

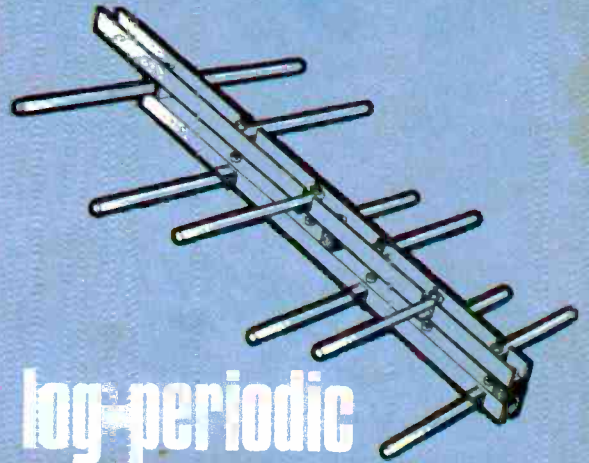
TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

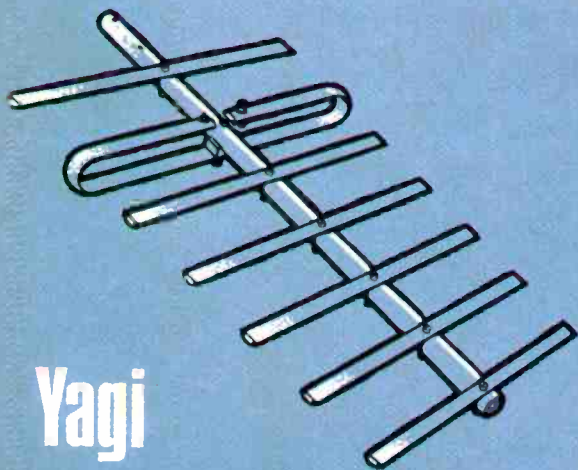
20p

AUGUST
1971

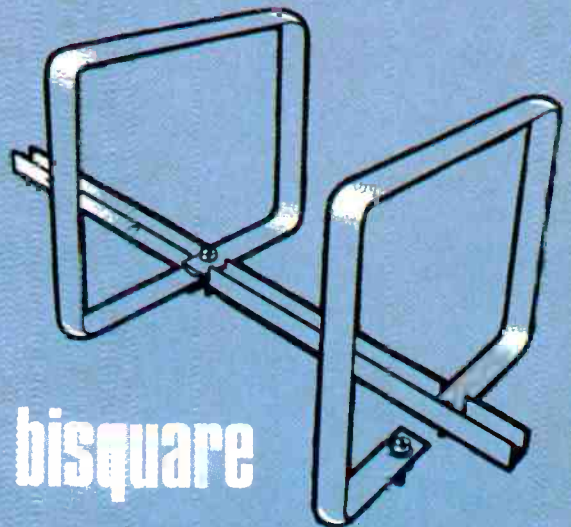
UHF aerials for the constructor



log-periodic



Yagi



bisquare

also: VIDEO MONITOR
SCOPE DUAL-TRACE UNIT
VIDEO HF RESPONSE

STEPHENS

**ELECTRONICS,
P.O. BOX 26,
AYLESBURY, BUCKS.**

**SEND S.A.E. FOR LISTS
GUARANTEE**
Satisfaction or money
refunded.

NOW INTRODUCE COMPONENTS

TELEVISIONS ELIZABETHAN TW12LZ PORTABLE TV

12 in. screen model complete with loop aerial system. Operates on 230/240v. AC or 12v. DC battery or 12v. DC car battery. All transistor covering UHF BBC1, BBC2 and ITA Channels 21-70. Size 15 in. x 12½ in. x 12 in. Weight 16½ lbs. List Price £75. OUR PRICE ONLY **£52-97**. Carr. £1.

Also the 14 in. Elizabethan Television Model No. F.14 (L2). OUR PRICE **£56-50**. Carr. £1.

MULTIMETERS AND OSCILLOSCOPES TWO NEW OSCILLOSCOPES FROM RUSSIA

CI-5 SINGLE BEAM OSCILLOSCOPE

10 mc/s passband. triggered sweep from 1 µsec. to 3 millisee. Free running time base from 20 c/s to 200 ke/s. Built-in time marker and amplitude calibrator, 3-in. cathode ray tube with telescopic viewing hood. **£39-00**

CI-16 DOUBLE BEAM OSCILLOSCOPE

5 mc/s passband. Separate Y1 and Y2 amplifiers, rectangular 5 in. x 4 in. cathode ray tube. Calibrated triggered sweep from 0.2 µsec. to 100 milli-sec. per cm. Free running time base 50 c/s to 1 mc/s. Built-in time base calibration and amplitude calibrator. **£87-50**

Full details on request. Full servicing facilities and spares available.

TWO NEW AC/DC MULTIMETERS FROM RUSSIA

TYPE 4313—High sensitivity for general electronic and TV-radio repair applications. Sensitivity: 20,000 o.p.v. DC and 2,000 o.p.v. AC.

DC ranges: 75mV-1.5-3-7.5-15-30-60-150-300-600V. 60-120-600µA-3-15-60-300mA-1.5 Amp.

AC ranges: 1.5-5-7.5-15-30-60-150-300-600V. 600µA-3-15-60-300mA-1.5A.

Resistance: 0.5-5-50-500kΩ. Capacity and Transmission level scales.

Accuracy: 1.5% DC; 2% AC. PRICE, with carrying case and leads, **£10-50**. Both instruments have knife-edge pointers and mirror scales.

TYPE 4312—Low sensitivity (667 o.p.v.) extremely sturdy instrument for general electrical use.

DC ranges: 0.3-1.5-7.5-30-60-150-300-600-900V and 75mV; 300µA-1.5-6-15-60-150-600mA-1.5-6A.

AC ranges: 0.3-1.5-7.5-30-60-150-300-600-900V. 1.5-6-15-60-150-600mA. 1.5-6A.

Resistance: 0.2-3-30kΩ. Accuracy: DC 1%; AC 1.5%.

PRICE, with carrying case and leads, **£9-75**.

BEST QUALITY CAPACITORS WIMA DUROLIT

Capacitance	Working Voltage	Tolerance ±20% Net
1000 pF	630	25p pack of 5
1500 pF	630	25p pack of 5
2200 pF	630	25p pack of 5
3300 pF	630	25p pack of 5
4700 pF	630	25p pack of 5
6800 pF	630	27p pack of 5
0-01 µF	630	27p pack of 5
0-015 µF	630	29p pack of 5
0-022 µF	630	33p pack of 5
0-033 µF	630	40p pack of 5
0-047 µF	630	42p pack of 5
0-068 µF	630	50p pack of 5
0-1 µF	630	56p pack of 5
0-15 µF	630	67p pack of 5
0-22 µF	1000	29p pack of 5
470 pF	1000	29p pack of 5
680 pF	1000	25p pack of 5
1000 pF	1000	25p pack of 5
1500 pF	1000	27p pack of 5
2200 pF	1000	27p pack of 5

WIMA TROPYFOL

Capacitance	Working Voltage	Tolerance ±20% Net
47 pF	400	21p pack of 5
68 pF	400	21p pack of 5
100 pF	400	21p pack of 5
150 pF	400	21p pack of 5
220 pF	400	21p pack of 5
330 pF	400	21p pack of 5
470 pF	400	21p pack of 5
680 pF	400	17p pack of 5
1000 pF	400	17p pack of 5
1500 pF	400	17p pack of 5
2200 pF	400	19p pack of 5
3300 pF	400	19p pack of 5
4700 pF	400	19p pack of 5
6800 pF	400	19p pack of 5
0-01 µF	400	21p pack of 5
0-015 µF	400	21p pack of 5
0-022 µF	400	23p pack of 5
0-033 µF	400	23p pack of 5
0-047 µF	400	25p pack of 5
0-068 µF	400	27p pack of 5
0-1 µF	400	33p pack of 5
0-15 µF	400	44p pack of 5
0-22 µF	400	46p pack of 5
1500 pF	630	21p pack of 5
2200 pF	630	21p pack of 5
3300 pF	630	21p pack of 5
4700 pF	630	21p pack of 5
6800 pF	630	23p pack of 5
0-01 µF	630	25p pack of 5
0-015 µF	630	25p pack of 5
0-022 µF	630	27p pack of 5
0-033 µF	630	31p pack of 5
0-047 µF	630	36p pack of 5
1000 pF	1000	21p pack of 5
1500 pF	1000	21p pack of 5
2200 pF	1000	23p pack of 5
3300 pF	1000	23p pack of 5
4700 pF	1000	25p pack of 5
6800 pF	1000	27p pack of 5
0-01 µF	1000	27p pack of 5
0-015 µF	1000	31p pack of 5

0-022 µF 1000 36p pack of 5
ADD 5p PER ITEM POST AND PACKING

WIMA MKS

Capacitance	Working Voltage	Tolerance ±20% Net
0-01 µF	100	27p pack of 5
0-015 µF	100	27p pack of 5
0-022 µF	100	27p pack of 5
0-033 µF	100	27p pack of 5
0-047 µF	100	27p pack of 5
0-068 µF	100	27p pack of 5
0-1 µF	100	29p pack of 5
0-15 µF	100	33p pack of 5
0-22 µF	100	40p pack of 5
0-33 µF	100	44p pack of 5
0-47 µF	100	52p pack of 5
0-68 µF	100	65p pack of 5
1-0 µF	100	83p pack of 5
1-5 µF	100	£1-23p pack of 5
2-2 µF	100	31p pack of 5
3-3 µF	100	41p pack of 5
4-7 µF	100	47p pack of 5
6-8 µF	100	63p pack of 5
0-022 µF	250	27p pack of 5
0-033 µF	250	29p pack of 5
0-047 µF	250	29p pack of 5
0-068 µF	250	33p pack of 5
0-1 µF	250	33p pack of 5
0-15 µF	250	42p pack of 5
0-22 µF	250	42p pack of 5
0-33 µF	250	50p pack of 5
0-47 µF	250	56p pack of 5
0-68 µF	250	73p pack of 5
1-0 µF	250	88p pack of 5
1-5 µF	250	£1-25p pack of 5
2-2 µF	250	30p pack of 5
0-01 µF	400	27p pack of 5
0-015 µF	400	29p pack of 5
0-022 µF	400	29p pack of 5
0-033 µF	400	31p pack of 5
0-047 µF	400	33p pack of 5
0-068 µF	400	38p pack of 5
0-1 µF	400	40p pack of 5
0-15 µF	400	44p pack of 5
0-22 µF	400	54p pack of 5
0-33 µF	400	65p pack of 5
0-47 µF	400	81p pack of 5
0-68 µF	400	£1-13p pack of 5
1-0 µF	400	£1-36p pack of 5
0-01 µF	630	29p pack of 5
0-015 µF	630	29p pack of 5
0-022 µF	630	33p pack of 5
0-033 µF	630	33p pack of 5
0-047 µF	630	38p pack of 5
0-068 µF	630	44p pack of 5
0-1 µF	630	50p pack of 5
0-15 µF	630	56p pack of 5
0-22 µF	630	71p pack of 5
0-33 µF	630	98p pack of 5
0-47 µF	630	£1-23p pack of 5
0-01 µF	1000	31p pack of 5
0-015 µF	1000	33p pack of 5
0-022 µF	1000	36p pack of 5
0-033 µF	1000	40p pack of 5
0-047 µF	1000	44p pack of 5
0-068 µF	1000	48p pack of 5
0-1 µF	1000	61p pack of 5
0-15 µF	1000	83p pack of 5
0-22 µF	1000	£1-04p pack of 5

+ 5p PER PACK OF 5

TOP-QUALITY CARBON FILM RESISTORS

Type	Watt	Tolerance	Ohmic Range From To	Net
WP0131	1/8W	±5%	5-1 330 K	6p per 10 24p per 25 80p per 100
WP051	1/2W	±5%	10 10 M	6p per 10 24p per 25 80p per 100 P. & P. 5p P. & P. 5p P. & P. 4p

ALL ITEMS ADVERTISED IN LAST MONTH'S ISSUE ALWAYS IN STOCK FOR SAME DAY DISPATCH

TERMS, CASH WITH ORDER ONLY. POST AND PACKING PAYABLE ON ORDERS UP TO £6, AFTER THAT, FREE EXCEPT C.R.T.'s.

Be a technician on radar, radio and electronics.



As an Artificer Apprentice, you train to be one of the Navy's top technicians: at 24 you'll be a £2,000 a year man responsible for ultra modern radar, radio and electronic equipment. If you're 15½-17½, with 'O' level standard in Maths, and Science or English, send for details.

APPRENTICESHIPS

Name _____

Address _____

Date of birth _____

(Enquiries from U.K. residents only)

Royal Naval Careers Service (829QE1),
 Old Admiralty Bldg., Whitehall,
 London S.W.1. Please send me,
 without obligation, your free booklet,
 "Royal Navy Technician Apprenticeships".

RN
 ROYAL NAVY

for men of vision
 rebuilt T.V. tubes

	Current types		
17"	£4.75	21"	£5.50
19"	£5.00	23"	£6.00

	Panorama & Rimguard types		
19"	£7.00	23"	£9.00

	Twin panel		
19"	£7.50	23"	£9.50

Cash or P.O. with order no C.O.D. Free delivery in U.K.

Each tube fitted with new electron gun assembly. Fully guaranteed for two years against any fault except breakage.

Special terms for Hospitals, Orphanages, Old People's homes.

Manufactured in our own factory backed by over 20 years' experience in the field of electronics. Callers always welcome (by appointment) at

k.s.t. Ltd.

Providence Mills, Viaduct Street,
 Stanningly, Nr. Leeds, Yorks.



KONTAKT 60

FOR INACCESSIBLE CONTACTS—More than just a cleaner. KONTAKT 60 guarantees perfect cleaning of contacts chemically in accordance with today's technology.

KONTAKT offers the following advantages:—

1. Dissolves oxides and sulphides the safe way without attacking contact substances.
2. Contains carefully selected solvents which do not attack plastics whereas they do dissolve resinified contact greases and dirt.
3. Contains *no silicone*.
4. Contains a light lubricant in order to avoid the contact paths being corroded.
5. Prevents further oxidation setting in.
6. Prevents "creep" currents.

Because of these outstanding properties KONTAKT 60 is one of the best and most popular contact cleansing agents in the world.

Users include: Rolls Royce Ltd., C.E.G.B., South of Scotland Electricity Board, Trinity House Workshops, Kolster Brandes, Mullard, Plessey Cos., etc.

