indicating almost certain loss of capacitance in one or more of the main electrolytics.

Although not a common fault we have several times come across loss of capacitance in the multiple units employed in these receivers. The reservoir capacitor (C112), main smoother (C113) and two h.t. decouplers (C47 and C91) are all contained in one can mounted on the right-hand side of the chassis. On holding a test $32\mu F$ from C113 tag to chassis we obtained a drastic reduction in hum level and were able to lock the picture normally. Although only this one particular section appeared to be defective we replaced the complete unit to forestall any possible further trouble from this source.

On a test run the 405 results were normal but on changing over to 625 the field hold became weak and subsequently as the set became fully warmed

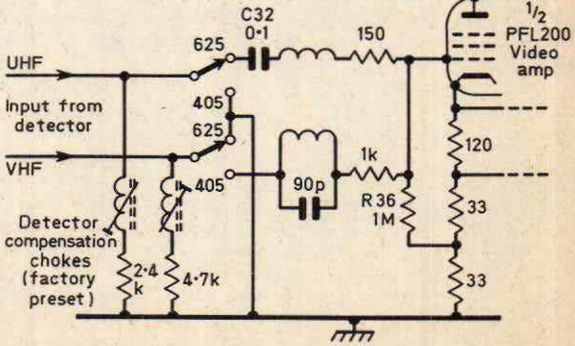


Fig. 1: Video amplifier grid circuit, Thorn 950 chassis.

up the line hold deteriorated. On reverting back to 405 both timebases locked perfectly. As is now fairly well known this is generally due to a slightly soft PFL200 video pentode which draws slight grid current on 625 due to the a.c. coupling from the vision detector but fails to do so on 405 due to the d.c. coupling used in this system with low resistance to chassis.

What is not so widely known, however, is that BRC have a slight modification which can be applied to these receivers should some batches of PFL200s be found to be more susceptible to this fault. The modification consists of changing the value of the 625 signal feed capacitor C32 from 0·1μF to 0·3μF and the grid leak R36 from 1MΩ to 330kΩ. In our case however replacement of the valve completely cured the trouble and there was no need to make the component changes mentioned.

Another cause of weak field lock on 625 lines only in these models—or more precisely intermittent field tripping—is a defective PCF805 in the v.h.f. tuner. In such cases it is usually found that there appears to be a narrow horizontal bar moving slowly up the screen, tripping the timebase when it reaches the top!

Boxing-up Troubles

QUITE often after servicing a TV chassis and returning it to its cabinet you may find that either the heater circuit has mysteriously gone open-circuit or that the raster intermittently blacks out or jumps to full and uncontrollable brilliance. Not to worry! The first symptom is usually caused by a valve being pushed over in its holder and failing to make contact or mains dropper resistor push-on clips having been disturbed and not making contact. In the latter instance, although the heater circuit may read open-circuit when meter tested the set will probably warm up normally when switched on and the mains voltage will overcome the clip-contact surface resistance.

On other occasions you may find the thermistor defective and the wire ends almost loose from the component body. It always pays to put finger pressure on old ones, especially if there has been a heater-cathode short in one of the valves.

When the raster intermittently blacks out or assumes full brilliance, the almost certain cause will be a disconnected or intermittently shorting lead on the c.r.t. base. On occasions you may even pull the e.h.t. cable away from the c.r.t. anode connector inside the anti-corona cap. The picture will continue however, though with severe screen spots, if the e.h.t. can jump the break.

Crackles on Sound

THERE were intermittent crackles on sound with random small white spots on the screen of a receiver fitted with the Thorn 850 chassis (the convertible, not the dual-standard, version). Tapping the valves as a first move had no effect on the symptoms but on reseating the EF80 sound i.f. pentode V11 which was quite loose in its holder a small ceramic capacitor on the i.f. deck suddenly glowed red. On switching off we found that this component, C123 in the maker's service manual, was a 1,000pF capacitor used as r.f. decoupler from one of the heater pins of the vision i.f. pentode V4 to chassis. We snipped it out of circuit and obtained normal reception completely free of crackles and screen spots.

The symptoms had obviously been caused by miniature sparks occurring inside the capacitor prior to its complete breakdown which equally clearly had been caused by momentarily breaking the heater chain when refitting V11. As there are only five valves and the c.r.t. in the heater chain between the point to which the capacitor is connected and chassis it would only normally be subject to about 50V r.m.s. However, on breaking the heater chain by reseating V11—one of the five valves—the capacitor would be subject to the full 240V mains voltage which rises to about 336V at peak values.

This demonstrates the strain that is imposed on valve heater-cathode insulation in series heater chains when a valve lower in the circuit is removed—although in this one instance the accidental action had located the fault far more quickly than was anticipated! Nevertheless, valves should not be removed from a working receiver although it must be admitted than many service engineers when pushed for time and in doubt about the function of a particular valve often push it over to one side in its holder to see its effect "out of circuit" till cathode temperatures reduce.

Although we have serviced many thousands of receivers this is the first occasion on which we have found a heater circuit decoupling capacitor breakdown. The capacitor was replaced to complete the repair as heater decouplers are important in preserving stability and eliminating the risk of patterning.

Intermittent Field Roll

INTERMITTENT field roll on a KB Model RV70 was found to be due to the field hold control only locking right at one end of its travel. Replacing the PCL82 field timebase valve produced no significant shift in locking position and in such cases we then tend to suspect resistor value change rather than a leak or value change in a capacitor.

As always we first check current-carrying types, these being most likely to alter in resistance value after some years of service. One of the first to attract our attention was the 180kΩ resistor connected from one end of the hold control to chassis—this would obviously have great bearing on the vertical locking point.

We shunted our meter on the 400V range across it and moved the locking point practically to the midway position. This action did not of course necessarily imply that the resistor in question was high-resistance—we could be compensating for a value change in a resistor elsewhere. On checking with an ohmmeter however we found this resistor to be about 1MΩ and on replacing it we obtained a perfect central locking position for the hold control.

Shunting a suspect resistor with a meter on an appropriate voltage range—and correct polarity—is a convenient way of seeing what effect resistance value reduction produces. It is especially useful in timebase faults such as the one described.

TO BE CONTINUED

DC Restorer Mod for Pye-Ekco sets

M. PITLOCK

MANY Pye and Ekco receivers—and the models of associated brands—from the period around 1965-6 use a video amplifier stage a.c. coupled to the c.r.t. cathode, with bias for the c.r.t. cathode provided by a simple potential divider across the h.t. line. These models include the Pye 40F recently covered in the servicing series (October-November, 1970), the Ekco T442 series, the 16in. "compact" models and the Pye 36/37 and Ekco T503-T506 groups of models. This form of video coupling results in a picture that is wishywashy in the dark scenes and soot-and-white-wash in bright scenes, particularly on 625-line reception which tends to exaggerate differences in picture brightness.

The modification shown in Fig. 1 comprises the addition of a d.c. restorer to the circuit without the need to make any changes to existing components in the circuit. The additional components required are a Mullard diode type OA202, a 10kΩ ½W and a 27kΩ 1W resistor. The d.c. restorer diode conducts when the junction of R79 and R79A is driven sufficiently positive (as it is when the sync pulse appears) and short-circuits the signal to the junction of the added components Ra and Rb. When the video information reappears the voltage at the junction R79 and R79A moves in a negative direction.

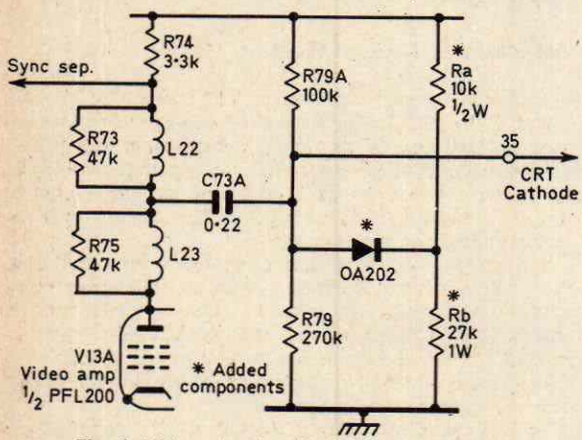


Fig. 1: Video circuit with d.c. restorer added.

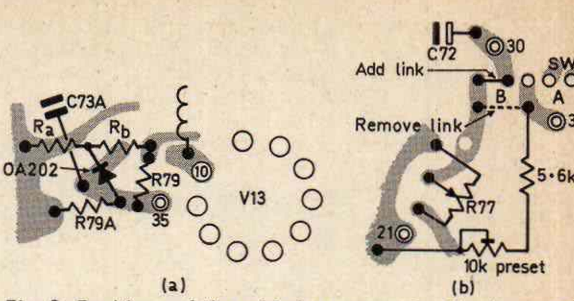


Fig. 2: Positions of the added components. The layout of the complete board was shown on page 27, October 1970.

The positions of the components added are shown on the layout diagram (Fig. 2). They can be easily soldered on at the back using layed-on joints. The junction of Ra, Rb and the diode (end coded red) may be left in the air or secured to an insulator made from a piece of tagstrip.

When this modification has been carried out it will be found necessary to turn down the brightness control. Some improvement will be noticed on 405 lines but on 625 lines the improvement is quite dramatic, due to the different method of modulation.

Note that in early versions of some of these models R79 was 470kΩ and R79A was omitted. Where this is found to be the case first modify the circuit to the later arrangement.

Contrast Equalisation

After carrying out this modification it will be found that the contrast level on 625 lines is far greater than the 405-line level. Instead of fitting a second contrast control and changeover switch, the further circuit change shown in Fig. 3 was adopted. The positions of the extra components are also shown in Fig. 2. The 10kΩ preset used is a small skeleton rotary type as this is more compact than the sliding type. Again these components, including the new wire link, can be soldered to the back though the original link must be carefully pulled out from the other side. The resistor leads must be sleeved.

Adjustment of the contrast equaliser can only properly be done when a test card is being transmitted on 405 and 625 lines. Switch first to 405 and adjust the contrast to the normal viewing level. Also adjust the brightness until the black squares look black. Then switch to 625 lines and adjust the 10kΩ preset until the test card picture has the same brightness. ■

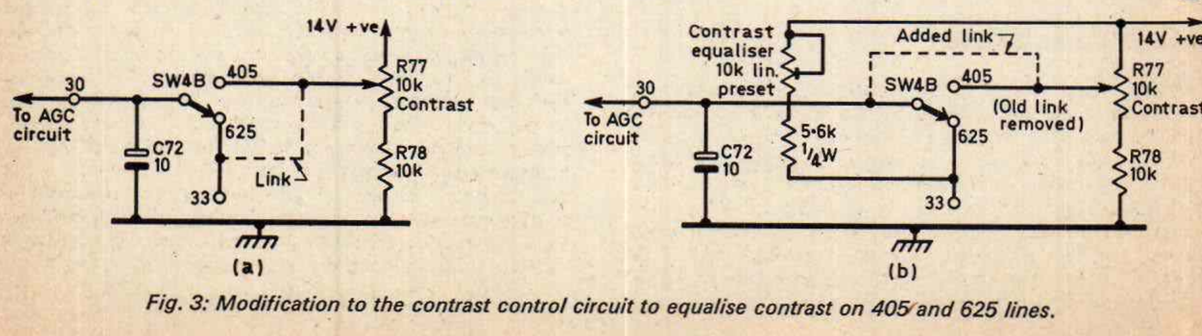
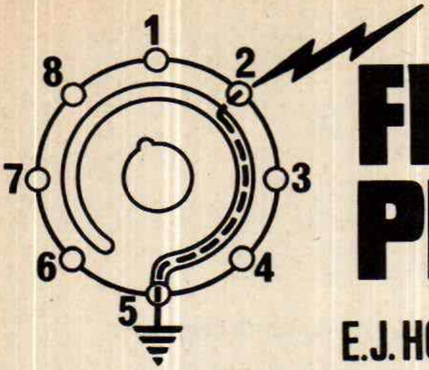


Fig. 3: Modification to the contrast control circuit to equalise contrast on 405 and 625 lines.

PART 2



FLASHOVER PROTECTION

E.J. HOARE

WE have so far confined our discussion to the immediate vicinity of the picture tube. This is where the trouble starts and this is the source of the large amount of energy involved. We saw earlier that at the instant of flashover an astonishingly large current of the order of 500-1000A flows, and this generates a pulse voltage of anything up to 8-10kV in the external circuit. Some of this energy has the nasty habit of cropping up in the most unexpected places almost anywhere in the receiver circuitry.

In one receiver known to the author it was not uncommon for about half a dozen transistors to fail simultaneously in widely scattered and unrelated parts of the circuit. It was a complete mystery at first, but the cause of the trouble turned out to be our new found friend—flashover. However with careful design and testing this sort of problem can be avoided.

In Part 1 we sorted out the techniques for protecting the picture-tube circuits. Now we must do the same for various other parts of the receiver in which a number of rather subtle problems can arise.

Coupling via the Deflection Coils

The line deflection coils are a snug fit on the neck of the c.r.t. and so there is an appreciable amount of capacitive coupling between the coils and the gun structure. Where flashover occurs between the final anode and one of the other electrodes, some of the e.h.t. energy is injected into the line deflection coils. The field coils are on the outside and do not usually receive enough energy to present any special problem.

The energy in the line coils however will travel down the leads to the line timebase and may be distributed via the transformer windings to all sorts of unexpected places. Rectifier diodes will be the first to go, but line output transistors can also be damaged. In some cases secondary flashover will occur between connecting leads and may be coupled into circuits which are apparently unrelated to the timebase.

If one side of the deflection coils can be connected to chassis it is probable that all will be well and no further precautions will be necessary. It is common practice however for the coils to be connected in a configuration balanced about the h.t. line. In this case special care is needed when attempting to bypass the flashover energy. The reason is that you can very easily bypass the line scanning energy as well and place a virtual short-circuit across the line output transistor with unhappy results.

In view of the special difficulties that can arise in this part of the receiver circuitry it is unfortunately not possible to give useful guidance of a general nature. The precautions that can be taken depend so much upon particular circumstances.

Line Output Transistors

In a valve timebase it is not necessary to take any special precautions to protect the output stage or the boost diode. They are both capable of withstanding quite large overloads of voltage and current for very brief periods. In a transistorised line timebase however the output transistor must be protected against overload because in common with all semiconductor junction devices it is strictly a go/no-go device. Any overload that overheats the junction will destroy it instantly: there is no second chance.

When flashover occurs the e.h.t. capacitance is completely discharged. This means that the line timebase is in effect looking into a short-circuited load. Thus the output stage sees only the leakage inductance of the transformer instead of the normal inductance of the deflection coils in parallel with the inductance of the transformer primary. The result is a large increase of peak voltage and peak current which occur to a decreasing extent every flyback period until the e.h.t. capacitance is recharged. This sort of problem can only be tackled by designing the output stage in a manner which makes it impossible for such large currents and voltages to be generated at all, whatever the load condition.