OTHER KONTAKT PRODUCTS ARE:

70 Protective Lacquer
 72 Insulating Spray
 75 Cold Spray For Fault Location
 80 Special Siliconized Polish
 100 Antistatic Agent For Plastics
 101 Dehydration Fluid

Write for full details of above complete range of Kontakt products to:—

SPECIAL PRODUCTS DISTRIBUTORS LIMITED

81 Piccadilly, London, W.1

01-629 9556

WILLOW VALE ELECTRONICS LIMITED

The Service Department Wholesalers

Compare our prices

e.g. NEW 19" C.R.T's ... OUR PRICE £7.95 Plus 65p 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 (5's)		
-001	400v.	£0.04
-0022	600v.	£0.04
-0033	600/1500v.	£0.04
-0047	600/1500v.	£0.04
-01	400v.	£0.04
-022	600v.	£0.05
-033	600v.	£0.05
-047	600v.	£0.05
-1	600v.	£0.05
-22	600v.	£0.10
-47	600v.	£0.14
-022	1000v.	£0.06
-047	1000v.	£0.06
-1	1000v.	£0.09
-22	1000v.	£0.14
-47	1000v.	£0.19
-001	1500v.	£0.08

BIAS ELECTROLYTICS (5's)		
25mfd	25v.	£0.07
50mfd	25v.	£0.08
100mfd	25v.	£0.10
250mfd	25v.	£0.15
500mfd	25v.	£0.19
1000mfd	12v.	£0.30
1000mfd	30v.	£0.30
2000mfd	25v.	£0.35
2500mfd	30v.	£0.45
3000mfd	30v.	£0.47
5000mfd	30v.	£0.55
25mfd	50v.	£0.08
50mfd	50v.	£0.10
100mfd	50v.	£0.13
250mfd	50v.	£0.18
500mfd	50v.	£0.24
2000mfd	50v.	£0.47
2500mfd	50v.	£0.55

WIRE-WOUND RESISTORS (5's)		
10 watt rating, suitable for mains dropper sections.		
1	Ohm	£0.09
10	Ohms	£0.09
13	"	£0.09
25	"	£0.09
33	"	£0.09
50	"	£0.09
87	"	£0.09
100	"	£0.09
150	"	£0.09
220	"	£0.09
330	"	£0.09
1K	"	£0.09
2.2K	"	£0.09
3.3K	"	£0.09
4.7K	"	£0.09

PULSE CERAMICS (5's) 12KV		
100pf	22pf	£0.06
120pf	47pf	£0.06
180pf	68pf	£0.06
250pf		£0.06

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

CERAMICS (6's)		
500pf	22pf	£0.03
680pf	47pf	£0.03
820pf	68pf	£0.03
1000pf	100pf	£0.03
1500pf	120pf	£0.03
3000pf	180pf	£0.03
5000pf		£0.03

SMOOTHING ELECTROLYTICS		
Wire ended, 450v. working.		
1mfd		£0.07
2mfd		£0.08
4mfd		£0.11
8mfd		£0.13
16mfd		£0.16
32mfd		£0.23
50mfd		£0.25
8/8mfd		£0.19
8/16mfd		£0.25
16/16mfd		£0.26
16/32mfd		£0.27
32/32mfd		£0.27
50/50mfd		£0.42
50/50/50mfd		£0.52

CANNED ELECTROLYTICS		
100/200mfd		£0.63
100/400mfd		£0.83
200/200mfd		£0.85
200/200/100mfd		£0.95
200/400/32mfd		£0.95
100/300/100/16		£0.95
100/400/32mfd		£0.95
100/400/64/16		£1.07

SKELETON PRE-SETS (5's)		
25K	Vertical	£0.07
50K	"	£0.07
100K	"	£0.07
250K	"	£0.07
500K	"	£0.07
1 meg	"	£0.07
2 meg	"	£0.07
500K	Horizontal	£0.07
680V	"	£0.07
1 meg	"	£0.07

SUB-MINIATURE ELECTROLYTICS (5's)		
1mfd	18v.	£0.09
2mfd	18v.	£0.09
4mfd	18v.	£0.09
5mfd	18v.	£0.09
8mfd	18v.	£0.09
10mfd	18v.	£0.09
16mfd	18v.	£0.09
25mfd	18v.	£0.09
32mfd	18v.	£0.09
50mfd	18v.	£0.09
100mfd	18v.	£0.09
200mfd	18v.	£0.09

THERMISTORS (5's)	
Miniature	£0.08
TH1	£0.13

RECTIFIERS Silicon Mains (5's)	
Westinghouse S10AR2	£0.33
BY127 Mullard	£0.26
BY327	£0.25

CONTACT COOLED FULL WAVE	
75ma	£0.60
100ma	£0.70
150ma	£0.86

CO-AXIAL PLUGS	
Bakelite top	£0.04
Egen metal	£0.08
Single point (car radio)	£0.10

SLIDER PRE-SETS (3's)	
100K	£0.08
1 Meg	£0.08
2.2 Meg	£0.08

JACK PLUGS	
Chrome standard	£0.20
Standard	£0.15
3.5mm. metal	£0.15

DIN PLUGS (2's)	
3-pin	£0.10
5-pin	£0.11
Sockets	£0.06

DOUBLE DIODE RECTIFIERS (5's)	
Bush/Murphy/BRC, etc.	
Line/frame timebases etc.	
3 leg	£0.31
4 leg	£0.31
5 leg	£0.31

RADIO/TV GLASS FUSES	
1 amp, 1.5 amp, 2 amp, 3 amp.	
Per dozen	£0.15

MAINS FUSES	
2 amp, 3 amp, 5 amp, 13 amp.	
Per dozen	£0.25

TERMINAL STRIPS	
2 amp	£0.12
5 amp.	£0.14
15 amp	£0.29

CARBON FILM RESISTORS		
1/2 watt, 1 watt and 2 watt.		
The following values are packed in cartons of six of each value.		
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 1/2 watt, 1 watt and 2 watt versions. *Special for Philips TV's: 8.2M 2-watt, 23p per pack. Price 1/2 watt -10, 1 watt -13, 2 watt -23

VOLUME CONTROLS	
Standard spindle with flat.	
Double pole switch	£0.25
Without switch	£0.19
(One per pack)	
5K, 10K, 25K, 50K, 100K, 250K, 500K,	
1 meg, 2 meg.	

MOBILE STORES VANS IN LONDON, WEST COUNTRY, WALES AND SCOTLAND

RECORD PLAYER CARTRIDGES	
ACOS: GP67/2g.	High gain general purpose Mono
GP91/3C.	Stereo-compatible replacement
GP91/3SC.	High gain version of above
GP94/1SS.	Stereo cartridge

GENERAL PURPOSE REPLACEMENT FOR TC8's etc.
High gain, plenty of output (Jap.)
Stereo version

SERVISOL AND ELECTROLUBE PRODUCTS (Nett trade)	
£0.83	Servisol aerosol can
£1.10	Electrolube 2AX aerosol
£1.10	Servisol Freezite
£1.89	Electrolube No. 1 Snorkel
£0.99	Electrolube 2GX Grease
£1.89	Servisol Aero-Clene for tape heads
	Servisol Aero-Duster

REPLACEMENT STYLII	
TC8	£0.23
GC8	£0.23

REBUILT AND NEW TUBES—TWO YEARS' GUARANTEE

REBUILT	BRAND NEW	A FEW SAMPLE TYPES, REMEMBER WE STOCK EVERY TUBE
17" @ £5.95	£6.50	CME1702, AW43-80, CRM173, MW43-80, MW43-69*, CRM172*, AW43-88, AW43-89, CME1705, CME1703, C17AF, C17SM, etc.
19" @ £5.95	£7.95	CME1903, CME1902, CME1901, AW47-90, AW47-91, A47-14W, C19AH, C19AF, C19A.
21" @ £7.95	£9.90	CME2101, AW53-88, AW53-89, CRM211*, CRM212*, MW53-20*, MW53-80*.
23" @ £7.95	£10.80	CME2303, CME2301, AW59-90, AW59-91.
COLOUR TUBES IN STOCK. PRICES ON APPLICATION		*NEW ONLY. NO REBUILDS
ALL PRICES ARE NETT		
TWIN PANELS	19" CME1906 A47-13W } ON APPLICATION	23" CME2306 A59/13W } ON APPLICATION

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

EVERY TUBE IN STOCK INCLUDING 12", 16" PORTABLES, PANORAMA & RINGUARDS. TERMS: CASH WITH ORDER. CARRIAGE ANYWHERE IN GT. BRITAIN 65p per Tube

RADIO AND TELEVISION VALVES SMALL SELECTION

British made valves normally supplied. EVERY TYPE IN STOCK

DY86/7	EY86/7	PCL86
DY802	EZ80	PD500
EABC80	EZ81	PFL200
EB91	EZ90	PL36
EBC90	GZ34	PL81
EBF80	GY501	PL81A
EBF89	PC86	PL82
ECC81	PC88	PL83
ECC82	PC97	PL84
ECC83	PC900	PL302
ECC804	PCC84	PL504
ECH81	PCC88	PL508
ECH84	PCC89	PL509
ECL80	PCC189	PY33
ECL82	PCC806	PY81
ECL83	PCF80	PY800
ECL84	PCF86	PY801
ECL86	PCF87	PY82
EF80	PCF801	PY83
EF85	PCF802	PY500
EF86	PCF805	UABC80
EF89	PCF806	UCH81
EF183	PCF808	UCL82
EF184	PCL82	UCL83
EH90	PCL83	UL41
EL34	PCL84	UL84
EYS1	PCL85	UY85

VALVE DISCOUNTS
42% ORDERS UP TO £50
50% ORDERS OVER £50

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 £5.00 in value otherwise postage and packing will be charged at 25p 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. 15p in loose stamps, please.

L.O.P.T.'s

LINE OUTPUT
TRANSFORMERS

ALL MAKES SUPPLIED

L.O.P.T.'s ONLY AVAILABLE
FROM LONDON DEPOT

EXCHANGE UNITS AND
NEW REPLACEMENTS

EVERY MAKE SUPPLIED
(EXCEPT MURPHY OIL-FILLED)

REWIND SERVICE FOR
OBSOLETE MODELS

FRAME OUTPUT, SOUND OUTPUT AND
MAINS TRANSFORMERS REWOUND

REMEMBER . . . We are the Service department Wholesalers and supply only the Service Engineers' requirements and can therefore carry large stocks, and also we know and understand your problems regarding getting the right spares QUICKLY and the RIGHT PRICE.
HOT-LINE ORDERS: LONDON 01-567 5400-2971. 01-579-3582. SOMERSET 045-84-2597

4 & 5 THE BROADWAY, HANWELL, LONDON, W.7
Telephones: 01-567 5400 01-567 2971 01-579 3582
42 WEST END, STREET, SOMERSET 045-84 2597

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)	C21/1A (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)	C21/5M (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)	

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.
CME 1601	£8.50		
17"	£6.25	£4.25	12" - 19" 62p
19"	£7.25	£4.87	
21"	£8.50	£5.25	20" - 23" 75p
23"	£9.75	£6.87	
19" Twin Panel	£10.25	£7.25	
23" Twin Panel	£15.50		
19" Panorama	£9.38		
20" Panorama	£9.50		
23" Panorama	£11.95		

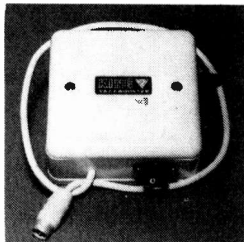
LAWSON TUBES

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.

THE NEW UM4 "COLOURBOOSTER" UHF/625 LINE



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

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

EQUALLY SUITABLE FOR BLACK AND WHITE

Also the M4 DUAL BAND VHF UNIT BOOSTS ALL BAND III and ANY SPECIFIED BAND I CHANNEL SIMULTANEOUSLY NOMINAL GAIN 17-18 DB BOTH BANDS

PRICES BOTH TYPES:

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

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



EX RENTAL TV's

19" — £29.95
23" — £39.95

All Channels 405/625
2 Years Guarantee.
Free List by return.

17" Slim line TV's £11.95, 19" Slim line TV's £15.95. Guaranteed 2 years. Send for List. Carr. & Ins. all sets £1.95. Daily demonstrations to personal shoppers.

TEAK HI-FI STEREO CABINETS £14.95

Brand New 44" wide x 16" deep x 18" high with Legs. A superb piece of furniture. Carr. £1.00.

Transistor Gang Condensers 30p, Miniature AM, post 5p, Precision Tape Motors £1.95, 200/200V, post 20p.

Transistor Radio Cases: 25p each. Size 9½" x 6½" x 3½". P. & P. 15p.
SPEAKERS 50p 25 8Ω BRAND NEW. P. & P. 5p.

TRANSISTORS Post Free

AC 125 AF 179 OC 81
AC 128 OC 44 OC 81D
AF 114 OC 45
AF 117 OC 71 15p each

POTENTIOMETERS 23p each

Double & Switched	500 KΩ/500 KΩ	3½" shaft
Double & Switched	500 KΩ/100 KΩ	2" shaft
Double & Switched	1 MEG, 100 KΩ	1½" shaft

Post. & Pack. 5p.—4 for 10p

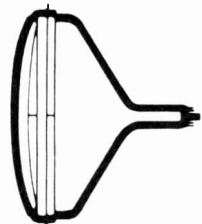
KNOBS 100,000 to clear (Brand New)

100 assorted Radio & T.V. knobs 50p. Postage 25p. (if you require sets 2 to 6 just ask)

DUKE & CO. (LONDON) LTD.

621/3 Romford Road, Manor Park, E.12
Phone 01-478 6001-2-3 Stamp for Free List

TV TUBES REBUILT GUARANTEED 2 YEARS



14"—£3.95, 17" & 19"—£5.95,
21" & 23"—£6.45.
Exchanged Bowls. Carr. 53p.

TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

VOL 21 No 10
ISSUE 250

AUGUST 1971

MONTY PYTHON'S EXPLODING TV SET

Most readers will remember those horrific reports in the daily newspapers last year when headlines screamed out about "Exploding TV Sets" and informed the public that one in ten colour television receivers would burst into flames, pour forth smoke, explode or otherwise exhibit alarming symptoms more appropriate to a Goon Show or the big top of Monty Python than the dear old homely telly.

Well, BREMA was also alarmed about all this, which was inspired by a report published in *Which?*, and asked the Consumers' Association to quiz its panel. Surprise, surprise!—several of the panel "had no recollection of saying there had been an explosion" and BREMA concludes that there was not a single incident which could be regarded as an explosion. BREMA also scotched the reports of "spontaneous" and "delayed-action" fires, there being no evidence of receivers bursting into flames on their own account—reports that fires occurred after sets had been switched off were found to be unsubstantiated. The nearest approach to an explosion consisted of a flashover or blowing fuse.

BREMA called the publicity "disproportionate press comment", a surprisingly restrained criticism under the circumstances. It strikes us as being more like irresponsible sensationalism on the part of the "experts" of the daily press. It also strikes us that this is not the first time that *Which?* has strayed into complex technical matters to the detriment of both manufacturers and the lay public to which its comments are directed.

When members of the publication's panel do not seem to know the difference between an "explosion" and a "sharp crack" and when reinvestigation brings forth a totally different assessment perhaps it is time someone did a *Which?* report on the Consumers' Association!

W. N. STEVENS, *Editor*

THIS MONTH

Teletopics	438
Colour Receiver Circuits—Primary-Colour Tube Drive Circuits <i>by Gordon J. King</i>	440
Circuit Note: Heater Protection <i>by H. K. Hills</i>	444
Basic Circuits for the Constructor—2 cont. <i>by J. W. Thompson</i>	445
Video HF Response <i>by S. George</i>	448
Twin-trace Oscilloscope Unit <i>by D. W. Nelson</i>	452
For the Service Engineer	453
Servicing TV Receivers—GEC-Sobell 2012- 1012 series cont. <i>by L. Lawry-Johns</i>	454
Long-Distance Television <i>by Roger Bunney</i>	458
The Rainbow Revolution—Part 2 <i>by I. R. Sinclair</i>	460
UHF Aerials for the Constructor <i>by K. E. G. Pitt, B.Sc.</i>	462
Montreux '71 <i>J. I. Sim reports</i>	466
Video Monitor <i>by Keith Cummins</i>	470
Your Problems Solved	473
Test Case 104	474

THE NEXT ISSUE DATED SEPTEMBER
WILL BE PUBLISHED AUGUST 20

TELETOPICS



SHOWTIME '71

May this year was certainly Showtime in the world of TV, with the Components Show at Olympia, the Montreux Symposium-Exhibition (reported on a later page) and the Radio-TV Trade Shows. The latter of course have previously occurred in August but it looks as if the move to spring—which we have long advocated as being better suited to the annual pattern of trade—has been a success. Deliveries of many of the models shown are not expected to start till autumn (indeed there were one or two mock-ups, presumably to gauge interest) but should then be available for the peak selling season.