Adding Series Resistance

The usual way of overcoming the problem is to add on extra series resistance in the h.t. supply to the timebase. This makes the regulation of the timebase sufficiently bad to limit the overload effects adequately, without seriously affecting the e.h.t. voltage regulation to the picture tube. Most home constructors use an off-the-peg line output transformer because the design of this component is a highly specialised art. If however you are being adventurous and doing it all yourself, it is important to bear this flashover problem in mind.

EHT Tripplers

Many all solid-state receivers, particularly colour ones, use e.h.t. tripplers. These operate with an input line flyback pulse of 6-9kV and produce an e.h.t. output of 18-25kV. The trippling action of the diode network requires charging capacitors and these are commonly of about 470pF.

A 470pF capacitor charged up to something approaching 25kV has a large amount of stored energy, and this is released during a flashover. Consequently a large current can flow out of the trippler and is present in the return path—usually an earth connection. This can cause trouble as a result of voltages induced in the earth paths and coupled into other circuits, and the trippler itself may be damaged.

Some tripplers have a series resistance built into the assembly to limit the peak flashover current that can flow and prevent any undesirable effects. If this resistor is not present it is good practice to add two carbon resistors—or a wirewound one—totalling about 47kΩ in series with the output lead. Good insulation or adequate air clearance will of course be needed.

Degaussing Coils

In the first part of this article we saw that the external aquadag coating of the tube can develop a pulse voltage during flashover of up to −10kV. Now in a colour receiver the cone of the tube is covered by a metal degaussing shield and the degaussing coils are looped in between. If one side of the coils is connected to chassis and the outside of the tube is at −10kV, what happens? Clearly there are two solutions to the problem. Either the coils are insulated to 10kV a.c., which is expensive, or else they are encouraged to take up the same potential as the tube coating.

Figure 9 shows a convenient way of connecting the degaussing coils so that they are free to float with the aquadag coating when a voltage pulse comes along. Note that the coils must be earthed via the aquadag earth connection. A separate lead to chassis

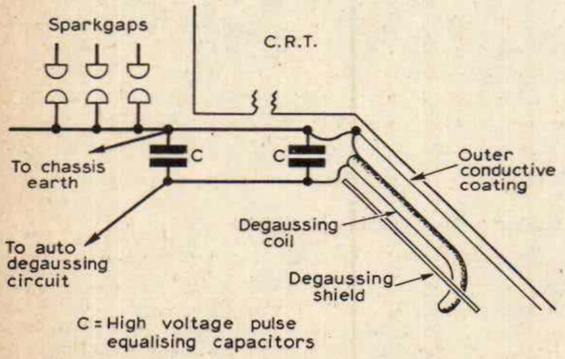


Fig. 9: This method of connecting the automatic degaussing coils leaves them free to float during a flashover, and prevents a secondary flashover between the coils and the shield or the conductive coating on the cone of the c.r.t.

would undo the c.r.t. circuit protection that we discussed in Part 1.

The two capacitors *C* equalise the pulse voltage across the coils and their external circuit connections. Without them a secondary flashover could occur across the coils or between the earthy and live feeds. These two leads should be arranged in a bifilar manner and a good technique is to enclose them in a piece of p.v.c. sleeving to ensure close proximity. The capacitors need to be capable of withstanding high pulse voltages, 470pF disc ceramics of the type used for aerial isolation purposes being a good choice.

Chassis and Lead Clearances

The −10kV on the cone of the tube that we have just been discussing in connection with the degaussing coils has some other implications. The first is fairly obvious but easily overlooked. The degaussing shield is sometimes a convenient place on which to tie a bundle of passing leads on their way to the front control panel, deflection coils, convergence controls, etc. It makes a tidy job, but don't do it! Did you really mean to inject a hefty great flashover pulse into that black-level clamp circuit?

The next point to beware of is the chassis and its contents. How close is it to the aquadag coating? If we assume a maximum pulse voltage of −10kV we need at least half an inch minimum air clearance in order to be quite sure that no breakdown can occur. And of course what we mean here is not just half an inch to the nearest piece of metal work, but to the nearest point of any component, lead, coil screening can, etc.

Chassis Currents and Receiver Earthing

The effects of a secondary flashover from a component or a lead are in general terms obvious enough. What may not be quite so obvious is that a flashover from the chassis itself may in some cases be even more disastrous. Let us see why.

Bearing in mind that an arc has a very low impedance, you can see that when a flashover occurs between chassis and aquadag the effect is to connect the chassis to a large source of energy at −10kV. This causes a large current to flow.

Now although the chassis is commonly regarded as a low impedance earth path, under flashover conditions the small amount of inductance in this path is important. It represents a high impedance (because of the high rate of change of current). As a result a large pulse voltage is developed between the point of flashover and the earth connection at the cold side of the c.r.t. sparkgaps. Fig. 10 shows how this comes about.

If you are building a receiver, particularly a colour one with its large amount of e.h.t. energy, try and follow this argument if you will, because it is the key to many flashover problems of all kinds. The path the flashover takes may be different in particular cases, but the mechanism is similar.

In Fig. 10 the flashover energy can, and does in this case, take two paths. Some of the current flows through the normal flashover protection path as we discussed in Part 1, and some flows through the chassis and other earth connections. Clearly point D is going to take up an instantaneous negative

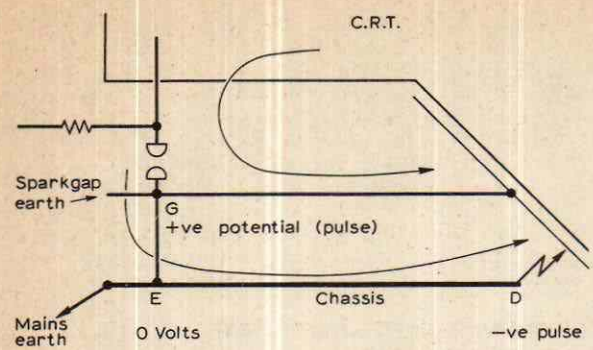


Fig. 10: A flashover to chassis produces a large voltage drop across it.

potential with respect to point E, which is connected to true earth. In passing it should be noted that by the same argument point G will take up an instantaneous positive potential with respect to E, and this will throw a further strain on the protection of the video output stage and other circuits.

Figure 11 shows the effect of this chassis flashover voltage on a perfectly normal circuit arrangement. The h.t. line is not affected by the flashover, nor is the voltage on the base of the transistor: they are both derived from sources tied to true earth. But now look at the emitter of the transistor! It is being pulled negatively by 10s or 100s of volts by the effect of the flashover current. The transistor conducts so heavily that the junction is destroyed instantly. No noise; no puff of smoke. This is the fundamental mechanism by which flashover currents do their damage, and sometimes frustrate the best intentions of circuit designers trying to build a reliable product.

It is important to note that the path E-D does not have to be a foot of steel strip. It may be an inch or two of copper on a printed board. Also the flashover current is not of course always caused by an arc between chassis and aquadag. Any flashover current leaking through the earth paths—perhaps from a c.r.t. electrode—will produce the same effect, although probably to a lesser degree. So our half inch of clearance between the chassis and the c.r.t. is very important indeed, but it is not a complete answer to all the sneaky earth path problems. And here is another aspect of the case.

Chassis Capacitance

A vertical chassis placed close behind the cone of a c.r.t. will probably have an air-coupled capacitance

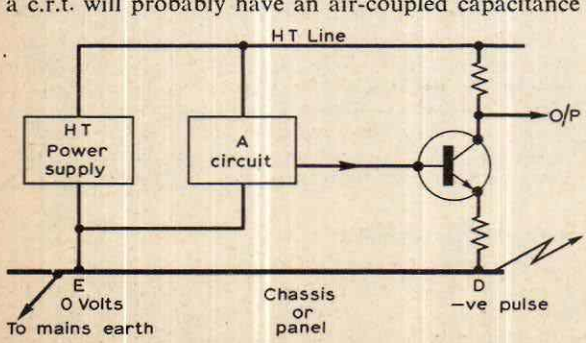


Fig. 11: An easy way of blowing up a transistor! Points E and D are the same as those in Fig. 10.

of a few tens of picofarads to the aquadag. Now if you replace the arc of Figs. 10 and 11 by a small capacitance, you have a very similar state of affairs. The impedance is higher and the flashover currents will be smaller, but the mechanism of the problem is more or less unchanged.

Note, however, that the currents are not confined to earth paths, although these will carry most of the current. It is quite possible for voltages to be developed in transistor base circuits as well, or even on collector heatsinks.

General Precautions

Before we go any further it may not be out of place to offer a word of cheer after this gloomy story of electronic mayhem and disaster. It is true that all these effects can and do happen, and they can be very serious in isolated cases. However if you do two things you will probably never experience any of them. First make sure that the protective measures around the electrodes of the c.r.t. are the best that you can devise. Secondly space the chassis well clear of the c.r.t. About two inches is probably enough in most cases for a colour receiver but the more the better. Blow the slimline styling.

In connection with the second point it is clearly good practice to avoid having large slabs of steel sheet running parallel to the cone of the c.r.t. and providing extra air-coupled capacitance. Don't forget the bulky screening cover of the line output transformer.

CRT Protective Band

The protective steel band round the seal between the cone and the faceplate of the c.r.t. has quite a large surface area. Consequently it has an appreciable capacitance to the internal aquadag coating which is at e.h.t. potential. The band will therefore build up quite a large static charge which could jump out and bite anyone touching the front of the cabinet near the edge of the tube.

This band must always be joined to chassis in order to keep it discharged. As however it is possible for the chassis to be connected to mains "live" in a.c./d.c. receivers, the connection to the band must be made via an isolating network. This may consist of a good-quality 2MΩ 1W resistor in parallel with a 470pF high-voltage ceramic capacitor. The earthy end of this network should be connected to the external aquadag coating, which in turn is joined to chassis.

During flashover the voltage pulse on the external aquadag coating will be coupled to the metal band. Make sure that it is properly isolated from leads, components, and any metalwork such as screens and trim that pass through the cabinet to the outside.

Earth Connection to the Aquadag

The conductive coating on the inside and outside of the cone of the c.r.t. is not such a good conductor as copper and it is only moderately resistive to wear and tear. Any connection to this coating must therefore have quite a large area of contact in order to keep the electrical resistance low and to withstand the very large flashover currents. Otherwise the coating will be damaged, a bad contact will develop and the protective measures we have discussed will be undone.

An easy way of making a good contact is to stretch a piece of copper braiding diagonally across the cone of the tube. It should be tensioned with a coil spring. Another piece of braiding can then be soldered to the middle and connected to the common earth point at the base of the tube (not the chassis).

Testing a Receiver

This is one of the most frustrating problems facing the home constructor. You can test any other aspect of receiver performance but not this one. You simply cannot afford to go blowing up transistors and diodes to see if they blow up! All you can do it to take all possible precautions, based on some fundamental principles, and then hope that all will be well and that you will not be caught out by a combination of circumstances that you could not forsee.

The chances are that if you apply the various techniques that we have been discussing you will not have any trouble. Then of course you will wonder what all the fuss was about and may even feel vaguely disappointed that your defences do not appear to have been tested. If on the other hand you even hear a sharp crack and the receiver carries on undismayed, you have every right to feel pleased.

Simulated Flashover

Receivers are tested for the efficiency of their flashover precautions by using an external adjustable sparkgap in place of the flashover path inside the c.r.t. One side of the sparkgap is connected to the c.r.t. final anode and the other side to one of the electrodes at the base of the tube. Fig. 12 shows the circuit arrangement. The connection to

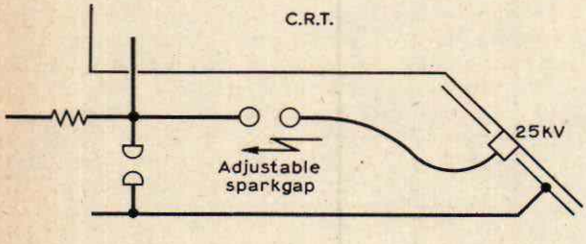


Fig. 12: Each electrode of the c.r.t. is tested in turn with several tens of flashovers. This test should be attempted only by fully qualified engineers. It may of course cause the destruction of a number of expensive semiconductors.

the tube base socket must go direct to the tag and must be neatly done so that no whiskers of lead or solder stick out and cause a flashover to neighbouring conductors.

To begin with the sparkgap is adjusted so that no arc occurs when the receiver is switched on. Then the two sparkgap electrodes are brought closer together until a spark jumps across. The art is to adjust the gap so that the artificial flashover occurs at the rate of several times a minute. If no fault develops in the receiver the test is continued for several tens of flashovers. After this the lead is connected to the next tag on the tube base holder and the test repeated. This process is continued until every tag, including the heater connections, has received its proper quota of discharges.

If a fault occurs in the receiver the flashover path that caused the trouble has to be located and a cure devised which either blocks the energy or bypasses it to earth. When this has been done the test is started again in order to prove that the cure really does work.

Locating the Flashover Path

Finding the exact course of the flashover path can on occasions be quite difficult. Sometimes it betrays itself by the telltale flash of a secondary breakdown somewhere amongst the copper print pattern when the receiver is inspected in total darkness. At other times you really have to get down to first principles, think hard, and deduce where the trouble must be. Then you have to prove it. It is a very time-consuming business and you can burn up quite a lot of perfectly good semiconductors. This is the price you have to pay for playing Sherlock Holmes!

At this point we must remind readers that handling sparkgaps with 20-25kV from a low-impedance source such as a TV receiver is a game to be played only by experts who know the rules. If in doubt—don't! Semiconductors can be replaced, but not you.

To the Constructor

If you are building an all-valve receiver you can afford to ignore most of this talk of flashover and sparkgaps. If on the other hand you are making a hybrid or all solid-state receiver you do so at your peril. Some c.r.t.s never flash over: some do so quite often. It is the sort of problem where you never quite know how you stand.

Colour Receivers

It is particularly important to take care with colour receivers. Colour picture tubes are a little more prone to flashover than monochrome ones; there are more flashover paths and the amount of stored e.h.t. energy is greater. Furthermore the transistors used for driving a colour tube tend to have fairly high voltage and power ratings and are consequently more expensive than their monochrome equivalents.

But do not be dismayed. Simple precautions of the kind we have been discussing can make all the difference between freedom from trouble on one hand and having a number of unexplained component failures on the other. Note in particular the importance of correct earthing arrangements for the c.r.t. *If you are doing any service work on a TV receiver make sure that you do not alter any earth connections.* They may have been very carefully devised.

Acknowledgement

Acknowledgement is due to A. Ciuciura of the Mullard Central Applications Laboratory who undertook much of the original research into flashover problems and devised the basic protection techniques described in these articles.