COMPONENTS EXHIBITION

The stands that caught our eye here as having something to say about future trends in TV sets were Mullard (of course!) and ITT. The following items were some of those on show on the Mullard stand. The recently introduced TBA series of integrated circuits for colour and monochrome receivers (see *Teletopics* February and March this year). New are the TBA560 which contains the equivalent of the TBA500 and TBA510 combined; and the TBA750 intercarrier sound channel which was featured in the 625-line i.f. strip design in our July issue. The latter is a five-stage limiter-amplifier with balanced quadrature detector and preamplifier that can drive a triode-pentode or suitable transistor audio amplifier: the limiting action starts at $1\mu\text{V}$ so that good suppression of a.m. signals above 1mV is achieved, and the d.c. volume control has a range greater than 80dB with good control characteristics and low spreads. There were also two development types, the 2870M and 3790M, which have similar functions to the TAA700 and TBA550.

On the transistor side Mullard were showing the BU108 which is for use in the line output stage of colour receivers fitted with 110° deflection-angle c.r.t.s and features a maximum total dissipation of 12.5W, a maximum peak collector voltage rating of 1.5kV and maximum peak collector current rating of 5A; the BD160 for use in the line deflection circuits of monochrome receivers fitted with 110° deflection angle 12in. c.r.t.s; a new range of transistors with increased voltage, peak current and power ratings for use in colour and monochrome receiver video stages, the BF336, BF337 and BF338 (these transistors can also be used as high-voltage drivers in monochrome receiver line timebases); and a new transistor, type BU126, developed for use in switched-mode power supply circuits in 90° and 110° colour receivers—it has maximum voltage ratings of 750V, can conduct

a peak current of 5A and has a total power dissipation of 30W.

In addition to their A56-120X 22in. shadowmask tube Mullard were also showing a 26in. version, the A66-120X. Mullard also now have a tube, type A31-120W, for use in 12in. mains/battery portable monochrome receivers. This tube requires a heater supply of only 11V at 75mA and is a narrow-neck type. For use in larger 17in. portable monochrome models is the A44-120W/R. All these tubes are protected types suitable for use with pushthrough presentation. Also on show were a new deflection coil-convergence assembly, type AT1060, for use with 110° shadowmask tubes and a new e.h.t. supply module containing a tripler circuit and giving focus and e.h.t. voltages of 8 and 25kV respectively for use with both 90° and 110° colour picture tubes.

ITT had on their stand a solid-state colour chassis fitted with their narrow-neck 110° shadowmask tube type A67-150X. This showed excellent convergence and focus characteristics and apart from the field output stage the circuitry was very compact. An innovation here that looks likely to be of considerable importance in the years ahead was the use of a thyristor line output stage. Two thyristors are employed, a BT119 to give the deflection current build up and a BT120 used in the control circuit to initiate the flyback. This type of circuit was originally devised by RCA in 1968 and has since been used in some half a million of their 90° deflection-angle colour sets. We hope to publish an article on this before long. Certainly thyristor line timebases appear to be reliable and simple.

Guest International Ltd. showed a new device for testing and extracting dual 8-in-line colour TV integrated circuits.

TRADE SHOWS AND OUTLOOK

At the Trade Shows pride of place from the TV point of view must undoubtedly go to BRC for their magnificent response to the challenge of low-cost colour TV from Japan: the *Ferguson* Colourstar 17in. colour Model 3712 has the extremely competitive recommended price of £189.75. It is a full PAL-D specification set using a new solid-state colour chassis—the Thorn/BRC 8000 chassis—which incorporates numerous interesting technical features. It is for example the first Thorn TV chassis to use integrated circuits—three of them, one for chroma signal demodulation and matrixing in the decoder, one as sound channel limiter, detector and audio amplifier, and the third as low-level synchronous detector in the i.f. channel. This is the first time so far as we know that a synchronous detector has been used for

i.f. demodulation in a commercial set for the domestic market: it avoids quadrature distortion and provides an inherently linear detection characteristic. Another first in this part of the set is the use of a crystal filter. Other features include the use of a field effect transistor in the decoder reference oscillator control loop, an exclusive BRC vacuum-impregnated line output transformer, complementary class B field output stage with heavy negative feedback and a thyristor controlled 180V line for the line timebase and video amplifier stages. The circuits are protected by a pushbutton reset cut-out.

Our other main impressions from the Trade Shows are of the still increasing number of imported sets, both colour and monochrome, on offer and secondly signs at last of a determined effort by UK setmakers to introduce some small-screen mains/battery portable models. In this connection *Philips* showed a new TVette, the TVette 12, a 12in. single-standard mains/battery portable with daylight viewing filter, two-speed rotary tuner, a phones/tape socket and 1W audio output. This model incorporates two i.c.s, weighs 17½lb. and is to be available later this year. The price has not been fixed. Likewise BRC showed in their *Ultra* range a 14in. mains/battery portable, Model 6818, which will be available later this year at about £68. *KB* showed the Featherlight 12 weighing just over 16lb. and expected to retail at about £65. *Decca* showed their Model MS1210 12in. mains/battery portable and *Pye* their Model 99 12in. mains/battery portable which has a suggested price of £78-80. The 12in. mains/battery portable shown by *Rank-Bush-Murphy*, Model TV300, is manufactured in Japan to RBM design, weighs 20lb. and is priced at £63-50. RBM also showed an e.h.t. meter at £24 plus 50p post and packing which measures up to 30kV and has an 0·1mA f.s.d. movement.

Amongst imports *Grundig* have decidedly come on the TV scene with four models, a 20in. monochrome model, the T2002, at £89-95, a portable version, the P2002, at £92-45 and a 24in. version, the R500E, at £97-80. Their 26in. colour model, the 717, is priced at £359-85. All these sets feature varicap tuners, slider volume, brightness etc., user controls, phones/external loudspeaker socket and provision for remote control. New colour models were also shown by *Kuba* and *Korting*. A combined radio (m.w. plus v.h.f.) and TV model with pop-up 6in. screen and built-in rechargeable batteries and a 4½in. colour set were shown by *National Panasonic*. The first Hong Kong built set on the market, the 12in. Minitele at £53, was shown by *Haskel Electronics Ltd.* *Europhon* had an Italian-built portable. *Hitachi* introduced a further 12in. mains/battery model, the TWU67 at £75. The surprise in the Russian-built *Rigonda* range—distributed by Brown Brothers Ltd.—was a 4½in. mains/battery model at £39-50.

On the home front *ITT-KB* introduced the first 20in. colour model, the Colourscene 20 Model CK500 at £247. This is fitted with their CVC5 chassis. ITT have also relaunched their *RGD* brand. Additions to the BRC ranges included the *Ferguson* 26in. colour Model 3711, *HMV* 26in. colour Model 2711, *Ultra* 22in. colour Model 6704, 17in. mains portable Model 6814 and 12in. portable Model 6805 at £58-60, the *Marconiphone* 22in. colour Model 4704 at £280-70, 12in. mains portable Model 4805 at £58-60 and 20in. dual-standard black-and-white Model 4673 at £83-45. *Philips* showed three new colour models fitted with their G8 chassis, the 22in. Nouveau Model 524 and two

26in. versions the 521 and 522. A new 24in. monochrome model, the 4308 at £87, was also shown. *Pye* introductions included two colour models, the 19in. Model CT153 at £259-50 fitted with the 691 chassis and the 26in. Model CT154 at £349 fitted with the 693 chassis. Monochrome introductions included the 24in. Models 98 and 151 fitted with the 769 chassis and the 20in. Model 155 fitted with the 169 chassis. In the *Invicta* range were the 20in. Model 7120 at about £80 and the 24in. Model 7124 at about £88, both fitted with the 169 chassis, and a 26in. colour model, the 7056, at about £325 fitted with the 693 chassis. *GEC* showed three colour models, the 19in. Model 2103 at £229, 22in. Model 2100 at £275 and 26in. Model 2107 at £310 and three new monochrome models, the 20in. Model 2084 at £72-50, the 20in. Model 2104 at £78-50 and 24in. Model 2105 at £86. The 2104 and 2105 are available in different colour finishes. *Sobell* introductions included the 22in. colour Model 1100 at £275 and two monochrome models, the 20in. 1101 at £78-50 and 24in. 1102 at £86. A very noteworthy introduction was the Keraclonic Sphere by *Kera-colour*. This is a 25in. colour set (fitted with a single-standard Decca chassis) with a spherical white swivel plastic housing on a reinforced stand: the price is £385.

The latest BREMA figures, for April, are as follows: colour set deliveries for the month 45,000, monochrome set deliveries 92,000. In comparison with April 1970 there was a marked increase in colour set deliveries and a marked fall in monochrome set deliveries.

Leonard Govier, managing director of Granada TV Rental, has suggested that at the current rate of colour TV set production in the UK there will soon be excess stocks leading to large-scale price-cutting. He estimates from BREMA figures that stocks will soon rise to 350,000 in comparison to 162,000 at the end of last year. During the first quarter he reckoned that 80,000 of the total production of 180,000 colour sets went into stock. It certainly looks as if the days of the sellers' market in colour TV are now over.

TWIN-PANEL TUBE REPLACEMENT KIT

Mullard have introduced a 23in. twin-panel tube replacement kit to enable the 23in. twin-panel tube type A59-16W to be replaced by their 23in. push-through type A59-23W (the ringtrap type A59-23W/R must *not* be used as the replacement).

TRANSMITTER NEWS

The ITA u.h.f. transmitters at Caradon Hill, Redruth and Belmont are now in operation. Caradon Hill and Redruth both carry Westward Television programmes, **Caradon Hill** on channel 25 with horizontal polarisation (receiving aerial Group A) and **Redruth** on channel 41 with horizontal polarisation (receiving aerial Group B). **Belmont** carries Anglia Television programmes on channel 25 with horizontal polarisation (receiving aerial Group A). BBC-2 transmissions have started from the **Bethesda** (Caernarvonshire) relay station on channel 63 with vertical polarisation (receiving aerial Group C). Many viewers in the area served by this relay station are at present receiving transmissions from Llanddona on the same channel. If they do not readjust their aerials for the new station unpleasant interference in the form of a double image from the stronger local signal will occur.

COLOUR RECEIVER CIRCUITS

PRIMARY-COLOUR TUBE DRIVE CIRCUITS

GORDON J. KING

THE display of colours on the screen of the shadow-mask tube is the result of each of the three beams of the tube being modulated by the appropriate colouring signal. In the previous two articles the circuits leading to this end result with colour-difference drive have been examined. It will be recalled that in this system the Y signal drives the three tube cathodes simultaneously while each grid receives its appropriate colour-difference signal. This means that between the grid and cathode of each tube gun appears a signal which carries the information of the original primary-colour signal delivered by the camera. Because both the grid and cathode of a gun can be modulated it follows that the guns can serve as matrixes combining the Y signal with the colour-difference signals so that the beams recreate the original primary-colour signals.

With primary-colour drive the primary-colour signals are reassembled from the colour-difference and Y signals *prior* to the picture tube. The primary-colour signals are then fed separately to the three tube cathodes, the grids controlling the tube biasing in the ordinary way.

Matrixing

A block diagram illustrating the scheme is shown in Fig. 1. The R - Y and B - Y colour-difference preamplifiers receive the appropriate signals from the synchronous detectors while the G - Y colour-difference signal is matrixed from the R - Y and B - Y ones in the same way as previously described for receivers using colour-difference drive. Instead of the colour-difference signals being fed to the tube grids however they are fed to separate primary-colour matrix/output stages along with the luminance signal. It is common for a single stage to act as matrix and primary-colour drive amplifier, feeding the primary-colour signal direct to a tube cathode.

One of the first colour chassis to employ this technique was the BRC (Ferguson, HMV, Ultra, Marconiphone, DER, etc.) 2000 dual-standard all-transistor one. The subsequent BRC 3000 single-standard chassis also uses primary-colour tube drive and the appropriate circuit sections are shown in Fig. 2.

Let us follow the circuit from the outputs of the synchronous detectors at the bottom left-hand corner. The signal from the V detector goes via filter R226/C210 and then C211 to the base of the R - Y preamplifier VT207 while the signal from the U detector goes via C229 to the base of the B - Y preamplifier VT213. The G - Y preamplifier is VT210 and is connected in the common-base mode, the base components C223/R253 giving an input (base) impedance similar to that at the other colour-difference preamplifiers. The emitter of VT210 receives the input signal which is compounded of suitable proportions

of R - Y and B - Y signals from the emitters of VT207 and VT213. The proportions of signal to yield the G - Y signal are obtained from R241 (R - Y) and R259 (B - Y) with the capacitors across them providing a degree of compensation.

Each colour-difference preamplifier is followed by a d.c. coupled emitter-follower (VT208 R - Y, VT211 G - Y and VT214 B - Y). The colour-difference signal from the low-impedance emitter output of each of these stages is then coupled directly to the emitter circuit of each of the three primary-colour output stages via a "set video gain" preset control network. In addition to providing tube drive each primary-colour output stage also serves as the appropriate primary-colour matrix as the Y signal is applied simultaneously to the bases of each of these three stages from the luminance channel. Addition of the luminance and colour-difference signals thus occurs in these stages.

Luminance Channel

The luminance channel in the BRC 3000 chassis comprises first a Y delay line driver which receives Y signal at its base from the luminance detector and delivers amplified Y signal from its collector to the delay line shown at the top left-hand side of Fig. 2. The delay line driver transistor is not shown but is a pnp device, R201 being its collector load. The delay line input is loaded by the collector impedance of the driver transistor in parallel with R201 and in series with R279. L202 is a stopper choke.

The output of the delay line then feeds signal to the base of the post delay line amplifier VT201 so that the delay line output is mainly loaded by VT201 base input impedance in parallel with R204. The Y delay is about 600nsec and it is rather important

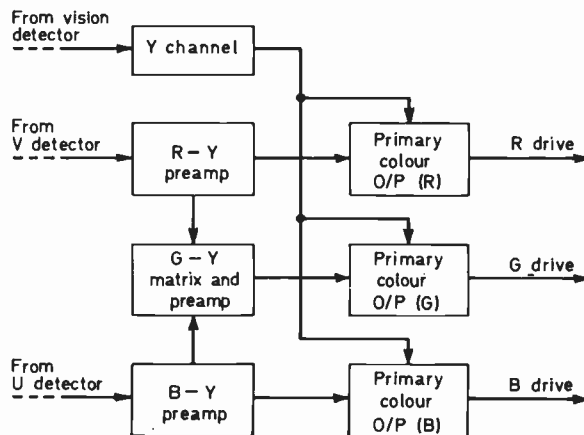


Fig. 1: Block diagram of the primary-colour drive system.

NEW LINE OUTPUT TRANSFORMERS

ALBA 655, 656, 717, 721 **£3-75**. 890-895, 1090, 1135, 1195, 1235, 1395, 1435 **£5-00**.
ARGOSY. 17K10 17K11, 17K12 17K14 19K17, 17K43. **£4-00**.
BAIRD. All models price **£5-90**. From model 600 quote part no. normally found on TX base plate.
BUSH TV53 to TUG69 **£2-00**. TV91 to TV139 **£4-75**. (From Model TV123 an alternative Square Tag Panel was fitted on Main Bobbin, please state if required.) TV141 to TV176 Rewind **£4-50**. TV75 to TV86 **£4-75** (except TV 80).
COSSOR 904 to 957 Rewind **£4-50**. CT1700U to CT2378A **£5-00**.
DECCA DM1, DM3C (90°), DM4C (70°), DR1, DR2, DR121 **£4-50**. DR95, DR100, DR101, DR202, DR303, DR404, DR505, DR606 **£4-50**.
DEFIANT 7P20 to 7609. Prices on request.
DYNATRON TV30, TV35, TV36, TV37, TV38, TV39, TV40, TV41, etc. **£4-00**.
EKCO T231, T284, TC267, T283, T293, T311, T326, T327, T330, TMB272, T344, T344F, T345, TP347, T348, T348F, TC347, TC349, TC356, T368, T370, TC369, T371, T372, TP373, TC374, T377A, T393, T394, 433, 434, 435, 436, 437 all at **£4-00**. 503, 504, 505, 506 **£4-75**.
FERGUSON 306T, 308T, 406T, 408T, 416, 436, 438, 506, 508, 516, 518, 536, 546, 604, 606, 608, 616, 619, 636, 646, 648, 725, 726, 727, 3600, 3601, 3602, 3604, 3611, 3612, 3614, 3617, 3618, 3619, 3620, 3621, 3622, 3623, 3624, 3625, 3626, 3627 3629 **£4-00**. Jelly Pots, please state colour: red, black or white.
FERRANTI T1001, T1002, T1002/1, T1004, T1005, T1023, T1024, T1027, T1027F, TP1026, T1071, T1072, T1121, TC1122, TC1124, T1125, TC1126 **£4-00**. 1154, 1155 **£4-75**.
G.E.C. BT302, BT342 **£3-50**. BT454DST-456DST, 2010, 2013, 2014, 2012, 2000DS, 2001DS, 2002DS **£4-25**.
H.M.V. 1865, 1869, 1870, 1872, 1874, 1876, 1890, 1892, 1894, 1896. All models to 2645 **£4-00**.
KB OV30, NF70, NV40, PV40, QV10, QV30, RV10, RV20, RV30, PVP20 **£4-50**. Featherlight **£4-50**. Chassis No. VC1-VC2-VC3-VC4 **£4-50**.
MASTERADIO 4013 DST, D500 DST, D507 DST **£4-25**.
MARCONI VT153, VT155, VT156, VT157, VT159, VT161, VT163, VT165, VT170, 4611, 4800, 4801, 4803, 4615 **£4-00**.
PAM 600S to 5106 **£4-00**.
PETO SCOTT. Prices on request.
PHILCO 1019, 1020, 2021 **£4-13**. 1029, 1030, 1035, 1036, 1040, 1050, 1060 **£4-13**.
PHILIPS 11TG190 to 24T301 **£5-00**. 1768U to 2196U Rewind **£4-75** (old unit required).
PILOT PT450, 452, 455, 650, PT651, P60A, P61 **£4-00**.
PYE V200, V400, 200LB, 210, 220, 300F, 300S, 310, 210S, 410, 510, 530, 600, 620, 630, 700 A or D, 710 A or D, 830 A or D or LBA **£4-00**.
 11U Series, 11U-P/NO. AL21003, 21F to 61. Part Nos. must be given when ordering Pye LOPTS **£4-00**.
REGENTONE 197-198, 298, TV402, TV401, TV501, TV502 **£4-50**. 10-4-10-6-10-21 17-18, 10-12, 191-192 **£4-00**.
R.G.D. 626, 627, 628, 726, RV202, RV302 **£4-50**. 519-619-620-621C, 723 **£4-00**.
SOBELL 1000DS, 1002DS, 1005DS, 1010DST, 1012, 1013, 1014, 1018, 1019, 1020, 1021, 1032, 1033, 1038, 1039 **£4-25**.
STELLA T1011U to 2149A **£5-00**.
ULTRA 1770, 2170, 1772, 1782, 2172, 1771, 2171, 1775, 2175, 1774, 2174, 1773, 2137, 1980c, 1984c, 100c, 200c, 2380, 2384, 1984, 1985, 1986, 1980, 1980a, 1780, 2180, 2181, 2183, 2182, 1871, 1783, 6600, 6625, 6626, 6628, 6632, 6642 etc. **£4-00**.
 We can rewind most LOPT **£4-75**.

Post and Package 26p. C.O.D. 30p extra.

LINE OUTPUT TRANSFORMER INSERTS ONLY

BUSH TV92-TV93, TV94-TV95-TV96-TV97, TV98, TV100, TV101, TV103, TV104, TV105, TV106, TV108, TV109, TV110, TV113, TV115, TV115R, TV115c, 123, 125, 128 **£2-75**. Complete with heater windings. TV75, TV85 **£2-75**.
DECCA DR95, DR101, DR202, DR303, DR404, DR505, DR606 **£2-75**.
EMERSON E700, E701, E704, E707, E709, E710, E711, Portarama **£2-00**.
FERGUSON 204T, 205T, 206T, 214T, 235T, 236T, 244T, 245T, 246T **£2-00**.
KB PV40, MV100, OF100, PV100, NV40, NF70, OV30, QV10, QV30 **£2-00** pair.
PETO SCOTT 1416, 1418, 1419, 1422, 1423, 1716, 1719, 1720, 1722, 1723, 1724, 1725 **£1-48**.
REGENTONE 10-4, 10-6, 1021, 17-18, 10-12 **£2-00**. T176, TT7, 191, 192 **£2-00**.
R.G.D. Deep 17, The 17, 590, 600, 606, 611, 710, 723 **£2-00**.
Guarantee. Post and Package 26p. C.O.D. 30p extra.

NEW REPLACEMENT L/OP/TX

MURPHY **£4-75** 26p P.P.
V310 TO 929

REPLACEMENT DROPPERS

Philips Type 30+125+2-85 **63p. P.P. 7p.**
 Ferguson, H.M.V., Marconi, Ultra 800 & 850 Series (Convertible) 37+31+97+26+168. **63p. P.P. 7p.**
 As above 85 series (Dual Standard) 14+26+97+173 **63p. P.P. 7p.**

BRAND NEW VHF TUNERS

uses PCF805, PC97 less valves **50p.** Plus p. & p. **26p.** Limited Quantity.

T.V. CANNED ELECTROLYTICS

64-100. 450v. **£1-23** each. P.P. 17p
 100-200. 275v. **£1-10** each. P.P. 17p

T.V. CANNED ELECTROLYTICS

100-200. 350v. £1-23 each. P.P.	150-100-100-100-150
100-200-60. 17p	320v. £2-05 each. P.P. 17p
300v. £1-23 each. P.P. 17p	200. 350v. 95p each. P.P. 17p
100-300-100-16. 275v. £1-50 each. P.P. 17p	200-200-100. 350v. £1-93 each. P.P. 17p
100-400-275v. £1-15 each. P.P. 17p	300-300. 300v. £2-00 each. P.P. 17p
100-400-16. 275v. £1-50 each. P.P. 17p	125+200+100+32-275v. £1-40
	400+400-350v. £2-30

POWER RESISTOR SECTIONS

These wirewound sections enable you to build up any Mains Dropper to your requirements. A central 2BA hole is provided for mounting.

Ohms 7, 9, 10, 12, 14, 17-5, 20. All at 7A	21p each
Ohms 22, 25, 28, 30, 33, 36. All at 7A	26p each
Ohms 40, 47, 52, 56, 60, 63, 66, 75, 87, 100 at 3A	21p each
Ohms 120, 140, 160, 180, 200, 220, 250, 270 at 3A	26p each
Ohms 300, 350, 400, 470, 560, all at 12A	21p each
Ohms 726 at 15A	26p each
K Ohms, 1 K ohm at 1A	21p each
K Ohms, 2 (-07A)	26p each

Postage each section 3p

ALL STOCK ORDERS DESPATCHED BY RETURN POST.

CALLERS WELCOME. But to avoid disappointment please phone to check that the items you require are in stock. All new components inserts are guaranteed for three months from the date of invoice subject to the breakdown being due to faulty manufacture or materials. **S.A.E. all enquiries.**

Dept. "R" D. & B. TELEVISION (Wimbledon) LTD. 80 MERTON HIGH STREET, S.W.19
 01-540 3513 01-540 3955

for the input and output loading to be correct if coincidence between the luminance and colour information on the display is to be secured. It is the purpose of the Y delay line to hold back for a small fraction of a second the luminance signal so that it arrives at the primary-colour matrixes at the same instant as the colour-difference information which will have been delayed relative to the pre-delay line Y signal because the chroma channel has a more restricted passband than the Y channel. Lack of coincidence shows on the display as a small horizontal displacement of the colour relative to the luminance.

The luminance signal from VT201 collector is fed to the base of the luminance emitter-follower VT206. Contrast control is effected at this point by R207 (the contrast control) which is in parallel with the luminance signal. The control is d.c. isolated from VT201 collector by C204 and from VT206 base by C205. Thus the level of the signal fed to the luminance emitter-follower is reduced as R207 is adjusted to reduce the shunt resistance.

The post-delay line amplifier incorporates a 4.43MHz chroma trap in its emitter circuit. This consists of L201, C201 and its purpose is to notch out any chroma signal which could result in picture interference if allowed to pass through the luminance channel.

The luminance signal developed across R240 the emitter load of VT206 is coupled directly to the bases of the three primary-colour output stages so that each of these transistors is in receipt of both the Y signal and the appropriate colour-difference signal. The collectors of the primary-colour output stages thus deliver true primary-colour signals to the tube cathodes.

Brightness Control System

There are several extra complications in the circuit. It will for example be seen that the luminance signal after passing through VT201 is subjected to brightness and beam current limiting controls by way of the offset-pulse generator VT204 and the following stage VT205 which operates the beam limiter. As these are rather unusual circuits it is worth taking a look at their operation.

The circuit of the beam limiter is shown in Fig. 3(a) and contains the brightness control. The picture tube grids are preset to a suitable negative potential and receive the line and field blanking pulses as shown in Fig. 3(b). The action of the brightness control differs from convention in that the offset system in Fig. 2 allows either positive or negative displacement of the picture information relative to the sync pulses and porches, such displacement occurring as the brightness control is operated or as the beam limiter comes into operation.

The offset-pulse generator VT204 in Fig. 2 is driven by positive-going pulses from the line output stage fed in at connector 14/7 (top-middle of circuit). After suitable processing these pulses are added to the luminance signal by the adder stage VT205 the base of which is biased from the brightness control and VT901 (Fig. 3) collector.

An idea of what happens can be gleaned from the oscillograms shown in Fig. 4 which apply to the offset luminance feed from VT206 (Fig. 2) emitter. Oscillogram (a) shows the offset pulses with the brightness control at minimum, (b) with a medium brightness control setting and (c) at maximum brightness control setting, with the contrast at minimum and the aerial

disconnected in each case. It is this action which produces the positive or negative displacement of picture information relative to the sync pulses. The end result (at the tube cathodes which are fed separately from the collectors of the primary-colour amplifiers) is that the effective d.c. biasing of the tube is regulated according to the setting of the brightness control and hence regulation of raster brightness (the three beams together) is achieved.

Offset Luminance Technique

Let us look in a little more detail into the operation of the "offset luminance" circuitry. The luminance signal proper passes from VT201 collector to VT206 base. Stages VT204 and VT205 which are linked to VT206 base are concerned essentially with the biasing of the tube guns—via the d.c. circuit existing from VT205 collector through VT206 and the primary-colour drivers (VT209, VT212 and VT215) to the picture tube cathodes. Now since the tube grids are clamped to a d.c. datum it follows that any change in the level of the d.c. in the luminance channel to the tube cathodes will affect the tube biasing, the beam current and hence the picture brightness.

The potential at the collector of the adder stage VT205 effectively establishes the d.c. level at the cathodes of the guns from the bias applied to its base from the brightness control/beam limiter circuits shown in Fig. 3. When the bias at VT205 base is increased positively the current in the collector load resistor R210 rises and the positive bias at VT206 base falls. This diminishes VT206 emitter current and thus reduces the positive bias at the bases of the primary-colour drive transistors. As a result of this the standing current through these three transistors decreases so that their collectors rise positively towards the collector rail potential. Because the collectors of these transistors are directly coupled to the tube cathodes the biasing of the three guns is increased reducing the picture brightness (a positive-going potential at a tube cathode drives that gun of the tube towards cut-off). Thus the tube beam current and hence the picture brightness decrease as VT205 base bias is raised positively.

The offset pulse generator stage VT204 effectively "stabilises" during the sync pulse and porch period the biasing of the luminance channel at the selected brightness setting. For this purpose line frequency pulses from a 400V source are fed to VT204 base through the resistive attenuator R217, R218 and R219. The pulses appearing at VT204 output are then given a d.c. datum by diodes W202 and W203. The job of the adder stage VT205 is to relate this datum to the sync pulses and porches present in the luminance signal.

Alteration in VT205 base bias has the effect of making the pulses from VT204 either positive- or negative-going since this bias change alters the conductivity of the diode pair W202 and W203 differentially. Since these pulses coincide with the sync pulses and porches already present in the luminance channel the effect is either to add to or subtract from the sync pulses and this is tantamount to a positive or negative displacement of the picture information relative to luminance signal black level (which of course is the porch level).

Fig. 3 (right): The beam limiter (a) and c.r.t. grid (b) circuits of the BRC 3000 chassis.

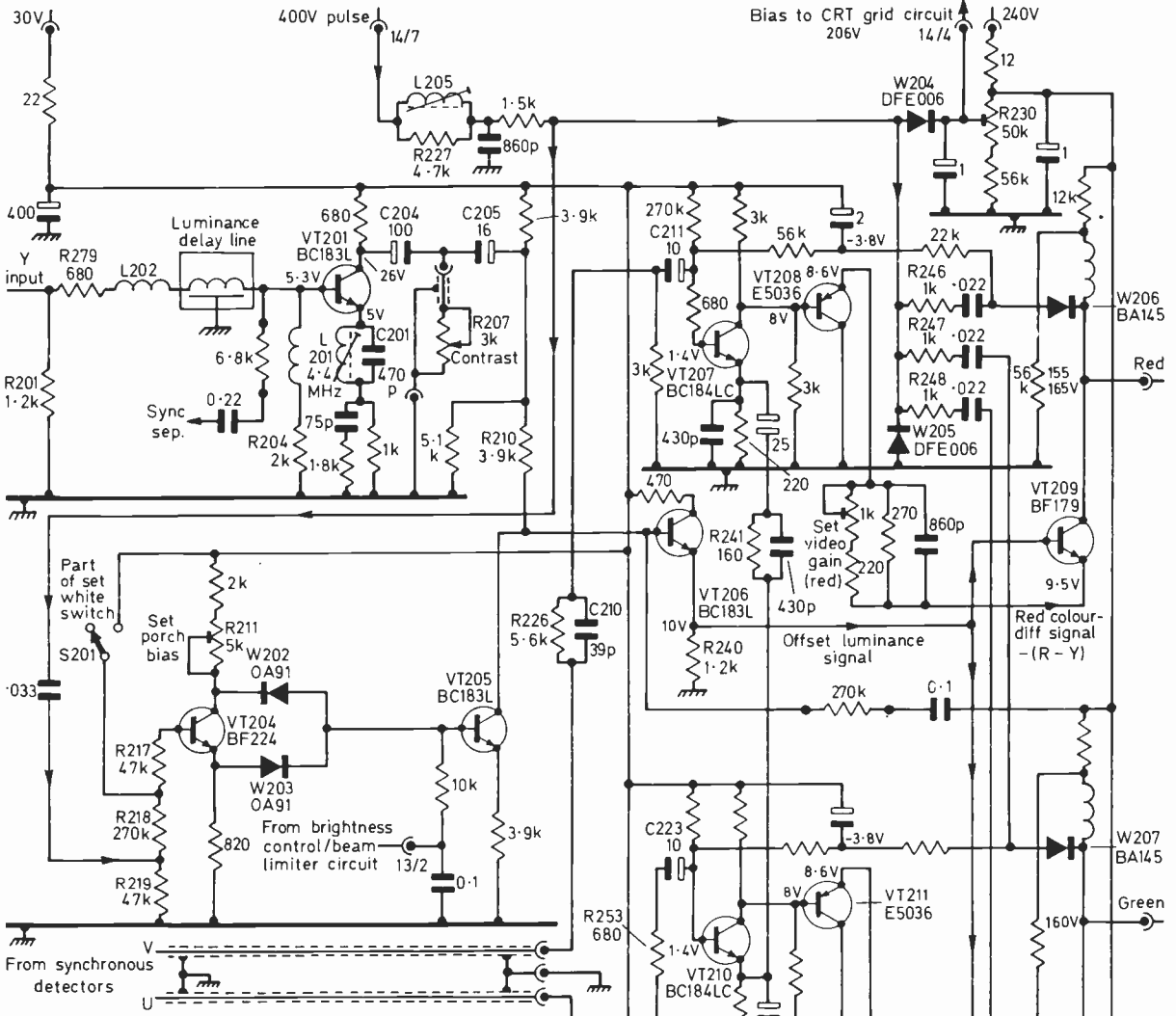
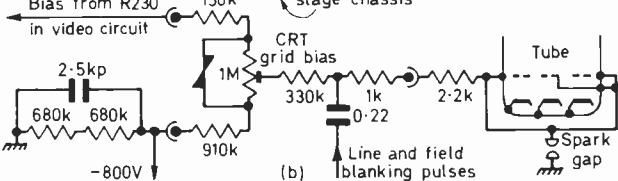
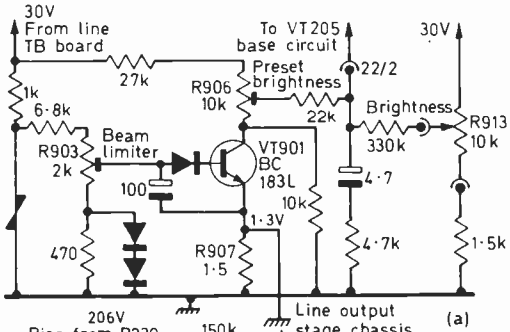


Fig. 2: Video section of the BRC 3000 chassis which employs primary-colour tube drive.