Part 1 *appeared in our November*, 1970, *issue.*

DX-TV

CHARLES RAFAREL

As expected for this time of the year, SpE DX drifted slowly down to even lower levels of activity during November. There was, however, some SpE DX about and I managed to log something each day. The signals have been of even shorter duration and at weaker levels than in the previous month and this has presented me with very great identification problems. Some possible loggings have "slipped through my fingers" for this reason, which is rather infuriating! The log shows that here stations mainly to the East and North East have been coming in, with the USSR as the best, and with no stations to the South, except Spain.

I recall that in previous years at this time there were different patterns. For example in the past two years it was Italy that was possible when all else failed. So if this year you want to check whether your gear is still OK try USSR R1 between 08.00 and 09.00: that should put your mind at rest!

Now for the SpE log for 1-30/11/70:

1/11/70	USSR R1, Poland R1.
2/11/70	USSR R1, Czechoslovakia R1, Austria E2a.
3/11/70	Czechoslovakia R1.
4/11/70	Czechoslovakia R1.
5/11/70	USSR R1, Austria E2a, Spain E2.
6/11/70	Poland R1, Austria E2a.
7/11/70	USSR R1, Spain E2.
8/11/70	USSR R1.
9/11/70	Poland R1.
10/11/70	USSR R1.
12/11/70	USSR R1, Poland R1.
13/11/70	USSR R1, Austria E2a, Sweden E2, Spain E2.
14/11/70	Austria E2a, Poland R1, Spain E2.
15/11/70	USSR R1, Czechoslovakia R1.
16/11/70	USSR R1, Czechoslovakia R1, Sweden E2, Spain E2, Switzerland E2.
17/11/70	Pol/MT test card R1 ? Poland or Hungary, Czechoslovakia R1, Sweden E2.
18/11/70	USSR R1, Sweden E2, Spain E2.
19/11/70	USSR R1.
20/11/70	USSR R1.
21/11/70	Czechoslovakia R1, Poland R1, Sweden E2, Spain E2.
22/11/70	USSR R1.
23/11/70	USSR R1.
24/11/70	USSR R1, Czechoslovakia R1.
25/11/70	USSR R1, Czechoslovakia R1, Pol/MT test card R1 ? Poland or Hungary.
26/11/70	Czechoslovakia R1.
27/11/70	Czechoslovakia R1.
28/11/70	USSR R1, Spain E2.
29/11/70	USSR R1.
30/11/70	USSR R1.

There was some F2 activity noticeable with the USSR sound only stations on 38-40MHz coming in well almost daily from the 1st to 18th November, and even the USA police were about here on the 3rd. The Trops have been very poor: when a signal build-up occurred the weather soon changed and put paid to it. I am still patiently waiting for a good Trop opening to see how the colour TV performs on West Germany!

I have heard rumours via R. Bunney of the ORF Austria electronic test card being seen on Ch.E3 as well as E2a and E4, so this looks like a new transmitter in service. Has any other DXer seen it? Roger has also provided me with some reports of F2 activity in different parts of the world: they are enough to make one just green with envy! He has a report from Bill Heusmann of Des Moines USA of his reception of France Ch.F2 sound there and another report from Glenn Hauser at present in Thailand of his reception of BBC-1 Ch.1 on sound and vision and France Ch.F2 sound on 22/10/70. Glenn also reports Japan up to 60MHz via F2 and Arabic on Ch.E2. He thinks that this is Lebanon and says that he has had Korea via F2, and India New Delhi plus Pakistan Karachi E4 via TE. In fact it was quite common from 1/9/70 onwards.

In spite of all this it seems we must be content here with occasional F2 reception of US Paging and Police stations at around 40MHz. There are reasons for this. Firstly our location in the Northern Hemisphere precludes us from getting the better F2/TE that prevails in more tropical areas like Thailand. Secondly, reception in the US of Europe is a little easier than in the reverse direction because the European frequencies for Chs. B1 and F2 are lower than the US counterpart Ch.A2, lower frequencies propagating better than the higher ones.

Roger reports US Police radio on 1/11/70, I quote "as high as 42·75MHz, which is as high a frequency I have heard across the Atlantic". This is still a long way l.f. of Ch.A2 in the States with vision on 55·25 and sound on 59·75MHz, so this is the real problem. It means that we need some really good F2 conditions before we can raise the USA via F2. As, however, the US Ch.A2 vision frequency is l.f. of the sound it is the signal we are more likely to receive: it will be easier for us to distinguish a 525-line 60Hz image from a 625-line 50Hz one than to try to identify an American voice that could originate either in the States or in Europe. This you may remember was what happened to Maurice Opie and myself with our reception some two years ago of a 525-line 60Hz picture ? origin Brazil.

NEW UHF STATIONS

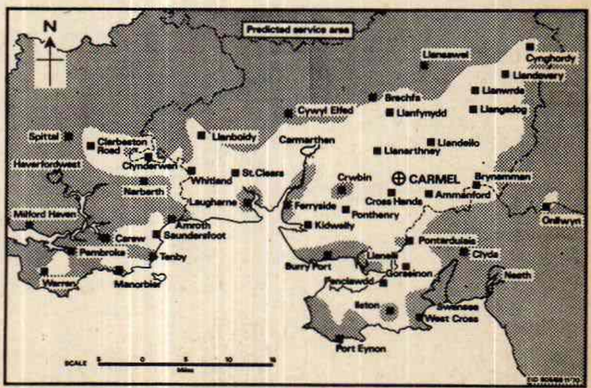
New u.h.f. stations are as follows:

Sweden. Mora Ch.22 1,000kW hor.; Falun Ch.40 15kW hor.; Visby Ch.41 1,000kW hor.; Motala Ch.45 1,000kW hor.; Sunne Ch.50 1,000kW hor.

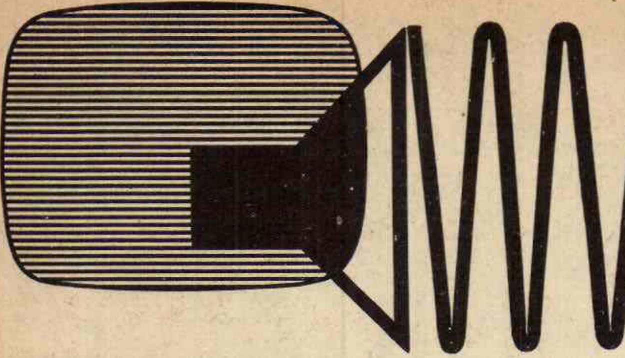
France. Porto-Vecchio Ch.34 25kW hor.

Holland. Arnhem Ch. 50 30kW hor. NOS1; Arnhem Ch.53 30kW hor. NOS2. (Ian Beckett has already logged Ch.53.)

CARMEL UHF SERVICES



The above BBC map shows the predicted service area. The channels are BBC-Wales 57, ITV 60, BBC-2 63. Aerial group C, horizontal polarisation, maximum e.r.p. 100kW.



IMPROVE YOUR TV AUDIO CHANNEL

M. A. HARRIS B. Sc.

ALTHOUGH the modern TV set gives by and large a fairly good picture, the sound output stages are generally left to their own devices. What with single-ended PCL82s and the like driving tiny side-facing loudspeakers, the quality of the output is poor.

One of the difficulties of connecting a high-fidelity or any other amplifier for that matter to the average TV set is that the television chassis is almost always connected to one side of the mains whereas the amplifier chassis is, or should be, earthed. The electricity boards frown on earthing the neutral supply, and the domestic fuses do not generally stand the live supply being earthed! Isolating capacitors are never very satisfactory since they invariably allow quantities of 50Hz hum into the audio circuitry. The amplifier to be described however is mounted inside the TV cabinet and so does not have these problems, the two chassis being connected together safely.

Amplifier Circuit

The design is based on the well-known Mullard 3-3 amplifier (Fig. 1). As can be seen the amplifier consists of only two valves and so the chassis for it can be made physically small enough to fit into the slimmest of slimline TV sets. The output transformer may be mounted separately from the amplifier chassis on the cabinet side. The bass control (50kΩ) can be omitted but is strongly recommended to compensate for the lack of bass obtained with a small speaker in a small box.

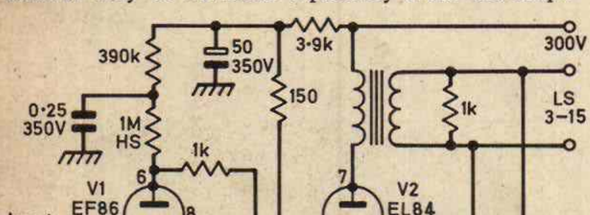


Fig. 1: The basic Mullard 3-3 circuit.

The circuit incorporates some interesting technical features. The EF86 voltage amplifier is operated with low anode and screen voltages and is directly coupled to the output pentode. This raises the gain of the voltage amplifier to two or three times that obtained under normal operating conditions. With direct coupling the cathode voltage of the output stage is higher than would be required with *RC* coupling. The d.c. conditions of the amplifier are stabilised by supplying the screen of the EF86 from the cathode of the output pentode, thus introducing d.c. feedback.

HT Supply

Since the amplifier chassis is connected to one side of the mains supply through the TV chassis, a.c./d.c. techniques can be used to obtain the 300V or so h.t. required. First identify the wire that goes from the on/off switch to the set's mains dropper—i.e. the wire *not* connected to the chassis. This is taken via a 10Ω 3W resistor (Fig. 2) to a silicon

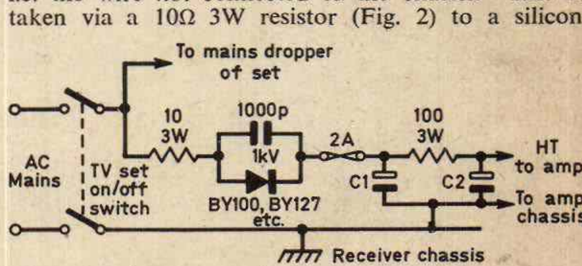


Fig. 2: Method of obtaining an h.t. supply of about 300V for the audio amplifier. See text for suggested values for C1 and C2.

rectifier across which (to eliminate "spikes" on the mains waveform) a 1000pF capacitor of 1000V rating is connected. The output of the rectifier is fed through a 2A anti-surge fuse to the smoothing and reservoir capacitors. This will give approximately 300V for the amplifier.

The values of C1 and C2 depend on what the constructor has in his spares box. Ideally they want to be something like 100μF (C1) + 200μF (C2) at 350V working. More than this may be used but anything less will not give the 300V or so needed. As space is at a premium in most TV sets the main electrolytic can be mounted in a clip on the cabinet somewhere convenient with the other components built on to a small tagboard or tagstrip soldered to the pins of C1 and C2. The rectifier does not have to be a BY100 or a BY127: any rectifier will do provided it will deliver 60mA and is rated at 800V p.i.v. at least.

Heater Supplies

The next problem is to sort out the heater supplies required for the two valves. A mains transformer could be used but is more likely to be an embarrassment than anything else because of the space required and more important the radiation of a 50Hz magnetic field which could easily distort the picture if the transformer is mounted close to the tube. A much easier way is to make use of the series heater chain that most TV sets have. The valves in the original Mullard design are an EF86 and an EL84. The EF86 requires 6·3V at 200mA. As most TV sets have a 300mA heater chain a 68Ω 1W resistor must be soldered across the EF86 heater pins to bring the total current to 300mA. The EL84 requires 6·3V at 750mA. Fortunately a roughly equivalent valve with 300mA heater is available—the PL84. The author has also tried a PL82, with no apparent difference to the ear. The constructor could use either—whichever is in his spares box. The heaters are of course wired in series.

If the original sound output valve is removed, the heater supply can be picked up using a B9A plug (most output valves have a B9A base). Fig. 3 shows the amplifier's heater chain. If an EF86 and

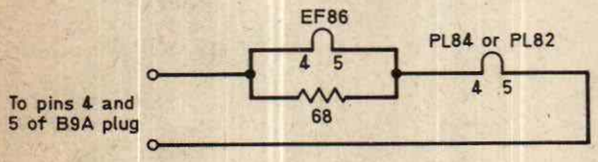


Fig. 3: The amplifier's heater chain.

PL84 are used the heater voltage required will be 21·3V. An EF86 and PL82 will require 20·3V. Audio valves commonly used in TV sets are the PCL82, PCL83 and PCL86 which have 16V, 12·5V and 14·5V heaters respectively. In the worst case—an EF86 and PL84 at 21·3V replacing a PCL83 at 12·5V—an extra 8·8V will have to be found. In practice the extra 8·8V means under-running the chain by (8·8/240) × 100 = 3·6%. This is quite in order although the purists could always drop the heater tapping on the mains selector 10V, i.e. from 240 to 230, and then insert a 10Ω 2W resistor somewhere convenient in the chain—say in the sound amplifier stage or next to the tube base, both being easy places to get to.

Audio Connections

The audio input to the amplifier is most easily picked up using the B9A plug used for the heater supply. For a PCL82 it is pin 1. Do not connect the braiding (use coaxial wire) at the PCL82 end. Leave it free and insulated (to prevent accidental shorts) but connect it to the amplifier chassis. If it is more convenient the audio can be taken from the slider and earth connections of the volume control.

The loudspeaker connections must be removed from the original output transformer if this is not being used for the new amplifier—a larger one is strongly recommended to prevent distortion due to saturation of the core which especially at high volume levels would almost certainly happen with the original—and connected to the new output transformer. The other connections to the old transformer can be left in place. The new output transformer should have a primary impedance of 5kΩ and a secondary impedance suitable for the loudspeaker being used

Constructional Notes

No layouts are given since the space available will depend on the make and type of TV set. The output transformer and power supply can be mounted almost anywhere on the cabinet sides to leave the amplifier chassis very compact.

Setting Up

The only point to watch when setting up is to get the feedback loop correctly phased. Leave the loop disconnected at first. Switch on and allow to warm up, then earth one speaker terminal and contact the feedback lead to the other one. If the hum and noise level drop this is correct and the leads can be permanently soldered in place. If on the other hand a large howl is heard the connections are the wrong way round and need changing over.

The writer has had this amplifier in his domestic television set for well over a year now and is very pleased with the results. One speaker of the high-fidelity installation in fact lives next to the TV set and is usually preferred to the set's own speaker.

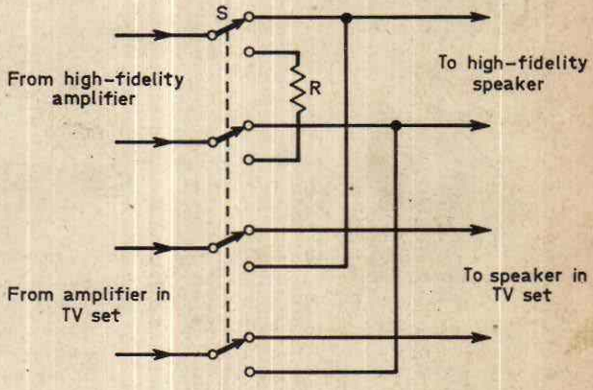


Fig. 4: Changeover switch for switching from the loudspeaker in the set to an external high-fidelity loudspeaker. S is a four-pole changeover switch while R is probably 15Ω and of wattage rating to suit the high-fidelity amplifier.

A changeover switch has been mounted on the back of the TV set with a dummy load for the high-fidelity amplifier when the speaker is used for TV sound. If any constructor wishes to copy this arrangement the connections are shown in Fig 4. It will be noted that double-pole switching is used. This is because the chassis of the high-fidelity amplifier is earthed whereas the TV chassis is (or should be) tied to the neutral side of the mains. ■

Workshop HINTS

by VIVIAN CAPEL

FEW engineers enjoy dealing with the paperwork that arises during the day-to-day running of a service department. Some firms, particularly the large multiples, seem to take a delight in flooding the workshop with forms, time sheets, tallies, requisitions, permits, progress sheets, job dockets and many others, all of course to be made out in triplicate. So much so that some engineers have been heard to remark that it is more serious to lose a ball-point than a soldering iron! Certainly time spent wading through unnecessary paperwork cannot be spent on benchwork.

Some smaller establishments on the other hand make do with rough and ready systems that are inadequate so that when queries arise much time is wasted in searching for information and sometimes costly mistakes occur. What is needed is a system of paperwork that provides as much information as necessary but with the minimum of time and effort spent in recording it. So we shall now outline a few suggestions which have been used in various workshops with success for dealing with this often irksome but necessary chore.

Progress Book

First some means of checking the progress of a job through the workshop together with an instant means of establishing its present state, i.e. completed, soak testing, awaiting parts or estimate acception, is needed. This can be provided by a progress book.

The progress book needs to be permanent so a hard cover ledger-type book would be most suitable. As soon as a job is brought into the premises it should be entered in the book. This should be enforced as a strict rule, as an intention to do so later can easily be forgotten with the result that there is a job in the workshop for which no record exists.

Job Numbers

Each job must be given a job number to readily identify it and this should be entered first in the left-hand column (see Fig. 1). Other information can then be entered along the same line. This will enable a large number of entries to be made to the page and will facilitate finding information at a future time.

The job number can be just a numerical sequence starting at 1 and progressing indefinitely. Alternatively it could take the form of an invoice number where the final invoice is made out in a numbered duplicate book. But this means checking the next available invoice in the book, reserving it by filling in details such as customer's name and address and then entering the invoice number in the progress book. When a field engineer is bringing in a number of sets for workshop attention this can absorb a lot of time.

Another system which has much merit is to incorporate the date or part of it into the job number. This can be just the month and year, written without hyphen, and then the actual job number. Thus the first job in June 1970 would be 6701, the second 6702 and so on. At the end of the month the numbers would revert to start at 1 again for the following month so that July would start 7701. This has the advantage that in any future reference the approximate date can be immediately ascertained, a useful feature because customers' memories regarding previous service dates are notoriously unreliable! The day could also be incorporated if desired but this could add complications as 112 could mean either the eleventh of February or the first of December. If the day was put after the year then similar confusion could result with the actual job number. If a more precise time location is required a week number could be included. Number 1 would start on the first of the month and subsequent numbers on succeeding Mondays. Thus the first week in June would be 1670. Job numbers could still run the whole month before reverting to 1. Generally however, the month should be sufficient in the smaller workshop as the part of the month can be estimated from the magnitude of the last number.

From time to time it may be necessary to analyse the work load of the workshop to determine which are the busiest or slackest times, or to compare months with previous years. This can easily be done without a lot of research by just consulting the progress book for the last job number in the months concerned. This of course will give the number of jobs received during that month.

Information Entered

After assigning the job number and recording it in the progress book the next entries are the customer's name and address and the make and model number of the set. Serial numbers can be recorded if desired. This is generally not necessary but there have been cases where two sets of the same type have been in for service and the wrong one has been returned to a customer, and also cases where a customer has claimed that a set wasn't his when it actually was. Such difficulties can be resolved by consulting the progress book for the serial number, though such problems are fortunately rare.

570131	Jones. 14 High St. Ferranti T1024. *Poor width*	C.D.
570132	Smith. 2 Valley Rd. Decca DM4. *Int. field sync*	ST.C.
570133	Brown. 4 Market Place. Ultra 6619. *No vision*	AP.
6701	James. 9 Beech Close. Philips 1768. *Line sync*	C.R.
6702	Evans. 102 Main St. Philips TG152A. *Tuner faulty*	C.D.
6703	Davey (Miss). 3 Hazel View. Dansette R. *No LW.*	C.
6704	Edwards. 8 Hill St. Pye V14. *Tube faulty*	E.

Fig. 1: Sample of progress book entries.

A small space can be left for further information to be entered by the engineer doing the job. This can be a standard letter-code such as E estimate, AP awaiting parts, ST soak testing and C completed. There is no need to detail the actual repair as this will be recorded elsewhere and double recording means wasted time. Finally. R can be added when the set is returned to the customer if he collects it or D if it is delivered. This is of course filled in by those concerned.

The state of any set in the workshop can thus at a glance be discovered, or the history of any previous repair. It can also be seen how many sets are in for repair, how many are held up for various reasons and whether the customer eventually collected his own set or had it delivered. Hence a large amount of information is available with the minimum of time and effort spent in recording it.

Identifying Sets

Once assigned the job number should be fixed in some way to the set so that it can be identified while in the workshop and also on future service calls—in the field or in the workshop—so that the date of the previous repair can be instantly seen. The use of tie-on labels which can be fastened to one of the back ventilation slots is one method. Another is to stick a piece of white p.v.c. tape on the back or on the chassis with the number inscribed on it.

Job Sheet

The next item of paperwork is the job sheet. The necessary information as to the owner's name and address, make and model is obtained from the progress book. These may be made out by one of the office staff or the service manager and put with the set or assigned to a particular engineer, or the engineer may make out his own sheet when he starts work on the job. Which method is used will depend on the existing organisation within the service department and its size. Job sheets can be printed with boxes for essential information, leaving the rest blank for recording work done, parts fitted and time taken. On completion the job sheet goes to the office for costing, invoicing and finally filing.

Short Cuts

For smaller businesses there is a short cut which reduces some of the paperwork. A duplicate book is required for this. On completion of the job the engineer fills in the information from the progress book and then details the work done and components used. The top sheet is then used as an invoice, going to the customer with the set, while the carbon copy remains in the book as a permanent record. Further information such as time taken can be inserted on the bottom copy without appearing on the customer's sheet. This avoids making separate invoices and filing individual job sheets. The engineer may cost the job himself after which he tears out the top sheet and puts it with the finished set, or it can be left in the book for the service manager to cost later.

This arrangement lends itself to a further simplification of paperwork involving the payment of accounts. As each bill is paid the bottom right-hand corner of the bottom copy can be folded over. It will then be possible to see at a glance without even opening the book whether there are any unpaid accounts remaining. When they are all paid the book can be put away while books containing unfolded pages can be left to hand as a reminder to follow them up.

Recording Faults

Whichever system is used—and there are many variants possible—one important item of information must not be overlooked. This is the specific nature of the fault or the customer's complaint. Without this the engineer can be led on a wild goose chase, especially if the fault is intermittent. How and where this is recorded will depend on the system adopted. If separate job sheets are made out by the service manager when the set is first accepted into the workshop then he can fill in this detail from the customer's first communication. If the engineer makes out his own sheet as he goes then the information must be recorded in the progress book by the field engineer or whoever accepts the job.

Initial Record

On receiving the first request for service an accurate record must be made of the details. Engineers' time is often wasted by calling at wrong addresses. If job sheets are used one can be made out there and then so that all the field engineer has to do is to make out his report on making the call. If the job must be brought into the workshop then the sheet can stay with it to be completed by the inside engineer. This is particularly useful where some work has already been carried out by the field engineer, as this will then have been duly recorded on the sheet.

Alternatively if the field engineer is just presented with a list of his calls he will have to make out his own records, probably using a duplicate book if the same is used inside the workshop. Any work that he might have done on a job before bringing it in can then be recorded in his book, the top sheet staying with the set and work being carried forward on to the final invoice instead of going to the customer as would be done if the job were completed outside. Here again the particular system used and the way it integrates with that of the workshop will depend on the circumstances.

Spares Pad

A very useful item of paperwork which can actually save a lot of time is a spares-pad. This should be kept in every workshop, large or small. Sometimes regular checks are made on the store of spares to see what is in need of replacement. This is often done when a traveller from one of the component firms calls. This too can be quite time absorbing and some items can be overlooked necessitating a later special order or running out of stock of an often-used part. A spares-pad kept hanging near the stores can prevent or at least reduce this possibility. Whenever an engineer uses a part and

—continued on page 181

CIRCUIT NOTES

H. K. HILLS

Noise-cancelled Sync Circuit

THE only disadvantage with negative picture modulation as used on u.h.f. is that noise pulses from car ignition systems and other sources are in the same (positive) phase as the sync pulses—both rise sharply to a high maximum value. This is the main reason for the general adoption of flywheel line synchronisation since with this the timebase generator is controlled by a d.c. potential produced by the a.f.c. discriminator. The control potential only changes—to vary line oscillator frequency—when a *sustained* disparity exists between the timing of the sync pulses and the reference waveform fed back to the discriminator from the line output stage. Continuous high-amplitude noise trains can still however impair flywheel sync performance and several circuits have appeared in the past to remove noise from the video information presented to the sync separator.

In the Beovision 3000 range of colour receivers there is an extremely interesting and ingenious arrangement which uses four transistors and a diode in the complete sync system. The first transistor is simply an *RC* video stage and being completely conventional is not included in the circuit shown in Fig. 1, simplifying the circuitry to the sync separator Tr1, noise inverter Tr2 and "cut-off" transistor Tr3. The sync separator operates in the usual manner, remaining cut-off during picture content but conducting heavily during the sync pulses, with the result that its collector voltage, fed from a +30V rail, falls to only +4V during the sync pulses, giving a peak-to-peak pulse output amplitude of 26V.

The difference between this transistor sync separator and those used in other receivers is that its emitter is not returned directly to chassis but via the "cut-off" transistor Tr3 which is normally held strongly forward biased by R207 from the +12V rail. Thus during noise-free reception Tr3 acts only as a low-value resistor grounding the sync separator's emitter.

The noise-inverter transistor Tr2 has no fixed forward bias and is therefore normally non-conductive. A vision i.f. feed taken from a transformer in the last vision i.f. stage however is applied via a 39·5MHz rejector to the noise detector diode D1 whose cathode is connected to the combination R1, R2 and C1 in Tr2's base circuit. As the rejector is tuned to the vision i.f. frequency it removes the video and sync information but as noise covers such a wide bandwidth it cannot prevent this from arriving at the diode which rectifies it and thus develops a small positive potential across C1.

When the positive pulse potential at the junction of R1 and R2 exceeds 0·7V Tr2 conducts so that amplified but opposite-phase noise signals appear at its collector. These negative-going pulses are fed via C208 to Tr3 base, overcoming the fixed forward bias via R207 and momentarily cutting Tr3 off so that the sync separator Tr1's emitter is connected to chassis via a very high instead of a very low resistance. In this way the sync separator is cut off when noise pulses are present and these are thus prevented from appearing at the output of the sync separator, which feeds only noise-free sync pulses to the timebases.

Colour-difference Signal Preamplifiers

TO prevent spurious colour appearing on monochrome (due to noise or video information within the chroma passband) the second chroma amplifier stage in the decoder in most colour receivers is not provided with fixed forward bias. Instead on colour a turn-on bias is produced by rectifying the ident signal (since this is only present during reception of a colour transmission) and this is applied as forward bias to the second chroma amplifier. To ensure that variations in ident signal amplitude do not vary this forward bias and thereby cause changes in saturation level many designs clamp the turn-on voltage by means of a biased diode or diodes.

This bias is often referred to as the colour-killer, but the term can be confusing since of course the voltage is *present* during colour reception only. In

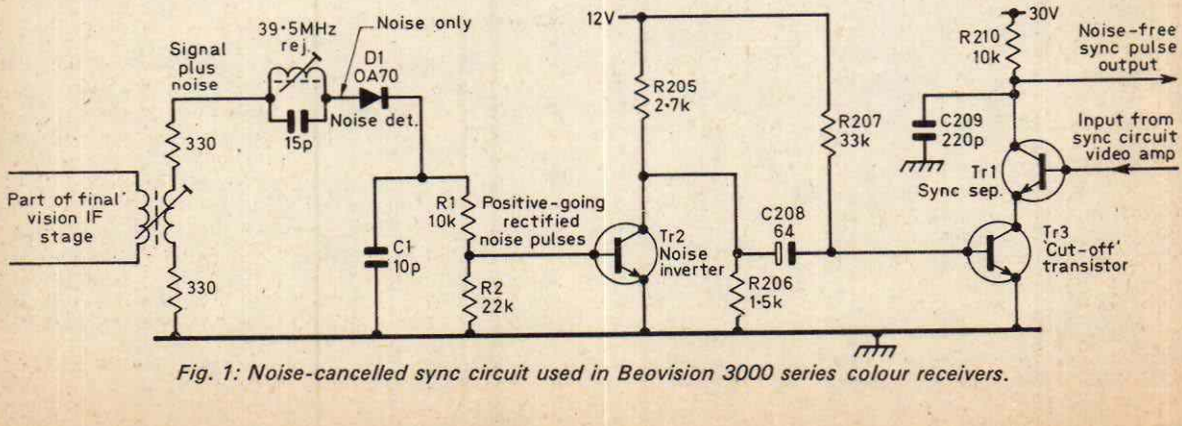


Fig. 1: Noise-cancelled sync circuit used in Beovision 3000 series colour receivers.