Components in the green and blue channels for which no value is given have the same value as the equivalent component in the red channel

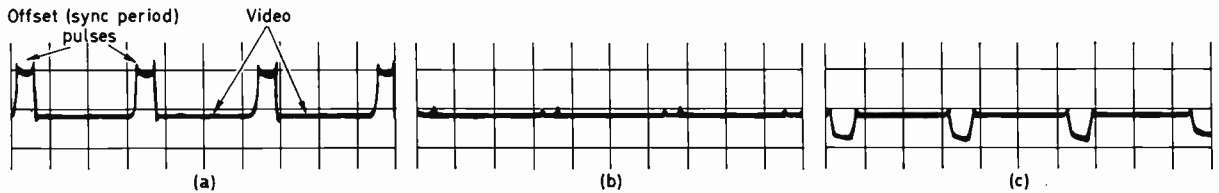


Fig. 4: Offset pulse waveforms present on the luminance feed to the primary-colour matrix-output transistors under three different brightness control setting conditions.

In this way the black level is maintained constant in spite of changes in picture brightness. Preset R211 sets the luminance channel bias during the sync pulses and porches. The bias is correct when R211 is adjusted to provide 10.7V at VT206 emitter on an Avo Model 8 switched to the 25V d.c. range. The adjustment should be made with the field collapsed by the set-white switch S201 and the beams switched off.

The oscillograms in Fig. 4 give a good impression of how the offset pulses at VT206 emitter change from positive-going through zero to negative-going as the brightness control is adjusted. The pulse amplitude here is of course significantly below that at the 400V source.

Clamping

For all this to happen correctly the primary-colour signals must be clamped to a d.c. potential. Stabilisation of this kind is provided by the same line pulses used to drive VT204. These pulses are timed by L205 (with R227 providing damping). Diode W205 deletes negative-going overshoot while the three clamp diodes W206-W208 to the three primary-colour amplifier collectors are in phase with the pulses. The feed resistors are R246, R247 and R248 and the negative potential at the anodes of the three clamp diodes is returned to the bases of the three colour-difference

preamplifiers, separately in each case. This effectively locks the black level.

The tube grid circuit also receives a clamping potential from diode W204 (top right-hand corner of Fig. 2), the clamping level here being preset by R230.

Beam Limiter Operation

Now let us return to Fig. 3 to see how the beam limiter works. To increase tube current the bias from connector 22/2 to VT205 base must be negative-going whilst to decrease tube current it must be positive going. The beam limiting action is based on the current flowing through R907 in VT901 emitter lead. This resistor is also connected in the earth return side of the e.h.t. and line scan circuits. Thus the beam limiter VT901 monitors a current which is proportional to the total e.h.t. current (i.e. the beam current). When the beam current rises above the permitted maximum established by the preset R903 the potential across R907 increases to a level at which VT901 collector current starts to fall. Its collector voltage then of course increases. A positive-going potential is thus reflected from R906 slider to VT205 base circuit, reducing the Y signal drive datum potential in the same way as when the brightness control is turned down and thereby diminishing the beam current. Preset R906 sets the range of the brightness control.

TO BE CONTINUED

CIRCUIT NOTE: HEATER PROTECTION

H. K. Hills

To reduce heat dissipation from mains dropper resistors—particularly important when only a few valves are employed, as in the current hybrid models—it is now usual to include a power rectifier in series with the heater circuit. This permits the use of a lower-value dropper resistor since conduction through the rectifier occurs only on alternate half-cycles of the input. The disadvantage with this arrangement is that if this rectifier should go short-circuit all the valves and the c.r.t. will be grossly over-run and although the brilliance, contrast and picture size will be abnormal the set owner may be unaware that a major fault exists.

As well as relying on the heater fuse blowing the various setmakers incorporate circuit dodges to prevent set use should this fault occur. In earlier Bush-Murphy models for example the sync separator screen voltage was tapped from a point along the rectified heater supply. Thus if the rectifier went short-circuit the heater current would be pure a.c., there would be zero sync separator d.c. screen potential and the peak 50Hz excursions would constantly trip the field timebase.

In some Thorn models the negative bias for the field output pentode was taken from the heater circuit. In this case if the rectifier goes short-circuit the loss

of bias results in a severely cramped raster with weak or non-existent lock.

In the latest Bush-Murphy single-standard models a new, simple but very effective method is employed. The arrangement is shown in Fig. 1. 3D9 is the heater circuit rectifier and produces a positive-going output. During normal operation the heater protection diode 3D12 is thus reverse biased and has no effect on the circuit. Should 3D9 go short-circuit however 3D12 will conduct heavily when the live supply goes negative, blowing the 1.25A fuse immediately. Should the protection diode go short-circuit 3D9 would conduct heavily during positive half-cycles, again blowing the fuse.

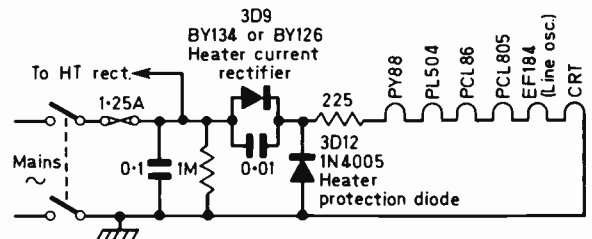
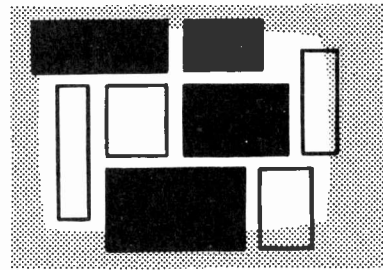


Fig. 1: Heater circuit used in the latest Bush-Murphy single-standard hybrid chassis: heater protection diode 3D12 prevents the valves and c.r.t. being over-run in the event of the heater rectifier 3D9 short-circuiting.

BASIC CIRCUITS FOR THE CONSTRUCTOR

WINDING the coils for the i.f. amplifier is the most tedious part and to obtain the best results it is suggested that the constructor should knock together a coil winding jig, possibly from Meccano. All that is needed is a rigid shaft with a handle and provision for the coil to be firmly mounted on the shaft during winding. The wire on all the coils should be close wound and sealed with wax or glue (enamelled wire) or acetone if TNA wire can be obtained. Having wound the basic coils components should be added on the inside of the coil base as indicated in Figs. 3 and 7. Take care to prevent loose ends shorting to the screening cans. The detector coil assembly (L209/L210, etc.) is wound on a $1\frac{1}{8}$ in. former.



2
CONT.

J.W. THOMPSON

Testing and Alignment

Remove link 4 and replace R211 with a $10k\Omega$ lin. potentiometer. This disables the a.g.c. and allows manual gain control adjustments to be made. Connect a stable 15V supply to the main rail and check voltages as follows: Tr201 emitter 3.2V, base 4.0V (set by manual gain potentiometer), collector 7.7V; Tr202 emitter 2.3V, base 3.1V, collector 10V; Tr203 emitter 1.6V, base 2.3V, collector 13.4V; Tr204 emitter 2.4V, base 3.1V, collector 14V; IC201 pin 2 12V, pin 15 5.8V. VR201 should be initially adjusted for 0.8V at the emitter of Tr207. All these voltages are measured with respect to chassis and should be within 10% of the stated figures. Any faulty components or wiring errors should be rectified before proceeding further. The alignment of the i.f. amplifier may then be carried out by one of the following methods: (1) Wobbulator, detector probe and oscilloscope alignment, adjusting each stage individually as a separate unit. (2) Signal generator, detector

amplifier and voltmeter, used as in (1). (3) Signal generator overall alignment. (4) Alignment without instruments on test card.

Methods (1) or (2) should be used if at all possible so that a good phase response may be achieved. If the phase response is incorrect it will show on test card either as preshoot (black before a white bar) or overshoot (black after white). In severe cases of bad phase response ringing will occur after sharp edges in the picture. The only way to ensure that an i.f. amplifier has a good phase response is to synchronously tune the stages of amplification. The frequency response of each coil assembly—apart from the traps—is centred on 37MHz and the individual responses all stack up to produce a totally predictable overall response.

Alignment—Methods 1 and 2

Disconnect R204 and link 1. Connect a 100Ω resistor across L204, i.e. across pins 3 and 6 of the coil former. Set the cores of the coils as follows: L201

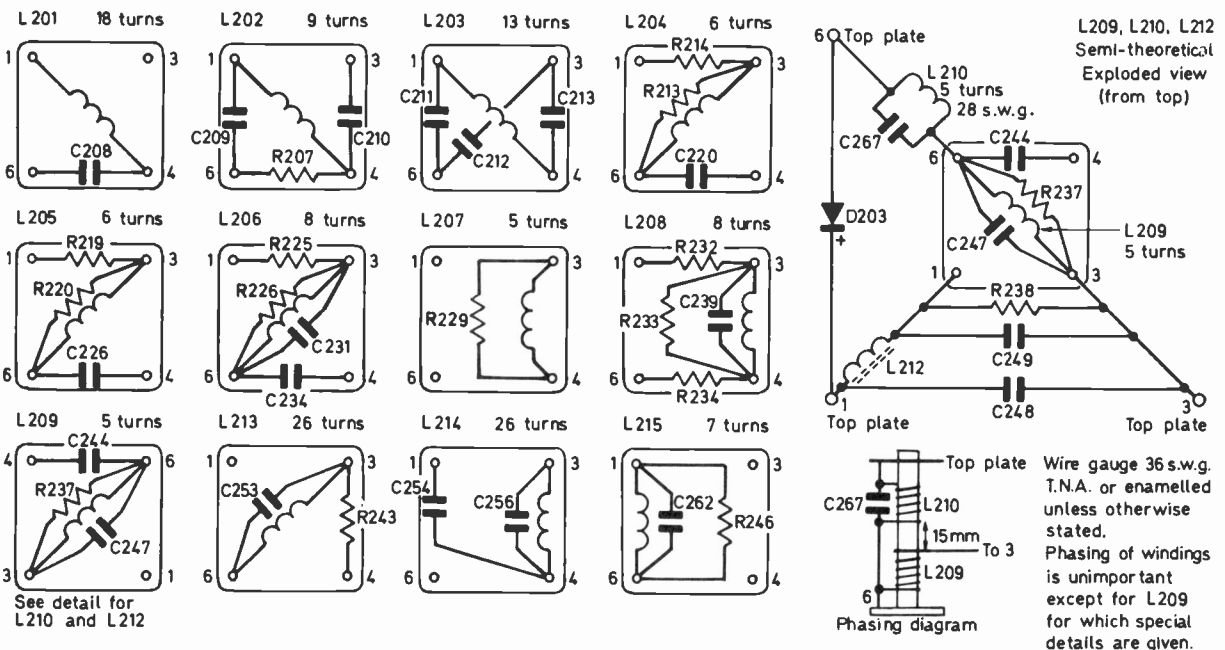


Fig. 7: Coil details for the 625-line i.f. strip.

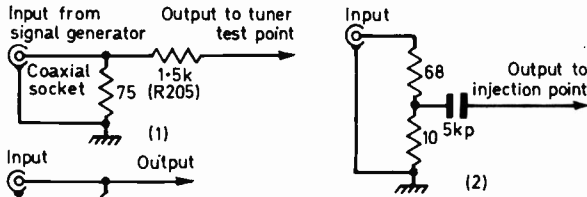


Fig. 8: Injection pads. For tuners other than the ELC1043 replace R205 with a 1pF capacitor. Injection is still at the tuner test point (see Fig. 2 for the usual position of this point on surplus u.h.f. tuner units).

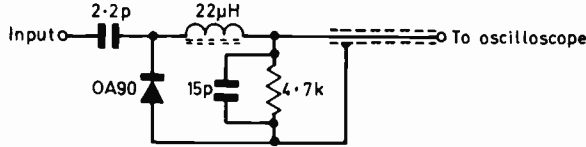


Fig. 9: Detector probe for use with a wobulator and oscilloscope.

fully screwed in, L202 midway, L203 full out, all other coils midway. Set the preset gain control (10kΩ lin. potentiometer in place of R211 as described earlier) so that the gain of Tr201 is reduced by 20dB. This level of reduction corresponds to 3.3V on the emitter of Tr201. Disconnect the earthy end of R205 and insert a 75Ω resistor in series (see Fig. 8 pad 1). Inject a 500mV signal across the 75Ω resistor, centred on 37MHz with a sweep width of about 15MHz. Detect the signal at the collector of Tr201. Adjust the tuner output coil and L202 to give response 1 (Fig. 10) then set the traps L201 and L203 to give response 2. Readers who are not too sure what a dB is in practical terms may find the nomograph (Fig. 11) useful. The golden rule to remember is that decibels add while ratios multiply: for example,

$$-27\text{dB} = -20\text{dB} - 7\text{dB} = 0.1 \times 0.45 = 0.045.$$

Reconnect link 1 and remove the 100Ω resistor from L204 placing it across L205. Disconnect link 2 and inject a 50mV signal at the tuner test point using

pad 1 as before. Detect the signal at the collector of Tr202. Keeping Tr201 at 20dB gain reduction align L204 to give response 3.

Reconnect link 2 and disconnect link 3. Remove the 100Ω resistor from L205 and place it across L206. Detect at the collector of Tr203 injecting as before except at about 15mV. Align L205 to give response 4.

With link 3 still disconnected inject 150mV at the base of Tr204 using pad 2. Slide the core of L210 fully into the coil. Monitor the voltage at the base of Tr207 with an oscilloscope (wobulator alignment) or connect a voltmeter between pins 1 and 3 of the detector coil assembly L209 etc. (signal generator alignment). Finely adjust the level of injection to give 0.5V detected output. Align L208 and L209 to give response 5 and then L210 to give response 6.

Short-circuit L208 and disconnect link 2. Remove the 100Ω resistor from L206 and reconnect link 3. Inject 200mV via pad 2 at Tr203 base. Align L206 and L207 to give response 7, detecting at Tr204 base. Change injection level to 10mV and remove the short across L208. Monitor the detector output as before, at the base of Tr207, and adjust the level of injection to give 0.5V detected output. A very slight adjustment of L207 will give response 8. Repeat the last two sections if large adjustment of L207 is necessary.