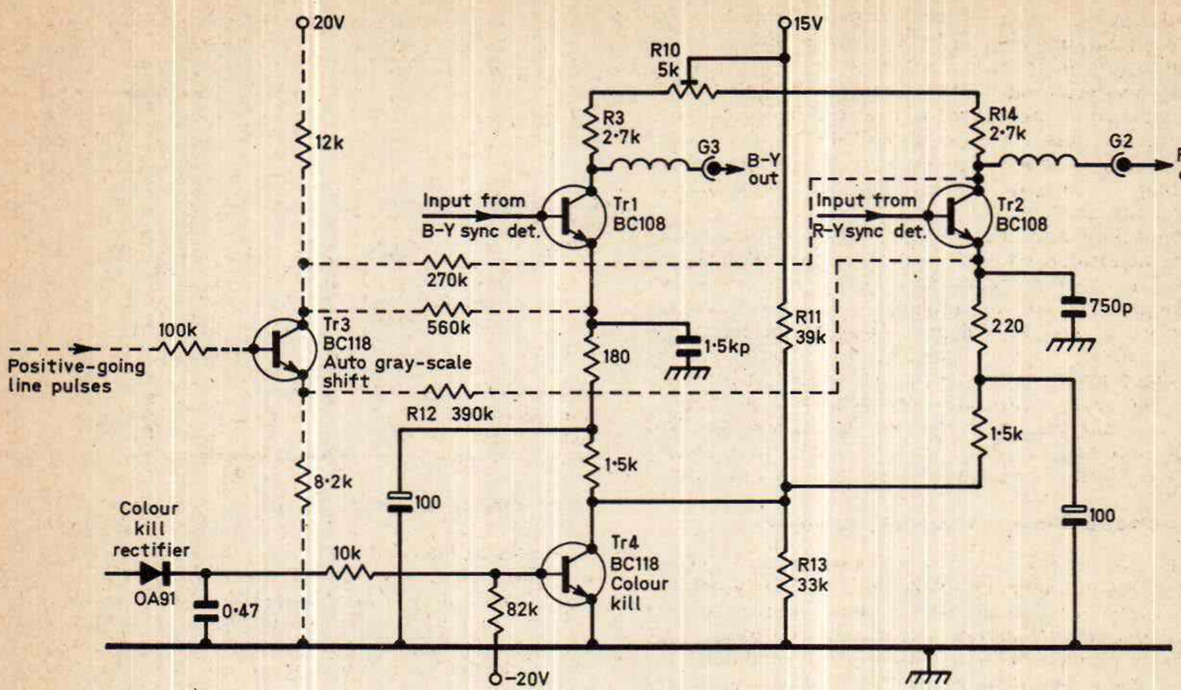


Fig. 2: Colour-difference preamplifiers, colour-killer and (broken lines) auto gray-scale shift circuit used in ITT-KB colour receivers (CVC1 and CVC2 chassis).

most instances therefore—depending on individual circuitry—it is better to regard the turn-on potential as a colour-killer de-activator.

Although the general practice, colour-killing need not necessarily be applied to the second chroma stage and in the KB-ITT single- and dual-standard models it is jointly applied to the R−Y and B−Y colour-difference preamplifiers. These two stages plus the colour-killer transistor and what is termed the "auto gray-scale shift" transistor are shown in Fig. 2 (applicable to the CVC1 and CVC2 chassis).

Following normal practice the output from the R−Y and B−Y synchronous detectors is fed to the respective preamplifiers Tr1 and Tr2. The amplified output developed across R3 and R14 is then applied to the grids of the R−Y and B−Y colour-difference output pentodes. Feed for the G−Y output pentode grid is obtained by matrixing together correct proportions of R−Y and B−Y taken from the R−Y and B−Y output pentode anodes (high-level mixing).

Concentrating on preamplifier circuitry however it will be seen that the emitters of Tr1 and Tr2 are returned to chassis via a common 33kΩ resistor R13 instead of by the usual resistor of a few hundred ohms value. R13 is shunted by the colour-killer transistor Tr4. A small negative base potential is applied to this transistor so that on monochrome being an npn type it is completely non-conductive. The l.t. current drain through R11 produces a potential of 6V across R13, raising the preamplifier emitter potentials to this voltage and thereby reverse biasing them to cut-off so that on monochrome reception both preamplifiers are inoperative, completely blocking the chrominance signal path.

On colour reception the ident signal is rectified to give a positive potential of sufficient amplitude to overcome the negative reverse bias at Tr4 base and drive it into full conduction. Its emitter-collector voltage then falls to only 0·2V, virtually short-circuiting R13 and permitting both the preamplifiers to operate at normal gain.

The preamplifier equalising potentiometer R10 linking the collector load resistors R3 and R14 is normally adjusted to give equal-amplitude outputs from the transistors measured at G2 and G3 on a colour-bar test pattern.

The purpose of the auto gray-scale shift circuit is to automatically tint monochrome pictures slightly blue in line with that of a normal monochrome receiver. The circuit operation is somewhat involved and mainly affects the driven triode clamps in the colour-difference output stages.

Positive-going flyback pulses from the line output transformer drive Tr3 into full conduction producing positive-going squared pulses at its emitter and negative-going pulses at its collector. This output pulse polarity develops because when bottomed or saturated the collector voltage of a transistor falls from its normal value (positive in this case) to a little above its emitter potential and is therefore negative-going while the heavy saturation current through the emitter resistor will produce an increased voltage drop across it to raise the emitter voltage providing a positive-going voltage change.

The pulse feed from Tr3 collector to the R−Y preamplifier collector reaches the anode of the R−Y triode clamp where the positive peaks are coincident with the normal clamping pulses from the line output stage. The pulses from Tr3 emitter are also fed via R12 to the emitter of the R−Y preamplifier and only partially offset the effect of the negative-going pulse feed to its collector. The B−Y preamplifier is fed with these pulses at its emitter only, from Tr3 collector.

The net effect on colour reception is that due to the selected component values similar amplitude rectangular pulses are presented to the R−Y and B−Y clamp triode anodes and if the gray-scale tracking is correct white will be equivalent to Illuminant D.

When however the preamplifiers are turned off on monochrome by the absence of the colour-killer potential to Tr4, there will be a large positive rectangular waveform applied to the R−Y clamp but none to the B−Y clamp. Due to the action of these triodes, which establish the basic colour-difference levels at the associated shadowmask tube grids, the beam contribution from the blue gun will be increased but that from the red gun decreased. The effect produced is therefore a distinct blue tinting in line with that experienced with monochrome tubes.

"Balanced Tone" Volume Control

WITH most radio and TV receivers, record players and audio amplifiers—except those of clearly defined hi-fi nature—reducing the volume control setting often disproportionately attenuates the lower freqencies. There are many factors involved and the effect may be accentuated by room and aural characteristics.

However, in the Philips G6 colour television chassis the effect is offset in the PCL86 a.f. stage by means of a 1kΩ potentiometer ganged to the volume control and connected in series with the triode cathode lead, its slider being linked to a negative feedback loop fed from a tertiary winding on the audio output transformer. As with most negative feedback loops the effect of the feedback increases towards the higher frequencies. As rotation of the dual control decreases the volume the degree of negative feedback is increased to increase treble attenuation and thereby produce a more balanced output.

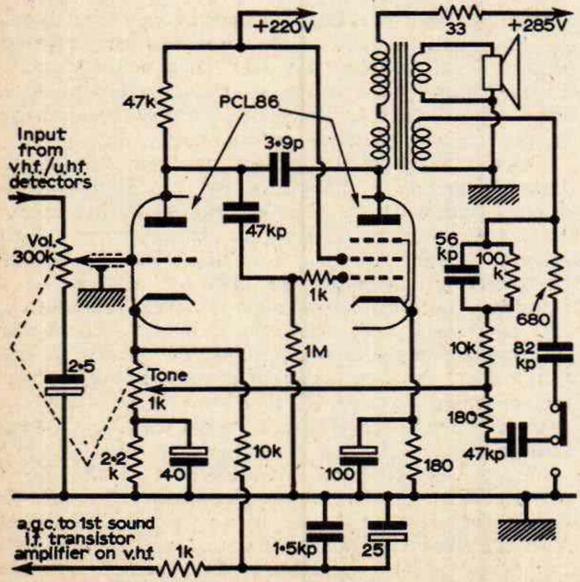


Fig. 3: Audio circuit of the Philips G6 chassis.

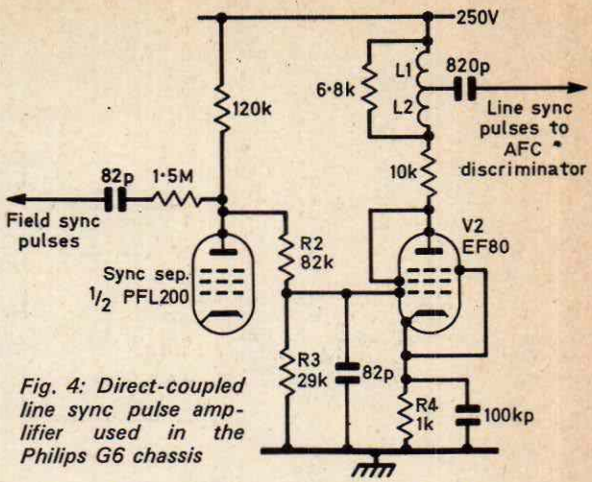


Fig. 4: Direct-coupled line sync pulse amplifier used in the Philips G6 chassis

The circuit is illustrated in Fig. 3 and also shows the use of the triode cathode potential as the source of forward bias for the first transistor sound i.f. amplifier when the set is switched to v.h.f.: the mean-level voltage variations produced by a.f. signal amplification provide a measure of a.g.c. action. On u.h.f. fixed bias by a conventional dual-resistor potential divider is applied to the first sound i.f. amplifier.

The 3·9pF capacitor linking the pentode and triode anodes provides negative feedback to high frequencies which could cause instability, and augment the action of the 1kΩ grid stopper.

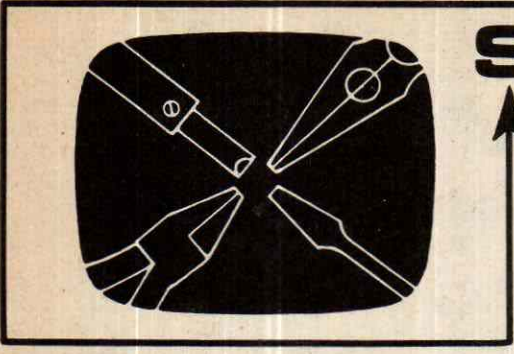
The 33Ω resistor between the h.t. rail and the output transformer is included to protect the primary from excessive d.c. current flow should a short-circuit develop: it will quickly overheat and go open-circuit if subject to excessive current.

Sync Pulse Amplifier

MANY receivers employ d.c. amplifiers to magnify the output voltage from the a.f.c. discriminator before applying it as a control potential to the line generator but in the Philips G6 colour chassis the line sync pulses themselves are amplified by a triode-connected EF80 before being fed to the a.f.c. discriminator. The circuit is shown in Fig. 4 and it will be seen that while the field pulse output is taken directly from the pentode sync separator anode the input to the line sync pulse amplifier V2 is determined by the ratio of R2 and R3 which also set V2 grid voltage (11V on 405 and 12.8V on 625).

The cathode voltage developed across the 1kΩ cathode resistor R4 automatically adjusts to provide a slight negative bias on both systems: on v.h.f. it is 11.7V, 0.7V greater than the grid voltage, and on u.h.f. 13V, 0.2V greater than the grid voltage. Despite the considerable positive grid voltage from the sync separator anode therefore the EF80 operates with normal effective bias. The pulse output is developed across a high *Q* coil L1, L2 in the anode lead which rings on both the leading and trailing edges—due to the sudden change in anode current—to produce sharply differentiated pulses which enhance the a.f.c. discriminator action.

TO BE CONTINUED



SERVICING television receivers

L. LAWRY-JOHNS

BAIRD 620-640 SERIES—cont.

Tuner Units

The v.h.f. tuner uses a PCC189 and a PCF801. A faulty PCC189 can cause loss of signal (partial or total) on v.h.f. only whilst a faulty PCF801 can cause loss of u.h.f. as well as v.h.f. as the mixer section is used as an i.f. amplifier on u.h.f. The aerial sockets are also a weak link, with improper soldered connections sometimes fractured by heavy handedness on the plug or the use of heavy low-loss coaxial feeder which may put too much strain on the socket. Normally the only trouble experienced with the v.h.f. tuner is improper contact between the biscuit studs and the contact springs as mentioned previously.

The u.h.f. tuner can be a little more difficult but servicing should be limited to valve replacement, checking for dry-joints and correct meshing of the tuning vanes. As we said earlier, it is the tuning drive which gives most trouble.

IF Stages

From the 405 point of view there is no common i.f. stage, the output from the tuner being fed direct to the system switch and thence through two small capacitors, one feeding the vision strip and the other the sound (C50 and C52). Both strips consist of two valved stages. The vision stages consist of one EF183 and one EF184 valve while the sound strip uses one EF183 and one EF80.

This is a convenient arrangement for quick servicing: if there is a fault which is affecting both sound and vision the chances are that the fault is in the tuner, whilst if only one side is affected the valves can be quickly swopped to prove a point or the fault narrowed to a small section of the total circuit. Weak links in the vision strip are the valves and the 22kΩ screen feed resistor R34 to the EF183. This can change value on its own or be damaged by a faulty valve or decoupling capacitor. Quite often a faulty EF183 can be replaced leaving a damaged resistor to fail hours or days later.

Once again, it is important to check the goodness of the system switch contacts.

Line Timebase

The line timebase is where the majority of the troubles will be encountered. The symptoms may vary from a no picture condition to lack of width, varying picture size and horizontal hold difficulties.

Starting with the no picture condition, this assumes that there is no illumination on the screen whatever the position of the brilliance control. The first move is to ensure that the set is switched to 405 and to listen for the line timebase whistle. If this is healthily present it is fair to assume that the timebase itself is functioning reasonably well and a quick check at the top of the DY86 will prove whether or not this is so. If this valve is not lighting up the heater could be open-circuit. If the valve is lighting up the e.h.t. is most likely to be in order and attention should then be directed to the tube base voltages at pins 2, 3 and 7. Pin 2 should be at chassis potential, pin 3 at over 400V, while pin 7 should vary with the brilliance control from zero (maximum brilliance) to about 100V (minimum brilliance). If the voltage at pin 7 stays high check C132 which may be shorted.

If there is no line timebase whistle and no e.h.t. check the appearance of the PL500 and PY88 valves. If one or both are overheated the ECC82 could be at

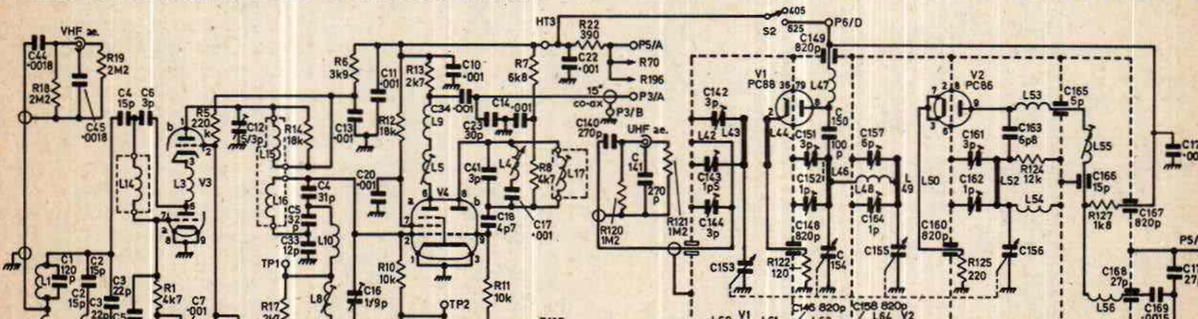


Fig. 3: Circuit diagram of the tuner units. R124 8·2k and R125 180Ω in later versions.

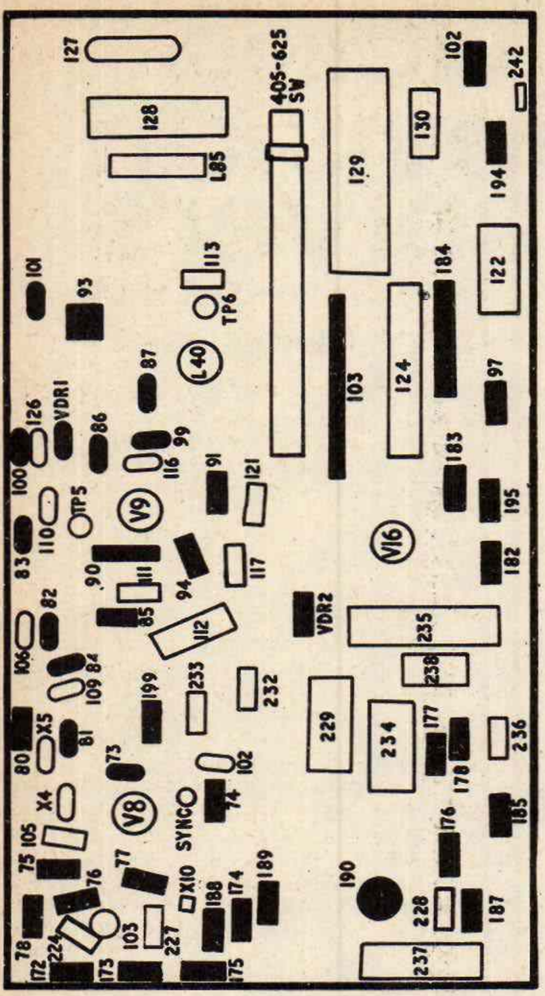


Fig. 4: Layout of the timebase printed board.

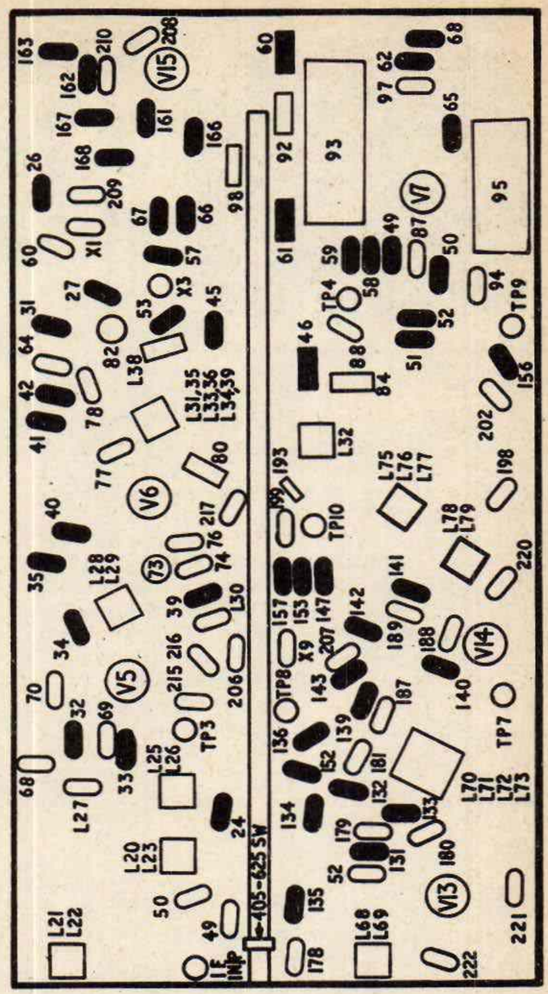


Fig. 5: Layout of the i.f. printed board.
In the above layouts capacitors are shown in white and resistors in solid black.

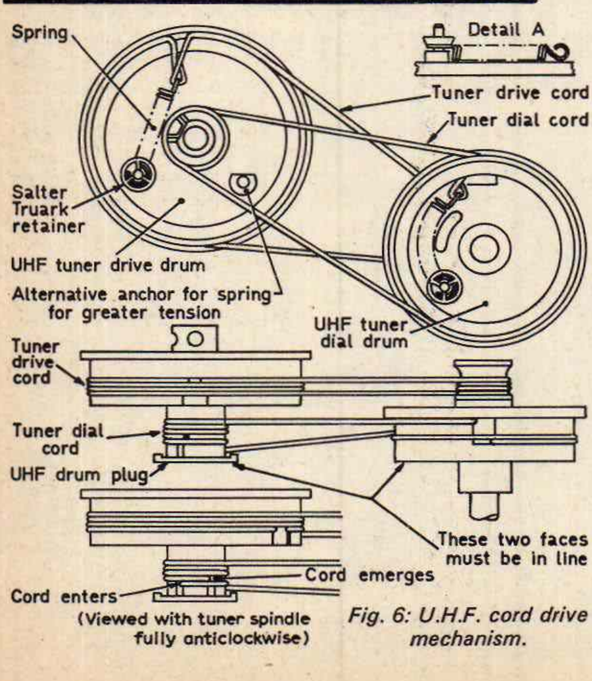


Fig. 6: U.H.F. cord drive mechanism.

fault and a smart tap on this valve may start the line oscillating to prove that this is indeed the culprit. The tap is only exploratory and a replacement should be tried in any case. The trouble could be further back however. If one of the flywheel sync diodes (X4 or X5) is faulty this can render the oscillator inoperative.

There are times when the PL500 may be overheating but not excessively. This can be due to an overload in the line output stage, the line oscillator functioning normally. Such an overload can be due to an internally shorted DY86 (remove top cap), a faulty PY88 or a shorted capacitor associated with the line output transformer. Finally the line output transformer may have shorted turns.

If the PL500 is not overheating, indicating that the line drive is correct (or even excessive) and that the valve is not at fault, try removing the top cap of the PY88. If this restores some degree of line timebase working change the boost reservoir capacitor C129 (0·25μF). This capacitor is rated at 750V but an 0·22μF capacitor rated at 1kV is a fair substitute.

If removal of the PY88 top cap fails to have any effect attention should be directed to the PL500 screen supply (pin 7). The resistor R97 should drop something like 10V across it under normal working conditions. If there is no voltage at all at one end the resistor is open-circuit; if it is cooking C122 could be shorted. If on the other hand there is little voltage drop across R97 the line drive may be excessive and it is the width circuit which should receive attention. Check the width control, R100 and R99, etc. The writer is not keen to specify voltages in this type of circuit because of the widely differing readings which can be obtained with different types of meter.

As far as the line oscillator is concerned the picture should first be locked on 625 lines with the normal hold control and then switched to 405 and locked with the preset R93. The coil L40 should be adjusted for a floating picture on 405 with the sync shorted or rendered inoperative.

Line hold difficulties can usually be resolved by replacement of the ECC82 and a check of the OA81 discriminator diodes X4 and X5. Other components may give rise to line hold troubles but the writer has not experienced much trouble with the smaller resistors and capacitors in this part of the circuit. We would not however be surprised to find that C110 and R83 could become faulty, giving rise to various line oscillator defects the symptoms of which would vary according to the degree of leakage through the capacitor or change of value of the resistor.

Models in the Series

Models in the series fitted with 19in. tubes are as follows: 622, 624, 626, 628, 640, 642. There are also the following 23in. models: 630, 632, 644, 646 and 648.

Voltage Readings

Typical voltage readings with the system switching in the 405-line position were given in Fig. 1 last month and were measured using an Avo Model 8 (20,000Ω/V). The mains input was 240V a.c. Readings in the vision and sound sections were taken with no signal input and the contrast and brilliance controls at minimum, those in the sync and timebase stages with a weak signal input, the contrast and brilliance set to low levels and the timebases locked. On 625 the screen voltage of V14 is 40V and the anode and cathode voltages of V7A 89V and 9·3V respectively: most other voltages on 625 are slightly lower than those quoted for 405-line operation.

Modifications

Width circuit modified as shown in Fig. 7 to increase the range of adjustment. C97 changed to 0·01μF. Aerial socket isolation circuits changed on later models.

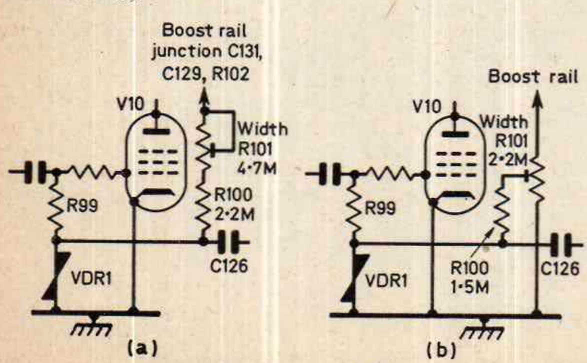


Fig. 7: Width modification.

NEXT MONTH IN

TELEVISION

HELICAL-SCAN VTRs
An upsurge of interest in videotape recording seems imminent. For amateur and semi-professional use this means the helical-scan v.t.r. Just what are the problems of recording video signals on tape, and why are helical scanning of the tape by the head and frequency modulation used? These points, together with an account of servo techniques for synchronising the tape, will be fully described next month.

DIGITAL ICs
The price of digital integrated circuits has fallen very substantially in recent months. This means that the time is ripe for their exploitation by the amateur constructor. They open up many fresh possibilities but, acting as switches instead of as linear amplifiers and operating with pulse inputs instead of ordinary waveforms, their principles are probably quite new to many constructors. A detailed account will be given of their characteristics, the supplies and inputs needed and their applications.

IN-SITU VALVE MONITOR
In servicing valved equipment it is a great advantage to be able to make voltage and current checks on a stage with the valve in position. The simple devices described enable this to be done. They can also be used in conjunction with an oscilloscope to plot dynamic valve characteristics.

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COLOUR RECEIVER CIRCUITS

THE IF STRIP—2

GORDON J. KING

WE have seen that the front-end and i.f. channel of a dual-standard model differs from those of single-standard models in that the front-end consists either of an all-band tuner or a pair of tuners, one for the v.h.f. channels and the other for the u.h.f. channels, and that the i.f. channel is basically tuned to yield the required response characteristics for the 625-line standard with the standard-change switch introducing extra filtering on the 405-line standard effectively to narrow the response while also altering the rejector frequencies and characteristics to change from intercarrier sound to the 405-line sound i.f.

The dual-standard i.f. channel has often been regarded as an exercise in compromise! It is of course possible to design such a channel for optimum performance on both standards, but few designers have been given complete freedom in this connection owing to economic considerations. Nevertheless over the years some remarkably efficient designs have been created which at the start of the dual-standard game would have appeared to have been virtually impossible at the price. These are noted particularly in colour models and are a credit to the craftsmanship of the British television industry.

Solenoid System Switching

While many dual-standard monochrome sets incorporate a system of levers coupling the standard-change switch to the band-change button or knob on the fascia quite a few colour models adopt a solenoid for activating this switch, the solenoid being energised when the viewer changes between channels of a different standard. The photograph in Fig. 1 for example shows the i.f. module of the well known all-transistor chassis used in the British Radio Corporation's dual-standard colour models (BRC 2000 chassis). The standard-change switch associated with the i.f. chassis can be seen towards the top of the picture coupled to the solenoid at the right-hand side which operates it.

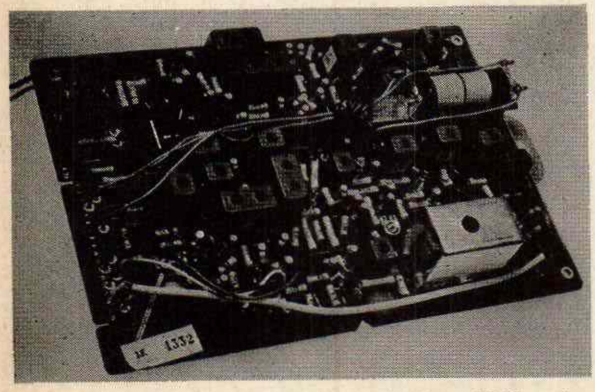


Fig. 1: I.F. module of the BRC all-transistor 2000 series chassis, showing (top right) the solenoid-operated standard-change switch.

Single-standard IF Input Filtering

With the advent of transistors, i.f. channel design has had to take into account the possibility of cross-modulation arising from a strong tuner signal, for although transistors are in many ways far more desirable than valves in this service they do tend to run into overload more easily. The risk has been minimised by various artifices, including the use of forward a.g.c., transistors which are designed to handle relatively large signal swings without undue non-linearity and by clever filtering between the tuner output and the i.f. channel input.

The idea of the filtering is to reduce the amplitude of unwanted signals at the i.f. channel input rather than filtering them out by means of traps within the channel—the usual technique with valve i.f. strips. Cross-modulation is encouraged of course not only by high-amplitude sound and vision carriers but also by the quantity of signals in the channel. The problems of filtering are significantly reduced in a single-standard i.f. channel and the main unwanted signals that have to be deleted after the tuner are the sound signal of the adjacent channel below the selected channel and the vision signal of the adjacent channel above the selected channel.

Rejectors

Figure 2 shows one single-standard i.f. filtering circuit as used in recent Pye single-standard colour models. L2, C2, C3, C4 and R1 form a bridged-T rejector. This is tuned to the adjacent channel sound frequency which at i.f. falls at 41·5MHz. A remarkably deep rejection notch is put into the response by this kind of circuit, the depth of the notch being increased and its width reduced by the balancing resistor R1. The adjacent channel vision signal is rolled off by the shunt trap comprising L1 and C1.

The correct attenuation of the in-channel sound signal is provided by the series rejector L4, C7 and C8. This puts a step on the response at the sound frequency to optimise the intercarrier sound performance and in colour to minimise the sound-chroma beat signal though there are other techniques used to keep this latter type of interference at the lowest possible level. Filter L3, C6 and R2 yields the required i.f. bandbass characteristic, all the filters working together of course to secure the net response characteristic.

The colour set i.f. channel must also provide adequate rejection of the adjacent channel chroma carrier. This however is the least critical since if

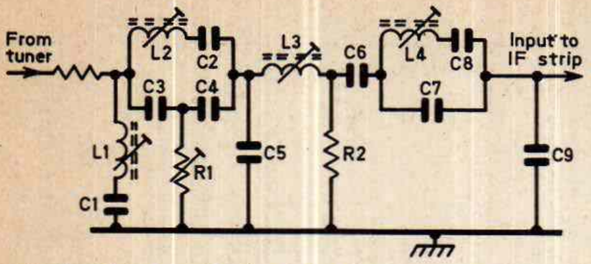


Fig. 2: Filtering at the input of the i.f. channel. This is done particularly to reduce the risk of cross-modulation in transistor circuits.

the other rejectors are working properly and are in correct alignment the adjacent channel chroma carrier should fall well outside the i.f. channel passband. If the adjacent channel sound rejector is mistuned it will affect that part of the response characteristic that deals with the low-frequency video components. This is critical since below-optimum performance in this region is very apparent subjectively, the main symptom being that of smearing.

As already intimated, the in-channel (sometimes called co-channel) sound rejector is also important for keeping the intercarrier beat at the right level and for minimising the beat between the sound and chroma carriers. Maladjustment here could well result in a form of Venetian blind interference at transition points on the display.