Overall Response

Reconnect link 2 and inject about 2mV via pad 1 to the tuner test point. As before adjust the injection level to give 0.5V detected output from the vision detector. Tr201 should still be set at 20dB gain reduction. If the instructions have been followed exactly response 9 should be obtained: this is the addition of all the individual responses. If the response is slightly tilted it is permissible to make a small adjustment to L205. Check that the response does not alter significantly with different degrees of gain control, maintaining the detector output at 0.5V throughout the test. If there is a great shift in response shape check that you are not running Tr201 into reverse gain control. Finally remove pad 1 and

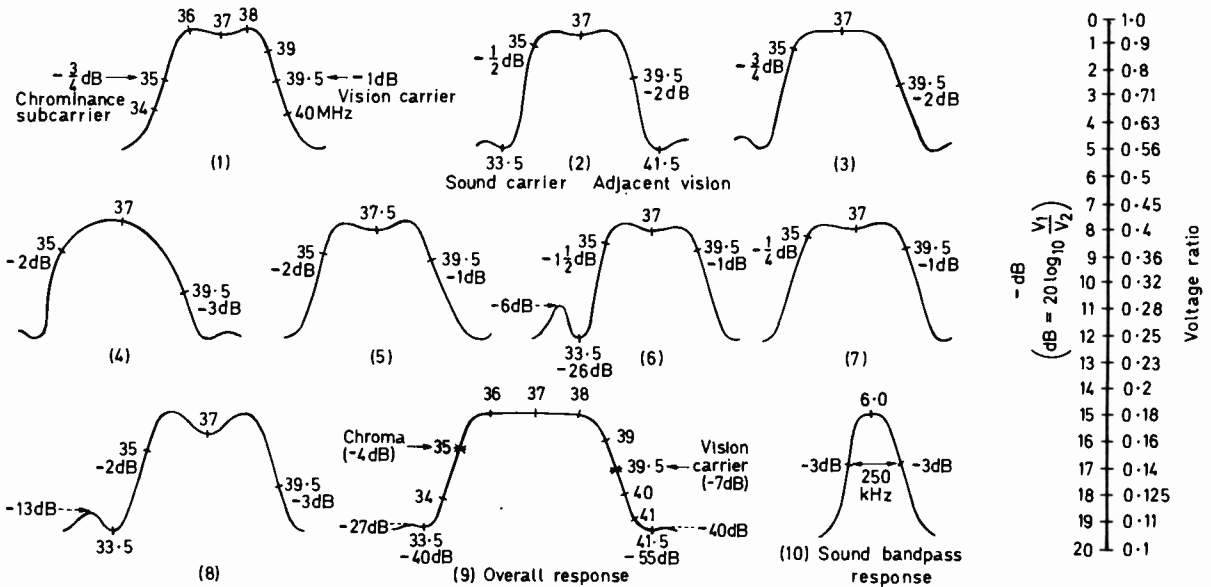


Fig. 10: Response curves. Fig. 11 (right): Decibel to voltage ratio nomograph.

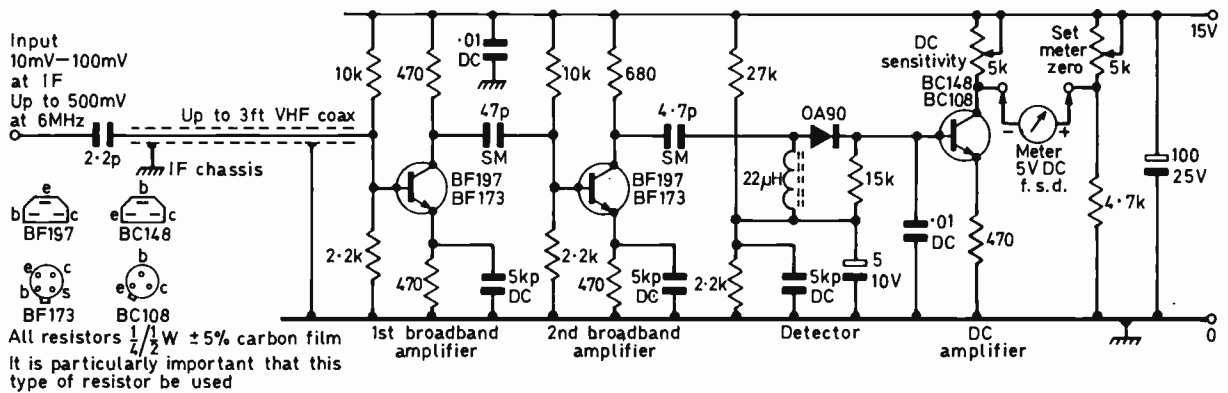


Fig. 12: Detector amplifier for signal generator alignment.

reconnect link 4, R204, R205 and R211 as for normal operation. This completes the alignment procedure for the composite i.f. amplifier.

Sound Alignment

Disconnect the lead going to pin 4 of L213 coil former and inject at pin 4 a 500mV 6MHz signal, going in via pad 3. Detect at pin 3 of IC201 and align L213 and L214 to give response 10. When the receiver is working and tuned to a test card on which there is a continuous tuning note align L215 for maximum audio output across R241. The audio may be measured on an oscilloscope or an a.c. voltmeter. Note that the i.c. will not work at all unless VR202 is connected.

Signal Detection

When a wobulator and oscilloscope are used for alignment the detector probe shown in Fig. 9 may be used for signal detection. With the signal generator and voltmeter method the detector amplifier shown in Fig. 12 is recommended. The amplifier may be built on a metal chassis using a similar method of construction to that of the i.f. amplifier itself. Alternatively it may be built on paxolin pinboard but in this case be sure to provide a really stout earthing busbar. As long as short leads are used for all components the layout is not critical. The response of the detector amplifier is virtually flat from 35 to 40MHz and 10mV at the input via the 2.2pF capacitor will produce 1V output on the meter. At maximum d.c. sensitivity the meter reading should not exceed 5V and the level of injection from the signal generator may have to be reduced below the levels stated in the previous alignment instructions in order to comply with this requirement.

Injection Level

With all methods of alignment it is most important that no part of the circuit is overloaded. The injection levels have been given as a guide and it is appreciated that many signal generators have an uncalibrated output. There should be no problems in using an uncalibrated generator provided reasonable precautions are taken: the generator output should be reduced to a level at which response "crushing" no longer occurs—if the shape of the response alters as the injection level is changed overloading is almost certainly occurring.

Signal Generator Alignment

This method of alignment is very much simpler than the previous methods but the amplifier will have rather a dubious phase response. Inject via pad 1 to the tuner test point and detect with a voltmeter connected between pins 1 and 3 of the detector coil assembly. Disconnect R204 and link 4 and replace R211 with a 10kΩ lin. potentiometer. Set this to give 3.3V at Tr201 emitter. Set all coil cores to their mid-position except for L203 which should be fully out and L201 and L210 which should be fully in.

Set the signal generator to 37MHz and peak up all the i.f. coils (not the traps) for maximum indication on the meter, constantly reducing the voltage injected to maintain a meter indication of 0.5V. Then manually sweep the signal generator frequency between 34 and 40MHz and adjust the coil cores (including the tuner output coil) until the response has a flat top between 36 and 38MHz. Set L201 and L210 for minimum meter indication at 33.5MHz and L203 for minimum at 41.5MHz. Make slight adjustments to all coils to bring the response as close as possible to response 9. Finally reconnect link 4, R204, R205 and R211.

Test Card Alignment

For experienced i.f. core twiddlers who would like to attempt alignment on test card the following tips may be useful. (1) Remove L203 core completely and forget about it. (2) Adjust all cores (except the traps) to give the best possible picture taking into account both phase and frequency response. (3) Set L201 and L210 for minimum sound-chroma beat patterning.

Performance

The video output from the i.f. strip has been tested on a Rank-Cintel video monitor and also a 26in. colour receiver. Excellent pictures were produced in both cases. The sound output is also of very high quality (less than 1% total harmonic distortion) and is suitable for feeding into a high-quality audio amplifier.

Varicap Tuner and ICs

Gurney's (Radio) Ltd. inform us that they have the varicap tuner and i.c.s in stock. The tuner, type ELC1043, is priced at £6.75. The i.c.s are priced as follows TAA550 £0.59, TAA570 £1.91, TBA750 £2.31. (Mullard recommended prices.)

PROVIDED the r.f. and i.f. alignment provide adequate bandwidth correctly shaped to accommodate the vestigial sideband transmission, picture quality in terms of fidelity to the transmitted picture is almost wholly dependent on the video circuits, ability to focus the c.r.t. beam sufficiently sharply to permit reproduction of the top video frequencies probably being the main secondary factor. The video circuits of a receiver extend from the vision detector to the c.r.t. cathode and should ideally provide equal amplification to all frequencies from zero (d.c.) to 3MHz on v.h.f. and 5.5MHz on u.h.f. with negligible or frequency-proportional phase shift (the phase shift, i.e. signal delay, introduced by the amplifier should be proportional to frequency over the entire passband).

It is convenient to think of the h.f. end of the video spectrum as that at which the reactance of the capacitance shunting the load is comparable in value with the load resistor. The reactance of any coupling and decoupling capacitors at h.f. is very low so that they can be ignored. Generally speaking the problems of h.f. amplification begin to emerge at around 100kHz.

Gain at HF

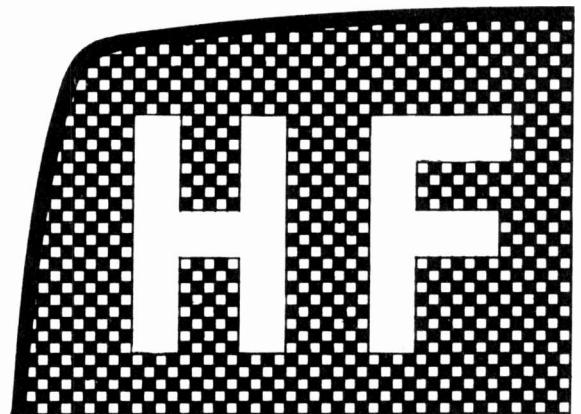
In this article we'll concentrate on valve circuits, following up in a later article with the peculiarities of transistor video circuits. The gain (A) of a pentode video amplifier is given approximately by the formula $A = gm \times RL$ (gm in mA/V and RL in k Ω). This expression is not completely accurate but is quite adequate for practical purposes. It brings out the fact that at medium video frequencies stage gain depends on the valve's mutual conductance (gm) and the value of the load resistor (RL). Thus high voltage amplification can be obtained simply by using a high-value load resistor. To obtain linear amplification at h.f. however it is necessary to use low-value load resistors. This is basically because at h.f. the load impedance is no longer RL but the combination (ZL) of RL and the reactance Xc of the load shunting capacitance. The formula for h.f. stage gain thus becomes $A = gm \times ZL$ and, unlike $gm \times RL$, $gm \times ZL$ is not a fixed figure since Xc varies inversely with frequency. This means that the gain progressively falls towards the top limits.

Shunt Capacitance

The total capacitance shunting the load is made up of (a) the pentode anode capacitance to chassis, (b) the capacitance present across the load component and leads, (c) the c.r.t. input capacitance, (d) the capacitance present because of signal feed components and wiring to chassis and (e) the sync separator input capacitance. While only (b) directly shunts the load the others also do so because the decoupled h.t. line effectively earths the feed end of the load resistor so that all these capacitances are from anode to earth.

The total shunt capacitance in practice can be between 20 and 30pF and an average value of 25pF will have a reactance of about 2.1k Ω at the top v.h.f. video frequency of 3MHz. This reactance is given by the formula $Xc = 10^6 / 6.28fC$ where Xc is in ohms, f in MHz and C in picofarads. The video load impedance at this frequency is thus the combination of this reactance and RL but as these two are elec-

VIDEO



RESPONSE

S. GEORGE

trically at right-angles to one another their net value must be determined vectorially. It is given by $Z = (R \times Xc) / (\sqrt{R^2 + Xc^2})$. Note that when both values in ohms are equal the total impedance is 0.707 of this value (not half as is the case with pure resistances).

Turnover Frequency

Thus high gain cannot be obtained from a high-value load resistor if the reactance of the load shunting capacitance is low at the frequency concerned—the capacitive reactance simply shorts the load resistor. The frequency at which the reactance of the load shunting capacitance is equal to the load resistance is regarded as the top practical response limit since above this the gain falls away rapidly. This frequency is given by $f = 1 / 6.28 \times RL \times Cs$.

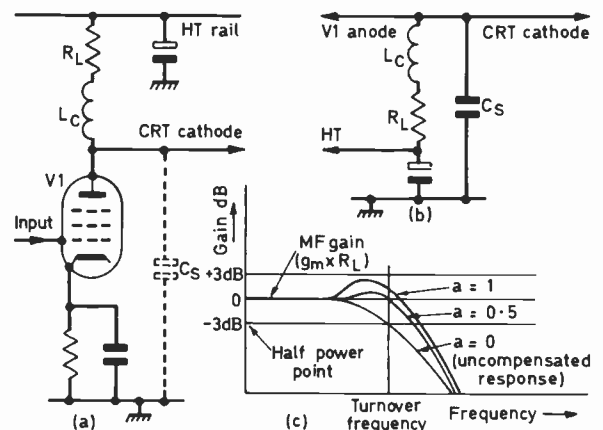


Fig. 1: Shunt compensation: the h.f. peaking coil Lc is in series with the load resistor but as shown in (b) in shunt with the stray capacitance Cs as the electrolytic earths the h.t. rail. Response characteristics with different peaking coil values based on different factors are shown at (c).

When the shunt reactance is very much less than R_L it effectively forms the total load impedance and the gain falls by close to 6dB per octave. The frequency at which X_c is equal to R_L is referred to as the turnover frequency, half-power or -3 dB point.

The gain at the half-power point is 0.707 times the gain at m.f. where X_c is so high that it can be ignored. Having found the total shunt capacitance and its reactance at the top video frequency required, therefore, the circuit designer must use a value of load resistor which will ensure that the gain is maintained at 0.707 that at m.f. up to this top video frequency. Now unless countermeasures are adopted a total shunt capacitance of 25pF will mean the use of a low-value load resistor if linear overall response is to be maintained. Two countermeasures are used in practice, (a) the inclusion of peaking or compensating coils which in effect offset the circuit capacitance—by introducing inductive reactance to offset the circuit capacitive reactance—and (b) the inclusion of a cathode-follower stage.

Use of Peaking Coils

The first method is very widely used and results in a lift in gain towards the top limit. This although resembling tuned circuit response must however not permit the circuit to even approach resonance or severe ringing will be produced. Response improvement by using peaking coils is both complex and largely mathematical and is further complicated by the fact that there is no one ideal inductor value for any circuit, the precise value being determined by the particular feature it is desired to optimise. To explain this, it is possible to aim for (a) maximum overall linearity, (b) best phase response, (c) best transient response without overshoot or (d) to raise the -3 dB point to the m.f. amplitude. The coil inductance adopted is usually a compromise between any two of these features. It should however be pointed out that, although the inclusion of a peaking coil will generally improve all these characteristics and any one in particular, a more rapid decline from the peak point than that obtained by normal h.f. roll-off in an uncompensated RC stage is produced. The precise peaking point must therefore be carefully chosen to avoid too sharp a fall in gain within the video passband.

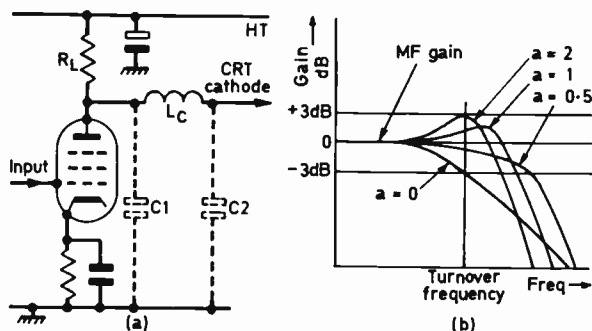


Fig. 2: Series compensation: here the peaking coil L_c is in series with the signal feed to the c.r.t. cathode. Responses shown at (b) vary with different a factors. Generally, higher coil values are used in comparison to shunt-compensated circuits, producing a steeper and more linear fall-off after the peaking point.

Shunt-compensated Circuits

Although as shown in Fig. 1 (a) the compensating coil L_c in a shunt-compensated circuit is placed in series with the load resistor it is effectively in shunt with the circuit capacitance as shown in Fig. 1(b). The coil inductance for any combination of R_L and C_s can be calculated from the formula $L = a \times R_L^2 \times C_s$ where a is a factor depending on the particular characteristic aimed for. These are as follows: for equalising the h.f. -3 dB response to the m.f. level, 0.5; for best overall linearity 0.414; for best phase response 0.322; for best transient response without overshoot (critical damping) 0.25.

If the pentode section of a PCL84 which has a gm of 10.4mA/V is used with a load resistor of 2.6k Ω the stage gain at m.f. will be 10.4 \times 2.6 or 27.04. It will be only 0.707 times this figure at the turnover frequency. Let's see what the inductance in microhenrys of a shunt coil required to achieve equalisation at this frequency, i.e. to raise the gain to the m.f. figure, is.

$$L = 0.5 \times \frac{2,600^2 \times 20 \times 10^{-12} \times 10^6}{a \times R_L^2 \times C_s \text{ in pF } \mu\text{H conversion}} = 67.6 \mu\text{H}$$

The response curve using a coil with this a factor is shown in Fig. 1(c). It will be seen that the gain rises above the m.f. gain just before the uncompensated amplifier turnover frequency and equals the m.f. gain at this frequency. The response with a coil having an a factor of 1 shows a more pronounced peak. Practical values tend to lie between 0.25 and 0.75.

Series-compensated Circuits

In series-compensating circuits the coil is connected in the signal feed from the anode of the video amplifier to the c.r.t. cathode. The arrangement functions by dividing the total circuit capacitance as shown in Fig. 2(a) where the divided circuit capacitance is represented by C_1 and C_2 . It will be seen that the coil L_c with C_1 and C_2 form a low-pass filter which gives a lift at the required point but sharply increases the attenuation to frequencies above the video passband.

Series-compensating arrangements can give slightly better results than shunt circuits but have the disadvantages that (a) the h.f. roll-off after the peak is steeper than for shunt types, (b) the component values are rather more critical while (c) the peaking coil inductance and effect is largely determined by how it separates the total circuit capacitance. This last factor is determined mainly by the physical position of the coil. Thus two types of graph must be considered in relation to series-compensating circuits, (a) a graph showing the response curves of coils with different a factors and (b) a graph of curves showing the effect of varying the total capacitance division each side of a specified coil. The graph shown in Fig. 2(b) shows the effect on h.f. response produced by coils with different a factors when C_2 is twice C_1 . Another widely used ratio is with C_2 equal to three times C_1 .

In some series-compensating circuits the peaking coil is connected in series with the anode load in a similar manner to Fig. 1(a): however as the c.r.t. drive is tapped from the junction of the coil and the load resistor instead of being taken direct from the

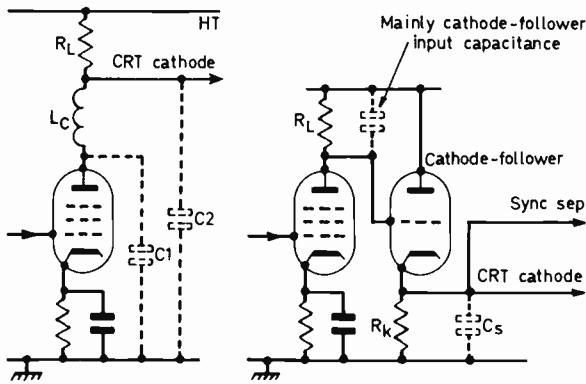


Fig. 3 (left): Alternative form of series compensation circuit. Although the coil is in series with the load resistor as with shunt compensation, since the c.r.t. feed is taken from the junction of these two components the circuit functions as a series type, dividing the shunt capacitance.

Fig. 4 (right): Basic cathode-follower circuit. By transferring most of the load capacitance to the cathode circuit of the triode a relatively high value pentode load resistor can be used, or the turnover frequency increased proportionally.

video pentode anode the circuit is still operationally a series one. The capacitance from the anode to chassis and from the junction of the coil and load resistor to chassis then forms the two capacitors in the filter as shown in Fig. 3.

Shunt-series Compensation

By using two peaking coils, one in shunt and the other in series with the load resistor, some further improvement is obtained though with the disadvantage that the circuit values are even more critical. Larger value load resistors for the same bandwidth can be used however with consequent greater gain.

All these arrangements are used in practice and it is an interesting exercise to identify the methods employed in different chassis.

Practical Experiments

Experimenting with peaking coils—changing their position in series circuits and thus the overall circuit capacitance distribution—and varying the load resistor value will give considerable insight into video stage operation. Suitable coils can be found in scrap chassis but their low average inductance makes them easy to wind. The components originally fitted in a particular chassis should not generally be altered, but experimenting along these lines makes subsequent fault diagnosis much easier. In particular note the increase in l.f. and m.f. gain obtained by increasing the value of the load resistor, the effect of partially or completely shorting the peaking coil and the effect of increasing the load capacitance by a further 5-20pF in both compensated and uncompensated stages. It will also become apparent that reducing the value of the load resistor not only reduces the overall gain but also degrades

h.f. resolution in a compensated amplifier since the peaking coil inductance will no longer be the optimum value—as we saw in the formula previously given the correct inductance for any a factor depends on the circuit capacitance and the squared value of the load resistor.

Use of Cathode-followers

Although not so widely used cathode-followers (see Fig. 4) are found in many chassis as a means of increasing or maintaining h.f. response without recourse to the use of peaking coils. In video circuits the cathode-follower cathode load resistor is generally of equal or higher value than the pentode anode load resistor. The cathode-follower does not contribute voltage gain—indeed its output/input ratio is slightly less than unity—but enables the pentode amplifier to give greater amplification by freeing it from most of the stray and circuit capacitance so that a much higher value load resistor can be used. Whereas a video pentode used on its own generally has a load resistor of about 4.7k Ω , in circuits using a cathode-follower—for example many Decca and Bush-Murphy chassis—a pentode load resistor of up to 10k Ω without any compensation is used.

When a pentode feeds a cathode-follower the only capacitance present—except for the anode to chassis capacitance and that across the load resistor—is the triode cathode-follower's input capacitance, approximately C_{ga} , which in this application does not exceed about 2pF. The c.r.t. input capacitance, wiring and feed component capacitances and that of the sync separator input are all transferred to the triode's cathode circuit. The input impedance of a cathode-follower is high so that it imposes negligible loading on the previous stage but its output impedance is low, being approximately equal to $1/g_m$ and averaging only a few hundred ohms. For example the triode section of a PCL84 has a mutual conductance of 4mA/V so that when arranged as a cathode-follower its output impedance is roughly $1/(4 \times 10^{-3})$ or 250 Ω . This low output impedance arises from the fact that $R_a = \mu/g_m$ and as the μ of a cathode-follower is about unity for all practical purposes $R_a = 1/g_m$. The output impedance is strictly the parallel addition of R_a and the cathode resistor but as the latter is usually so very much greater than the former it has negligible effect.

The value of the cathode load resistor is mainly dictated by normal anode current considerations and must be large enough to permit the cathode voltage to be raised close to the grid voltage without over-running the valve. The stage gain is actually $\mu/(\mu+1)$. Thus increasing μ slightly decreases the disparity between the input and the output while the load resistor value, provided it exceeds the minimum value dictated by R_a , has no real effect on amplification.

As we saw previously an uncompensated video amplifier may have a total load shunt capacitance of about 25pF which has a reactance at 3MHz of 2.1k Ω so that the load resistor must not exceed this value if the response is to fall to only -3dB at 3MHz. The use of a cathode-follower will reduce the total shunt capacitance to about 7pF. Thus a proportionately higher value load resistor can be used, increasing the gain, or if the load is kept con-

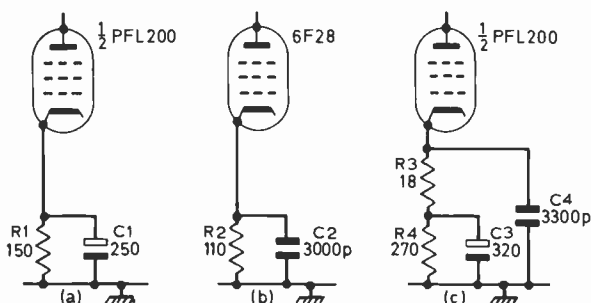


Fig. 5: Use of negative feedback in the video amplifier cathode circuit. In (a) C1 decouples all frequencies except those approaching d.c. (Philips 210 chassis). In (b) C2 provides decoupling mainly at h.f., introducing negative feedback at m.f. and l.f. (BRC 1400 chassis). C3 in (c) fully decouples R4 but slight negative feedback is developed across R3 at m.f. and l.f. since C4 provides effective decoupling only at h.f. (Bush-Murphy A640 chassis).

stant the turnover frequency is increased proportionally. In practice a mid-position is chosen, i.e. a load resistor of greater value than can be used with a single pentode is employed and with the reduced load capacitance the turnover frequency is made much higher than with an uncompensated stage.

Use of Negative Feedback

The techniques so far described linearise the response by increasing the h.f. gain. There is however another method of linearising the response—by reducing the m.f./l.f. gain through the use of frequency-selective negative feedback. This commonly used technique is achieved by the use of cathode decoupling capacitor(s) with a value that offers negligible reactance at h.f. but a high reactance (capacitive reactance increases as frequency decreases) at m.f. and l.f. so that negative feedback, reducing stage gain, is introduced progressively at these frequencies.

Video Pentode Cathode Circuits

Figure 5 shows three typical video pentode cathode circuits. In (a) the 150Ω bias resistor is shunted by a 250μF electrolytic which gives virtually complete decoupling at all frequencies. In (b) the decoupler is only 3,000pF which has a reactance of more than 1MΩ at 50Hz while by proportion its reactance is 50Ω at 1MHz and 17Ω at 3MHz. Clearly although there will be some slight decoupling before 1MHz the decoupling only becomes fully effective towards the top end of the u.h.f. video spectrum. Thus negative feedback is applied at l.f. and m.f. but becomes negligible at h.f. where full gain must be maintained. Example (c) operates similarly but to a reduced extent because the main 270Ω bias resistor is fully decoupled by the large electrolytic, only the 18Ω resistor being partially decoupled by the 3,300pF capacitor to give a small amount of l.f. and m.f. degeneration.

As with peaking coils many interesting experiments can be undertaken using different values of cathode decoupler. Where the smaller values are tried it is an advantage to use a compression trimmer so that the effect of adjustment can be observed.

NEXT MONTH IN

TELEVISION

TV INTEGRATED CIRCUITS

Integrated circuits are beginning to appear in the new TV chassis in increasing numbers, particularly in colour receivers. The types used have been specifically developed to fulfil the signal processing requirements of TV sets but nevertheless bring with them numerous new techniques. In a new series starting next month we shall be examining these new i.c.s to familiarise readers with the various changes in TV set design they involve.

TRANSISTORISED VIDEO AND SYNC SEPARATOR CIRCUITS

In the next instalment of our series on basic circuits for the constructor we shall be presenting fully transistorised video and sync separator circuits.

A LOOK AT IMPORTED TV SETS

It is always interesting and informative and for the service engineer frequently essential to become familiar with the often very different circuits and overall designs used in the many imported TV sets now on the market. In a new occasional series we shall be taking a look at some of these models, starting off next month with the Crown 7TV105 7in. mains-battery portable.

SERVICING TV RECEIVERS

Recent articles have concentrated on fairly up-to-date chassis. Next month however we are going back to a widely distributed "625-line convertible" chassis, the Sobell ST195/ST282 series. This will give us an opportunity to examine the faults common in older sets.

PLUS ALL THE REGULAR FEATURES

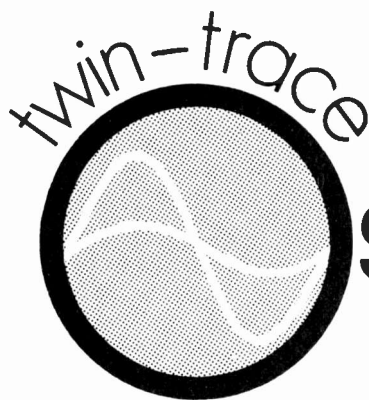
ORDER YOUR COPY ON THE FORM BELOW

TO.....
(Name of Newsagent)

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

NAME.....

ADDRESS.....



OSCILLOSCOPE UNIT

It is often an advantage when using an oscilloscope for servicing or design work to be able to view two different waveforms at the same time. For example when measuring the gain and possibly the harmonic distortion of an amplifier, input and output waveforms can then be compared directly. If, as is usually the case, only a single-beam oscilloscope is available the experimenter need not despair however: it is possible to look at two different traces using a single-beam scope for the minimal outlay and time required to construct this twin-trace oscilloscope unit. No power supply is necessary and the only other instrument required is a signal generator to provide an output to switch on and off the two transistors used in the unit. The frequency range is limited only by the transistor types used and the method of construction adopted. The unit will operate satisfactorily from a few Hertz to well beyond the audio range.

Circuit Description

The circuit (Fig. 1) is extremely simple. The two transistors used act as electronic switches whose "on-off" repetition rate is determined by the frequency of the squarewave signals applied to their bases. During the first half cycle of the squarewave input one transistor is reverse biased while the other is forward biased. The transistors must be driven quite hard so that the reverse biased one is fully cut off (non-conducting) and the other one is fully on (bottomed).

Now suppose a signal is fed to one of the inputs—say Input 1—and the output from the circuit is

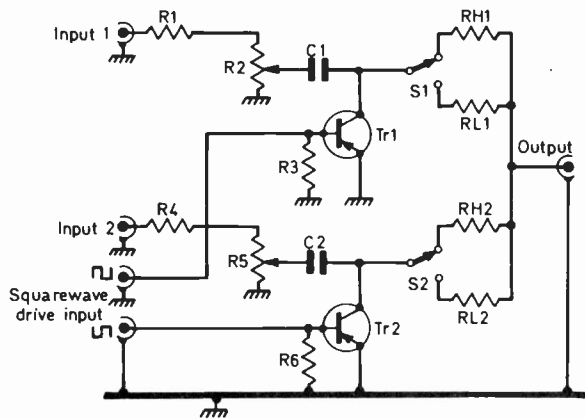
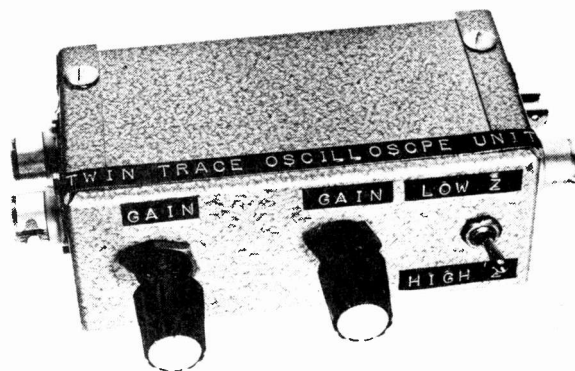


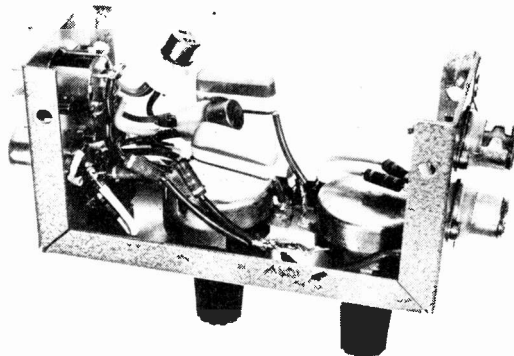
Fig. 1: Circuit diagram of the unit. In the prototype a single double-pole changeover switch is used for S1, S2.

monitored on an oscilloscope. During the half cycle that Tr1 is cut off this transistor presents a very high collector-to-emitter impedance to the incoming signal and thus acts as an open switch, having no effect on the signal. The incoming signal consequently passes straight through to the output terminal via one of the series isolating resistors RL1 or RH1 and may be seen on the oscilloscope. During the next half cycle Tr1 is turned hard on by the squarewave at its base and the collector-to-emitter impedance then presented to the input signal is extremely low, the transistor acting as a short-circuit (or closed switch). The incoming signal is thus clamped to ground and no signal is seen on the oscilloscope.