Less critical however is the adjacent channel vision rejector, for the job of this is to roll-off the response so that the effective passband is concluded prior to the frequency corresponding to the adjacent channel vision carrier. A quick appraisal of the various rejectors and their positions on the response can be obtained from Fig. 3.

Phase Shifts

Last month it was stated that an important colour set i.f. characteristic is that of delay/frequency. This of course has to do with the phasing of the signal components through the i.f. channel. In normal bandpass circuits where the Q is relatively low serious phase effects are uncommon. However the rejector circuits, owing to their very high Q, can present some complex phase problems. This is not really the place in which such matters can be thoroughly explored but it is worth noting that the rejector circuits employed in colour sets can differ from those used in simple single-standard monochrome models. The differences though are in detail. The basic rejector characteristic will generally be appreciated from the circuit, but additional reactive elements are sometimes employed to reduce the phase shift over the rejector bandwidth. Certain types of rejector circuits, called non-minimum phase circuits, are also

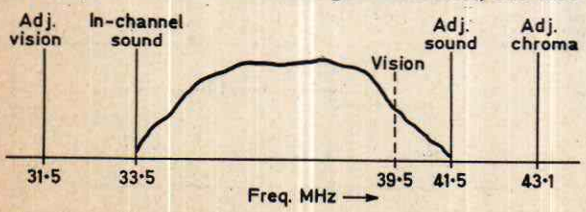
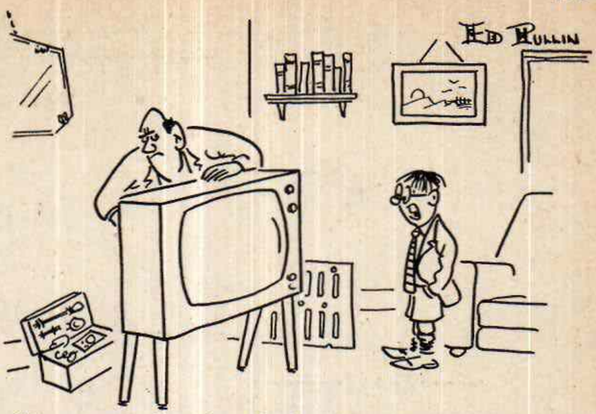


Fig. 3: Position of the various rejector frequencies over the passband.



"Have you thought of checking those video circuit drop-off safety resistors?"

adopted in colour sets, one example being the bridged-T trap shown in Fig. 2.

Image Response

There is another unwanted response which is well worth considering at this juncture even though to do so we must return for a while to the tuner front-end.

With the majority of channel groups the frequency relationship between the highest and lowest transmissions is only 1MHz from the image frequency of a receiver using the standard 625-line i.f. (i.e. 39·5 MHz). For example, consider the channels assigned to Emley Moor. These are 41, 44, 47 and 51. Here as in most other cases the highest channel is ten channels away from the lowest channel. Since each channel covers a spectrum of 8MHz this means that the frequency between the highest and lowest channel of the group is 88MHz.

The image response of any receiver is displaced from the tuned frequency by twice the i.f. Twice 39·5MHz is 79MHz. Thus it is seen that when a dual-standard or single-standard receiver is tuned to a u.h.f. channel at the end of the local group the passband of the image response will fall within the frequency of the u.h.f. channel at the other end of the group! Whether the image response is above the lowest channel of the group or below the highest channel of the group depends on whether the local oscillator is working above ("high") or below ("low") the incoming frequency by the amount of the i.f. The local oscillator is commonly tuned "high". This puts the image response above the tuned channel so that when a receiver is tuned to the lowest channel of the group the image response appears over a passband acceptable to signals of the highest channel of the group.

This is a dangerous situation as can well be imagined and steps were taken in the early days by BREMA (the association of setmakers) to stipulate a minimum image rejection ratio for British u.h.f. receivers. This is 53dB, a ratio which must be engineered into the tuner circuit design. It is noteworthy that the situation is somewhat less critical on the Continent owing to the smaller density of transmitters and to the use of a standard i.f. of 38·9MHz. The image rejection ratio provided by the tuners in sets destined for the Continental countries is around 45dB.

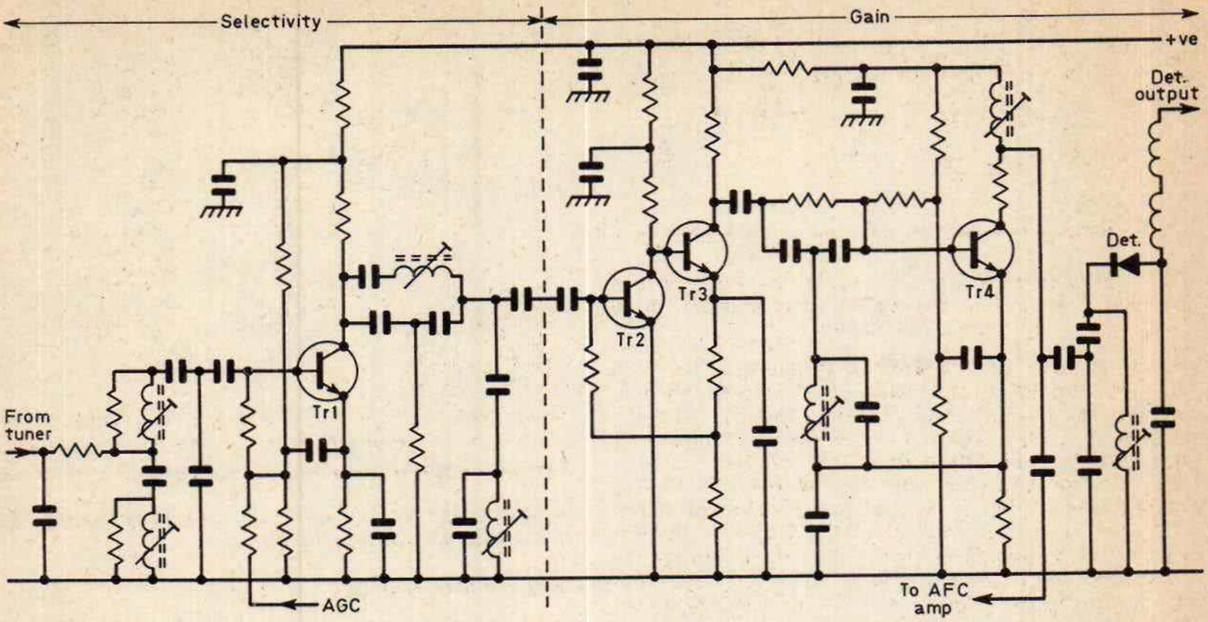


Fig. 4: I.F. channel of the Philips G8 single-standard colour chassis.

Selectivity in the u.h.f. tuner is generally taken care of by three continuously tuned circuits prior to the mixer as was shown in Parts 1 and 2. There is of course always an extra tuned circuit ganged to the pre-mixer circuits for the local oscillator, but this does not come into the selectivity equation.

The Philips varactor-tuned u.h.f. tuner described in Part 2 and shown in skeleton circuit in Fig. 3 of that instalment embodies these three pre-mixer tuned circuits (quarter-wave lines) plus one for the local oscillator, all tuned by capacitance-diodes. It will be recalled that an extra capacitance-diode (CD5 in the skeleton circuit) is used in this tuner to equalise the oscillator signal amplitude over the tuning range.

In this tuner in particular image rejection is neatly tailored into the aerial input circuit by means of a continuously tuned image rejector located between the aerial socket and the emitter of the r.f. amplifier transistor. The design is such that the rejector frequency always corresponds closely to the image frequency over the entire tuning range.

All u.h.f. tuners carrying three pre-mixer continuously-tuned circuits feature some form of continuous tuning at the emitter of the r.f. amplifier which, in conjunction with the tuned bandpass coupling between the output of the r.f. amplifier and the input of the mixer, provides the necessary 53dB of image rejection. However, the Philips tuner is the only one known to the author where the image rejector itself is tuned to yield the high ratio. The circuit also ensures good coupling efficiency from the aerial to the r.f. transistor emitter, this being necessary for a good signal-to-noise performance.

To avoid frequency drift when varactors instead of capacitor-gang sections are used a high degree of voltage stabilisation is necessary relative to the tuning potential, for drift here would of course tend to swing the circuits off tune. This is taken care of by a stabilised supply source and wide pull-in-range a.f.c.

Philips G8 IF Channel

Returning now to the i.f. channel, that in the Philips G8 chassis (the chassis carrying the varactor tuner) is divided into two sections. The first provides the selectivity with a single transistor and numerous

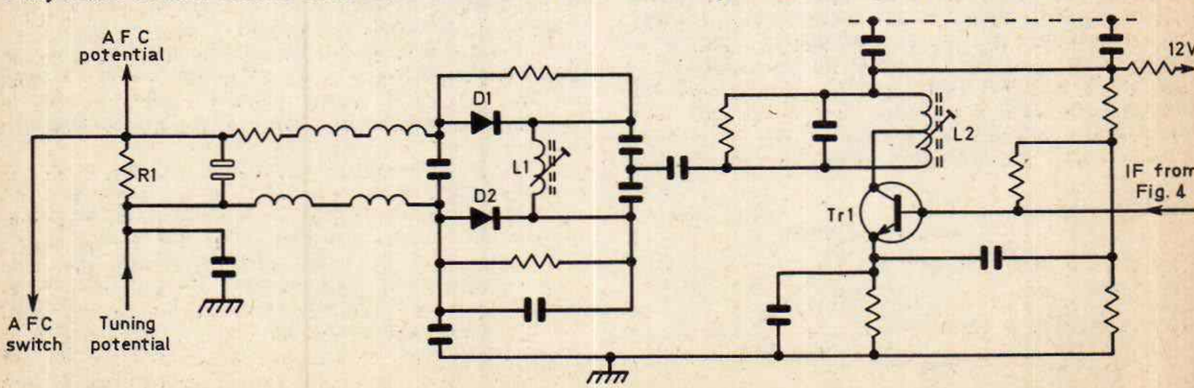


Fig. 5: A.F.C. circuit used in the Philips G8 chassis.

filters while the second section yields the i.f. gain and coupling to the vision detector diode with three transistors and one or two filters. A single detector is used for the sound, chroma and luminance signals, filters in the following stage being used to separate these three components of the composite received signal. The basic circuit of the i.f. channel with detector is shown in Fig. 4. It will be noticed immediately that it is far less complicated than comparable dual-standard i.f. channels. In fact some of the latest single-standard models—even colour ones—seem to be hardly any more complicated (indeed less so in some respects) than the early 405-line only single-standard models before the agony of the dual-standard era! Many designers favour the technique of lumping together all the components concerned with selectivity (rejectors, bandpass couplings, etc.) and then adding the gain later, as in Fig. 4 and as explained in relation to Fig. 2. This logical arrangement lends itself admirably to single-standard design where transistors abound.

AFC Amplifier

Before leaving this month, just a word about the Philips G8 a.f.c. amplifier. This is fed with i.f. signal from the collector of the fourth i.f. transistor in Fig. 4 via a coupling capacitor. The complete circuit of the a.f.c. section is shown in Fig. 5. The i.f. input signal is amplified by Tr1 and the vision carrier is selected by L2. This signal is fed to the discriminator comprising diodes D1 and D2 and their associated networks. The tuning provided by L1 "balances" the discriminator about the selected carrier so that when the carrier frequency coincides with the tuned frequency of L1 the load resistor R1 receives equal strength rectified signal currents from both diodes. Since however the current from diode D1 is flowing through the load in the opposite direction to the current from diode D2 the two currents are effectively cancelled and zero control potential is present across R1. Should the tuning drift the i.f. will shift one side or other of the frequency tuned by L1. This will unbalance the discriminator and one diode will then pass a greater current to the load than the other diode. This causes a potential to develop across the load and it is this which is used to alter the bias of the tuner varactors. The control bias swings, of course, more or less negative as required to correct the tuning error. The tuner part of this function was fully described in the November, 1970, issue.

The a.f.c. system provides a pull-in-range of 1 to 2MHz either side of the correct tuning point and readers now wondering how on earth the required channel is tuned in the first place under the influence of such a large pull-in-range can rest in peace with the knowledge that the a.f.c. bias is automatically shorted by the a.f.c. switch when the tuning button is depressed. This works via the link from R1 going to the a.f.c. switch in Fig. 5. It will be appreciated that the tuning potential is effectively in series with the a.f.c. potential under normal operating conditions.

TO BE CONTINUED

TELEVISION SUBSCRIPTIONS

Readers with a year's subscription to TELEVISION will have this automatically extended by one month to take into account the loss of the December 1970 issue.

WORKSHOP HINTS

—continued from page 171

notices that the normal stock of that part is low he makes a note on the pad. Thus there is no need to do a virtual stock-take every time spares are ordered—merely consult the pad. If an item does not appear there then it can be assumed that there are adequate stocks and no further investigation is necessary. When the item is ordered a note should be made in the pad of the date ordered and the name of the supplier. This will prevent double ordering. On delivery of the spares the entry can then be crossed through. This also enables it to be seen at a glance what spares have been ordered but not received so that these can be chased.

Time Sheets

Lastly we come to the particular bane of many engineers, the time sheet. Many firms insist on keeping time sheets while others do not. Their usefulness is certainly dubious. Time spent on each job should be filled out on the job sheet for costing purposes. The only function of the time sheet then is for overtime payment and for keeping a check on the way engineers spend their time in the workshop. Overtime periods can be added and turned in without accounting for each hour of the working day and with much less time spent in doing so, so this leaves the check on engineers as the only function.

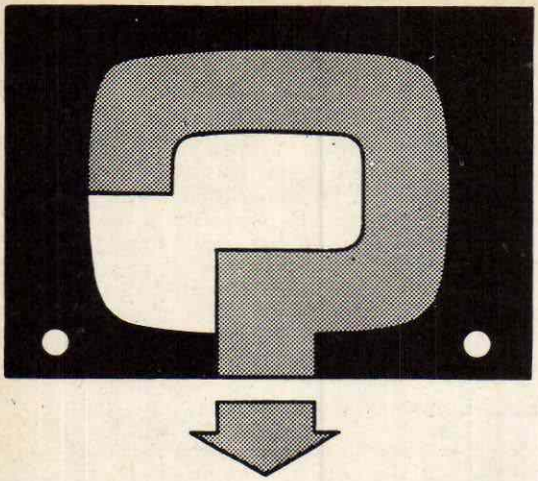
As many engineers who have worked with detailed time sheets will affirm, it is impossible to be gainfully employed the whole time one is on the premises. Clearing up, putting away manuals, answering customers' technical queries, setting up demonstration sets for the shop and many other things bite into time and are almost impossible to list individually. Thus time sheets are invariably fiddled and it is not too difficult to do this. If an engineer is loafing this will soon be apparent to a keen eyed service manager and will be evident from the number of jobs completed over a period compared with the others. Really, then, time sheets are of little use and usually absorb a goodly amount of time themselves in filling and straightening out.

Thus while paperwork can be a nuisance it is also essential and not nearly so bad if confined to the basic fundamentals needed.

FEATURE TO BE CONTINUED

FILM SHOW

Readers are invited to the *Practical Wireless/Television* Film Show which will be held this year at the Caxton Hall, Caxton Street, London SW1 (Great Hall Site) on Friday March 5th, 1971, at 7.15 p.m. for 7.30 p.m. The films this year include *The Electron's Tale* and the lecture, by Ian Nicholson of Mullard Ltd., is entitled *The I.C. Story—Continued.* Free refreshments will be served during the interval. For tickets send s.a.e. to Film Show, Television Editorial, IPC Magazines Ltd., Fleetway House, Farringdon Street, London EC4.



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FERGUSON COURIER

This 16in. model fitted with the Thorn/BRC 950 chassis looses line hold about 10 minutes after being switched on. Channel changing also causes the line hold to be lost, and the refrigerator switching itself on has also triggered the line oscillator. I have changed the line timebase and sync circuit valves and tried resetting the preset line hold control according to the manufacturer's instructions.—H. Townsend (Macclesfield).

Check the flywheel discriminator diodes W401 and W402. If these are OK check the anode load resistors in the flywheel d.c. amplifier and line oscillator stages and try modifying their values. Check for insulation breakdown of the blocking oscillator transformer.

SOBELL ST195

The sound does not come on for a long time after switching on and the picture takes a couple of minutes longer to appear. It is very faint at first but gets better the longer the set is on.—L. Titmus (Basingstoke).

The long warm-up time could be due to two things. The first is that the h.t. is slow to appear and builds up over a long period of time. This can be checked by metering and if it is the case the probable cause is the h.t. rectifier. It would be worthwhile replacing this with a silicon type. The second possibility is that the heater chain has gone high resistance at some point so that it takes some time for the heaters to reach their full operating potential. This could be caused by the heater circuit thermistor. Also check the mains adjustment. The first of these possibilities is the most likely however.

KB VV20 VANGUARD

When the aerial lead is plugged in or the contrast control turned up the line timebase ceases to operate with no voltage on the line output valve. As soon as the aerial lead is disconnected the line timebase starts and works perfectly. If the contrast control is turned up just a little the brightness pulsates in and out once every second. There is then some unlocked picture content.—G. Griffiths (Swansea).

The fault you describe seems to be beam limiting, the appearance of signal at the c.r.t. cathode causing a severe reduction of e.h.t. The most likely cause is a faulty e.h.t. rectifier (V16, R20) but it is also possible that the line output valve or the efficiency diode is faulty and these should be checked.

PHILIPS 1768U

There are two pictures on the screen with a black bar in the centre and flicker is bad. The field timebase will only lock like this. The line hold is also touchy but will lock with careful adjustment. Any movement of the height and field hold controls will send the picture rolling with flyback lines appearing. I have changed the timebase valves and the 330kΩ resistor associated with the line hold control, also checked all high-value resistors in the field hold control circuit and all electrolytics—all were OK. I have checked the presence of the field sync pulses by means of headphones—they are strong on each side of the sync feed capacitor.—G. P. Beck (Heston).

The field fault gives every indication that boost capacitor failure is the problem. Check this component. The fact that the line hold is also sensitive could indicate a sync separator fault. For this check not only the valve but also its anode load resistors and the screen feed resistor and its decoupling capacitor: also check the grid biasing. If these are OK try replacing the video amplifier valve.

SOBELL TPS180

The fault is no picture. The sound is OK but the e.h.t. very low, with low EY51 heater voltage (1V on Avo 8, 10V range). The 10kHz whistle is present and all line timebase valves have been checked by substitution. I can get a picture by connecting the EY51 heater to a 6V battery. The insulation on the EY51 heater winding looks OK.—A. Holliday (Birmingham).

The fact that you can get a picture by using a separate voltage source indicates that there is almost certainly a shorted turn on the line output transformer EY51 heater winding—this will be most unlikely to show up on a resistance check. We suggest you try putting your own heater winding on to save the cost of a new line output transformer: you will probably get sufficient voltage by putting just two turns around the transformer.

SOBELL T192

There is lack of width (4in. on either side of the picture) with the width control at maximum. I have replaced the line timebase valves. When the brilliance is increased the picture size varies and a dark shadow appears in the centre of the screen.—G. Camshaw (Malvern).

Check the 100μF capacitor connected in the anode circuit of the boost diode and the line output valve screen feed resistor, also its 680kΩ grid resistor if necessary. We presume you have checked the h.t. supply and found it correct at over 200V. If this is low check the reservoir capacitor C105 (100μF).

PHILIPS G22K511

After the normal warming up time the sound and vision are OK. Then thirty seconds latter there is no sound and vision, only a raster. About two minutes later FS1115 goes open-circuit and the sound returns. With the raster only displayed the brilliance control has little affect. The PFL200 was replaced with one of unknown quality. Sound and vision can now be obtained if the brilliance is kept low but is lost if the brilliance setting is advanced. The quality of the picture obtained is very poor.—A. Brown (Southend).

The fault is in the video stage and a known good PFL200 should first be tried. Then check the associated components, especially the cathode resistor and screen decoupling capacitor.

McMICHAEL M75T

The field has collapsed to a ½in. horizontal line. The field timebase valves have been renewed without changing the situation. The field output transformer is very hot—does this indicate that it is faulty?—G. Turnstile (Newbury).

Check the 0·001μF capacitor (high working voltage type) wired from the transformer primary to chassis. This is C55 in the maker's circuit.

BUSH TV66

The following intermittent fault may occur a couple of times a night but sometimes doesn't occur for several nights. The picture gradually creeps upwards from the bottom sometimes finishing as a narrow line. Switching off for a couple of minutes and then switching on again produces a full-size picture. — L. Mason (Richmond).

First check the PCL83 field output valve. If you are certain that this is OK change the 0·1μF coupling capacitor from pin 1 of the triode section to the height control.

GEC BT2155

The picture is blurred and out-of-focus on channel 3 though the set works well on channel 10. Also, is it possible to retune the channel 11 turret coils to channel 9.—J. Doig (Fife).

The blurred picture on channel 3 is presumably due to the local oscillator being off tune on this channel. To retune, set the fine tuner to mid-travel and adjust the core, using a non-metallic trimming tool, for maximum picture definition without sound-on-vision. Access is through a hole in the right-hand side of the tuner unit cover, viewed from the top. On the second point you could probably adjust the channel 10 oscillator section for channel 9 and the channel 11 section for channel 10: there is unlikely to be sufficient pull-in range to be able to tune the channel 11 coil for channel 9. We would point out that the selectivity of the front end of a television receiver is not very high so that if the channel 9 signal is fairly weak in your area it would probably be impossible to completely eliminate the channel 10 signal in the tuning.

PETO SCOTT 738

The fault in this 17in. receiver is that the picture is tapered towards the bottom, i.e. there is full scan at the top of the picture but not at the bottom. I suspected a heater-cathode short in the boost diode but this has been replaced without improvement.—D. Park (Bradford).

The non-vertical edges of the raster means that one half of the line scan coils is faulty. Check for any obvious physical short-circuit in one half of the coils. If there is nothing visible the problem is probably internal shorted turns.

SOBELL 1018DS-T

Sound quality is often poor on v.h.f. with a grating noise developing at the middle frequencies. Occasionally sound-on-vision also appears. A resistor on the front left of the printed panel seems to have heated and discoloured.—L. Jones (Arundel).

The discoloured resistor is the 18kΩ screen feed resistor to the EH90 sound detector. This should be changed, using a 1 or 2W type. Then check the 5·6kΩ resistor in front of the EH90 as this may also have suffered.

MURPHY V689X

There is some trouble in the line output stage. The picture gradually gets darker and darker until it completely disappears. I then have to replace the PL36 line output valve.—G. Harkiss (London N1).

First check for low h.t. and replace the h.t. rectifier if necessary. Then make sure that the two screen grid feed resistors to the line output valve (1·5kΩ each) have not changed value.

ULTRA V21-70

When first switched on the vision and sound are OK but after two minutes the picture disappears leaving only the raster, with increased sound accompanied by loud buzzing and two vivid horizontal flashes across the screen during the break. After about five minutes the sound returns to normal and a broken picture appears which can be tuned in. The set sometimes functions correctly thereafter all evening or breaks down as previously. During the raster intervals lines sometimes appear on the screen.—D. Black (Buckingham).

The fault seems to be in the vision i.f. amplifier or video stages. The sound comes up because when the signal disappears the a.g.c. brings up the gain of the early stages. The fault is likely to be the result of instability in the vision i.f. amplifier section and this should be checked for a faulty decoupling capacitor, a poor connection or crack in the printed circuit board. Additional decoupling might improve matters.

GEC BT318

After about five minutes the line hold control has to be adjusted but from then on it is satisfactory. The line timebase valves have been substituted without any change in the fault condition.—K. Alton (Penrith).

The line oscillator is type Z749 and a new valve should be tried in this position as it is quite critical in operation. Also check the 360kΩ resistor from pin 2 to the hold control.

SOBELL ST282

The problem is no raster. The line timebase whistle is very subdued and the EY86 heater does not light up. If I remove the boost diode top cap the line timebase whistle starts, the EY86 lights and the left-hand half of the screen lights up.—W. Truscott (Bristol).

The boost reservoir capacitor has shorted and must be replaced. It is C97, 0·25μF.

FERGUSON 308T

The trouble is lack of brightness. When the control is turned up the picture flares up and disappears. The picture is of reasonable quality but can only be viewed in a darkened room. The line timebase valves, dropper resistor and h.t. rectifier have been replaced.—S. Hussey (Redcar).

Change the 0.001μF coupling capacitor to the control grid of the PL81 line output valve. Check also that the blocking oscillator load resistor which is between this capacitor and h.t. is the correct value—47kΩ.

GEC BT337

There is a dark vertical band down the centre of the screen. Sometimes when the set is first switched on the vertical band appears to the right of the screen and slowly travels over to the left and might then even disappear for 10-20 minutes after which it re-appears down the centre of the screen. When this happens the fault cannot be cleared by adjusting the horizontal hold control.—H. Durban (Coventry).

The dark band is probably caused by the switching action of the boost diode. Check this (V13 U349) and the boost capacitor. Also check the scan-correction capacitor in series with the line scan coils (C162). It is also possible that the fault is caused by reflection of the line sync pulse back into the picture. For this, check the video amplifier and sync separator valves.

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TELEVISION, FEBRUARY, 1971

TEST CASE

98

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

? *A dual-standard valve set was troubled with severe vision "overloading" when the contrast control was advanced normally to obtain a picture of the proper black-to-white ratio. The condition would occur suddenly at an advanced position of the contrast control and once present could only be cured either by switching the set off or turning the contrast right back to zero, though sometimes this failed to effect a cure. By turning the contrast control up a threshold point could be established at the onset of the condition, but this was generally below the setting required for the correct contrast ratio. If the control was set just below the threshold point an increase in picture white would sometimes precipitate the condition.*

The contrast control was tested and found to be in good condition. What was the most likely cause of this symptom which occurred only on the 625-line standard? See next month's TELEVISION *for the solution and for a further Test Case.*

SOLUTION TO TEST CASE 97

Page 138 (last month)

The line timebase signal is commonly used for switching actions in the decoder and a very critical switching action is that of the burst gate. A pulse from the line timebase is fed to this via an *RC* network so that the gate opens only during the periods of the bursts. If something happens to this rather delicate timing the gate will not be fully open during the bursts and the amplitude of the chroma signal applied to the chroma detectors is likely to be affected because the a.c.c. potential is derived from gated and rectified bursts.

Since the colour saturation could be restored by adjusting the line lock control within the locking range of the line generator mistiming was a very strong possibility. In fact it was found that one of the resistors in the network used for processing the line pulses (taken from a tapping on the line output transformer) for the gating circuit had decreased in value. This was causing the gate to open a fraction of a second before the burst, though the error, which was very slight in this case, could be corrected by slightly "misphasing" the line generator (flywheel-controlled variety). Replacing the resistor completely cured the trouble.

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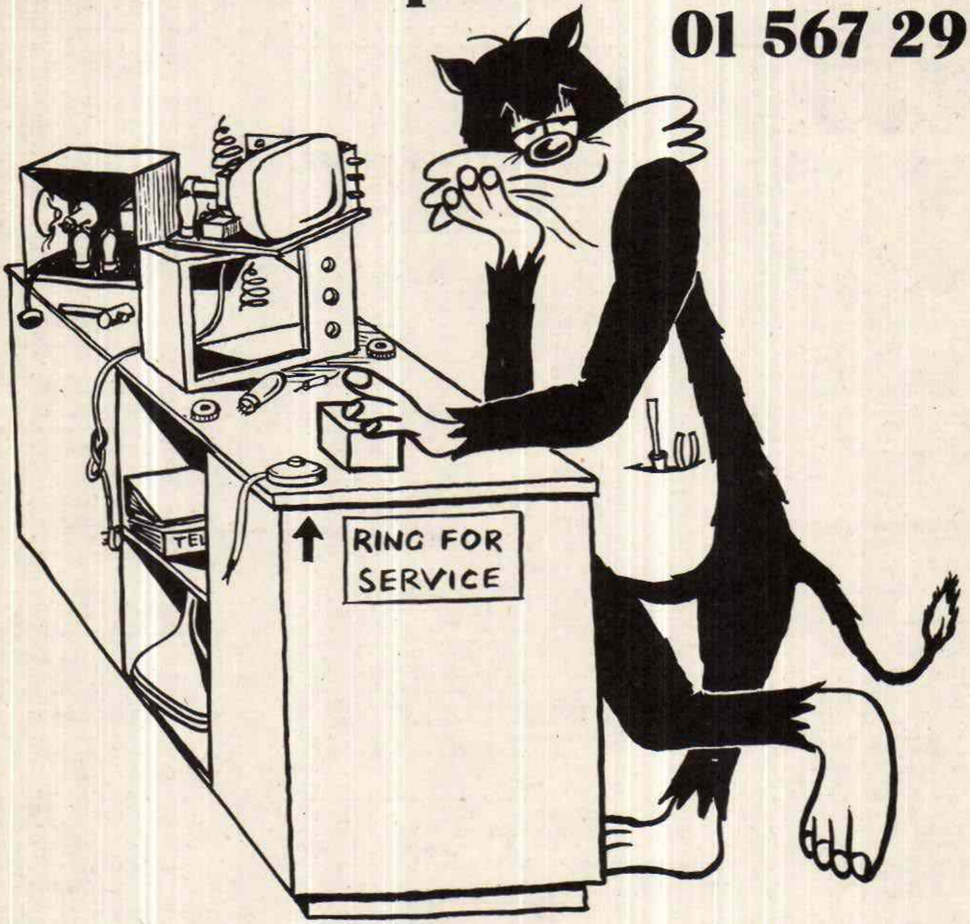

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