If now two separate input signals are connected to the unit, one to each input, and a switching waveform



External view of the prototype.



Internal view showing method of construction.

★ components list

Transistors:

Tr1 NKT222, AC128, etc.
Tr2 NKT222, AC128, etc.

Miscellaneous:

Coaxial input and output sockets.
Painton panel-mounting two-pin socket for drive input.
S1, S2. See text.
Transistor sockets, knobs, case, etc.

Resistors:

R1 3.3k Ω
R2 2M Ω
R3 560 Ω
R4 3.3k Ω
R5 2M Ω
R6 560 Ω
RH1 100k Ω
RH2 100k Ω
RL1 820 Ω
RL2 820 Ω

Capacitors:

C1 0.47 μ F
C2 0.47 μ F

is applied simultaneously but in antiphase to the transistor bases, then it will be apparent that only one input signal at a time will appear at the output. And if the output of the unit is observed on an oscilloscope the two separate waveforms can be seen at the same time.

Potentiometers R2 and R5 are used as gain controls to permit a variable fraction of the input signal to be passed. To introduce a degree of matching between the input and output, resistors RL and RH are included. These also serve as isolating resistors. If a signal from a low- to medium-impedance source is being observed the lower value resistor is switched into circuit whereas for a signal with a high source impedance the higher value resistor is switched into circuit.

Construction and Use

There is nothing critical about the construction of this unit. The circuit may be assembled on a tag-board, printed-circuit board or as in the author's prototype simply by component interconnections. Carbon or wirewound potentiometers may be used for controls R2 and R5. The double-pole changeover switch used in the prototype was a miniature one used primarily to conserve space; this is not necessary and any suitable switch may be employed. What happens when the two different signals being observed are from two different impedance levels, one high and one low? In this case switch in the higher value resistors (i.e. RH1 and RH2) and shunt the one that is too high with a suitable resistor. Alternatively two separate single-pole changeover switches may be used, one for each transistor output.

The maximum frequency response or bandwidth of the unit depends on the mode of construction and transistors used. Printed-circuit construction and the use of high-frequency transistors yields a very acceptable unit. If the instrument is housed in a metal box

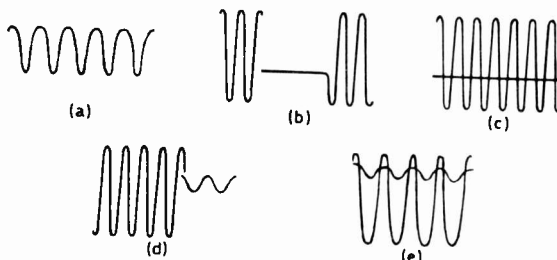


Fig. 2: Types of trace obtained.

the box itself may be used as a common earth point and coaxial sockets may be fitted for the inputs and outputs.

Having constructed the unit and thoroughly checked that there are no errors it may be tested. First plug into Input 1 one of the signals to be observed and ensure that switch S1 is set in the appropriate impedance position. Because of the non-linear nature of the transistor a sinewave input signal will appear on the oscilloscope—connected at the output—as in Fig. 2 (a). If phase relationships between input signals are to be observed then synchronise the oscilloscope with this input signal; adjust the oscilloscope timebase so that about eight complete cycles are observed on the screen.

Next connect the squarewave generator and set the frequency to about half that of the signals being observed. Increase the generator output level until the trace appears as in Fig. 2(b). If only a sinewave oscillator is available it will be found that a higher drive voltage is necessary and the trace will not be as good.

To observe one trace directly superimposed over the other the oscilloscope timebase frequency is decreased so that the trace appears as in Fig. 2(c). Finally the second signal to be observed is fed into Input 2 to give—in the case of a sinewave input—a trace such as Fig. 2(d) or (e).

The unit has numerous uses including the design of transistor amplifiers, filters and radio receivers and if correctly built will have a bandwidth equal to that of the oscilloscope with which it is used.

Although not tried by the author improved performance and a simplification in the drive requirements could be obtained by the use of an npn-pnp complementary pair of switching transistors. ■

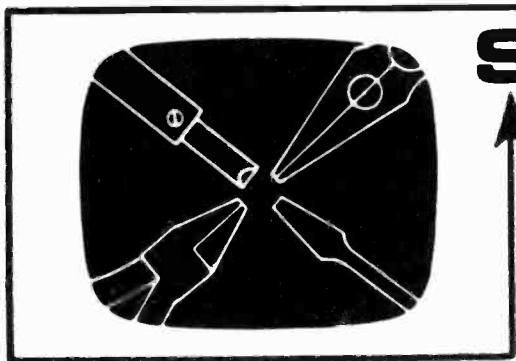
FOR THE SERVICE ENGINEER . . .

Telequipment have introduced a 25MHz bandwidth oscilloscope with full delayed timebase facilities, 3% measuring accuracy and an 8×10cm. viewing area for less than £300.

Newmarket Transistors Ltd. have introduced the NKT-Servikit for service engineers. This contains an updated range of 23 NKT transistors (germanium and silicon types) and diodes which the company claims can be used to replace over 90% of the faulty devices likely to be encountered in servicing radio and TV sets. The Servikit container is easily replenished and comes complete with substitution guide. The recommended retail price for each kit is £10.95.

Adcola have introduced a new range of lightweight, thermally-controlled soldering irons called the Invader range. They feature Noryl plastic handles which remain cool over long periods of use and are claimed to be the slimmest available irons at wattage ratings of 25 and 27W. There are seven stock voltages—6, 12, 24, 50-55, 110, 220 and 230-250V and any specific bit temperature between 250 and 410°C can be supplied. The temperature at the bit face is thermally controlled to $\pm 10^\circ\text{C}$. Recommended price of the largest tool is £1.95.

Antex have introduced a 12V soldering iron, type MES12, which comes complete with crocodile clips for direct connection to the battery terminals, 15ft. of two-core lead and a durable plastic wallet. The UK recommended price is £1.95.



SERVICING television receivers

L. LAWRY-JOHNS

GEC-SOBELL 2012-1012 SERIES—*cont.*

No Results

This implies that the receiver is totally inoperative. A glance in the back however will nearly always show that the valves are glowing normally. This suggests that the h.t. is out of action and the cause is nearly always an open-circuit section of the dropper. From the mains input at the centre of the dropper there are three sections to the front end of the set. For some reason the centre section of the three is the section which is the first one to go. It has a value of 17Ω and although this value is not critical ($14-22\Omega$ is good enough) it should not be shorted out. With a Radiospares dropper section and two PK screws replacement can be effected in minutes without soldering.

When one of the other h.t. sections fails the screwed on section can be removed and a 33Ω resistor fitted in its place. The new faulty section can then be linked across. By this means the total value remains sensibly the same and the dropper does not resemble a Christmas tree with bits hanging all over it with the all too often attendant poor soldering.

So here is the first and easily the most common

fault which will be encountered. Having said that the very next one on the bench has to have an open-circuit section on the heater end. Well, it happens! In this case the valves were not lighting and a neon check showed that R150 was at fault.

Blown Fuse

It is often the case that there is no indication of mains voltage at any part of the set including the on-off switch. If it is known that the supply source is in order it remains to check the supply lead and the input fuse FS1. This latter item is not in a convenient clip. It is suspended in the mains wiring to the on-off switch in a similar manner to a car radio fuse. This 1.5A fuse will often be found to be blown and not merely melted. There are many possible reasons for this and a new fuse will probably meet the same fate. The reader may well say: "Well, if the fuse has failed in such a manner a meter check will reveal a dead short which should be rectified before a new fuse is fitted". Quite so. But what if there is no short?

When one meets this one it is prudent to disconnect

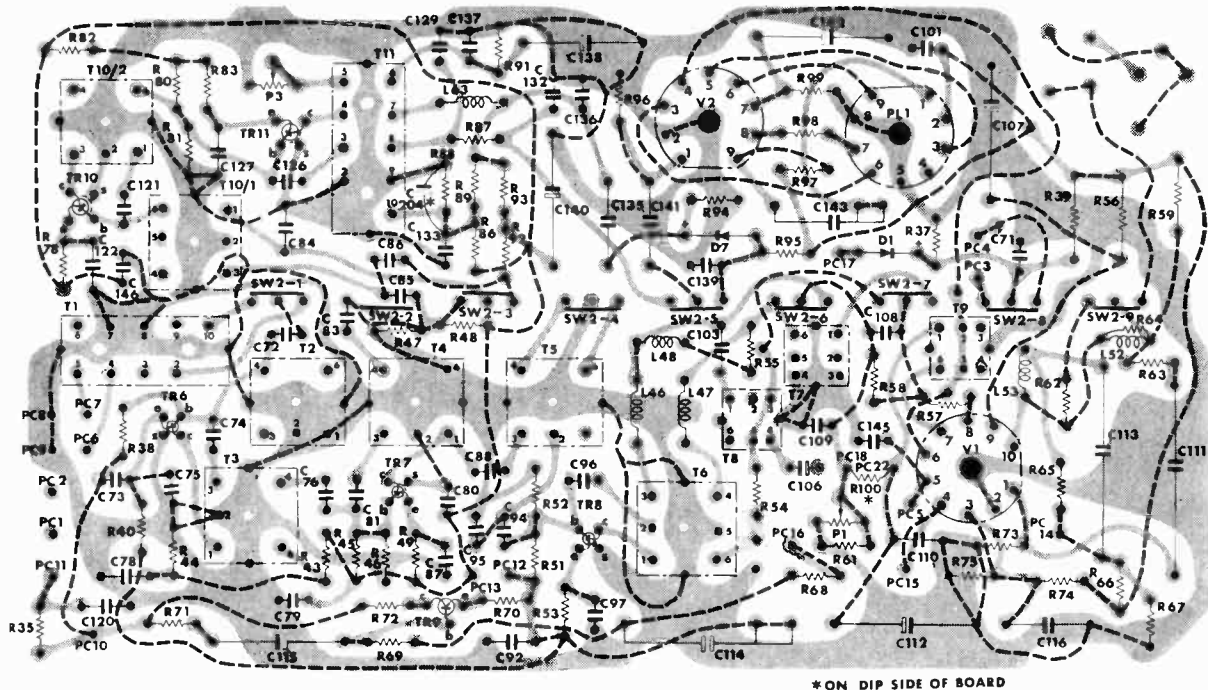


Fig. 3: Layout of the i.f. printed board, viewed from the tin-dip side.

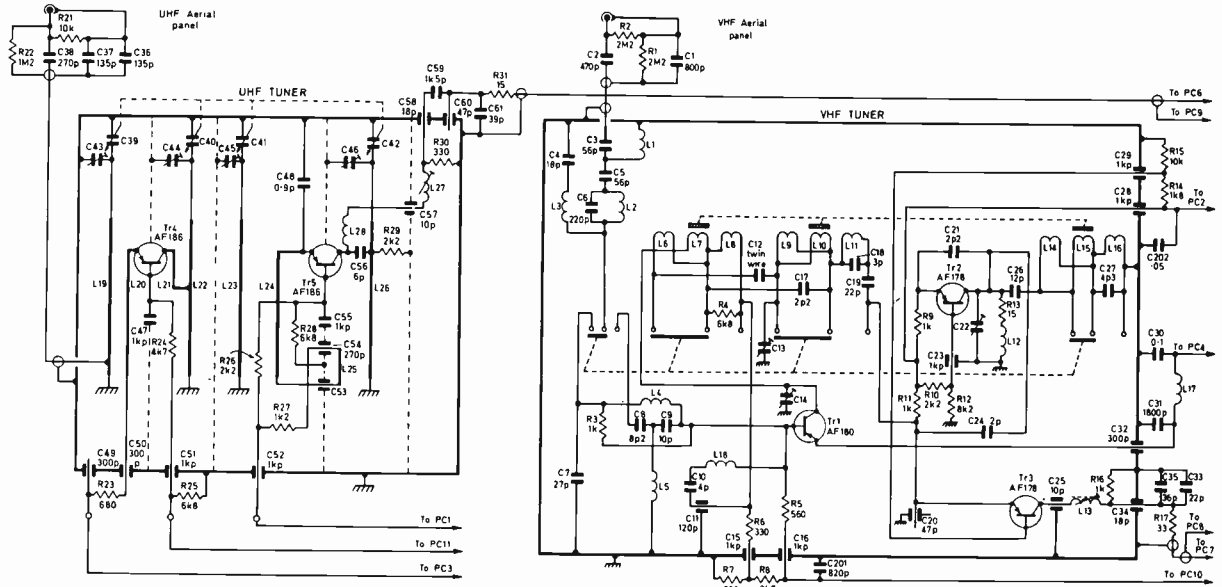


Fig. 4: Circuits of the u.h.f. and v.h.f. tuner units.

one of the wires from the centre sections of the dropper. Inspection will show that there are two leads here. One is the supply lead to the on-off switch which should be left connected, the other goes down under the chassis and connects to the mains filter capacitor C196. This is the item which can be as innocent as a new-born babe on a cold test, viciously shorting as soon as the set is switched on. Thus by disconnecting the lead to its evil influence can be removed while a new fuse is fitted and the set tried again. A replacement should be rated at 1kV d.c. or 250V a.c. and wired in a convenient position to avoid unnecessarily removing the chassis.

Other causes of a blown fuse include a faulty on-off switch, shorted rectifier (or its shunt capacitor), shorted electrolytics etc.

Field Timebase

Troubles in the field timebase are probably the next most frequent complaint. The usual advice applies here, which is to replace the PCL85 first. If the trouble continues one can then look further.

A frequent offender is C156, 0.05 μ F. This tends to become open-circuit (not leaky) thus failing to filter the line sync pulses out of the field sync circuit and presenting an enlarged, distorted pulse to the field oscillator. Needless to say, this upsets the oscillator and it is impossible to lock the picture vertically. A test capacitor bridged across the suspect will confirm whether this is indeed the fault.

Insufficient height is quite a regular fault. Having checked the PCL85 the next item to check is R132 (1.2M Ω) in the boost feed to the oscillator triode V9A. This often rises in value to cause an equal loss of height top and bottom. On more than one occasion however the writer has found C179 (0.01 μ F) leaky to cause the same effect.

When the loss of height is far more accentuated at the bottom, the top being stretched in relation, check C154, R108 and the linearity control P8. C151 and C155 are less often at fault in these more recent chassis.

Moving over a few inches (on the chassis of course) we come to the line oscillator stage. The oscillator valve is a PCF802 and this is most often at fault when it is found to be impossible to lock the picture horizontally, the line hold control having no effect at all. A new PCF802 should put matters right but on the odd occasion it may be found necessary to check the line discriminator diodes (MR1-MR2) as an unbalance here will upset the oscillator frequency or perhaps stop it altogether.

Check the value of R117 and R118 if the locking position has moved to the end of the control.

Lack of Width

Whilst this is normally due to a worn PL500 (PL504) the width control should not escape attention as a dud spot can develop on this (P11, set boost). Operating the control will immediately prove whether it is at fault or not. Whilst the PY800 could be at fault this is more likely to develop arcing inside and is obvious on inspection. A quite alarming variation of this happens when the insulation of the linearity sleeve on the tube neck punctures due to discharge from the line coils. This produces some fireworks on the screen (and sound) and rapid variation of width, tending to lead one to suspect the line output transformer. Withdrawing the sleeve from the coils will prove whether or not it is at fault.

No Picture

If advancing the brilliance produces nothing on the screen at all switch to v.h.f. and note whether the line whistle is normal. If it is, remove the screening and check whether the DY86 is lighting up. If it is not the chances are that this valve has an open-circuit heater and needs replacing. If it is lighting up the e.h.t. is probably in order and the fault is in the supplies to the tube base socket. A voltage check here will probably show absence of supply to the first anode (pin 3). The decoupling capacitor C197 (0.05 μ F) may well be shorted. A replacement should

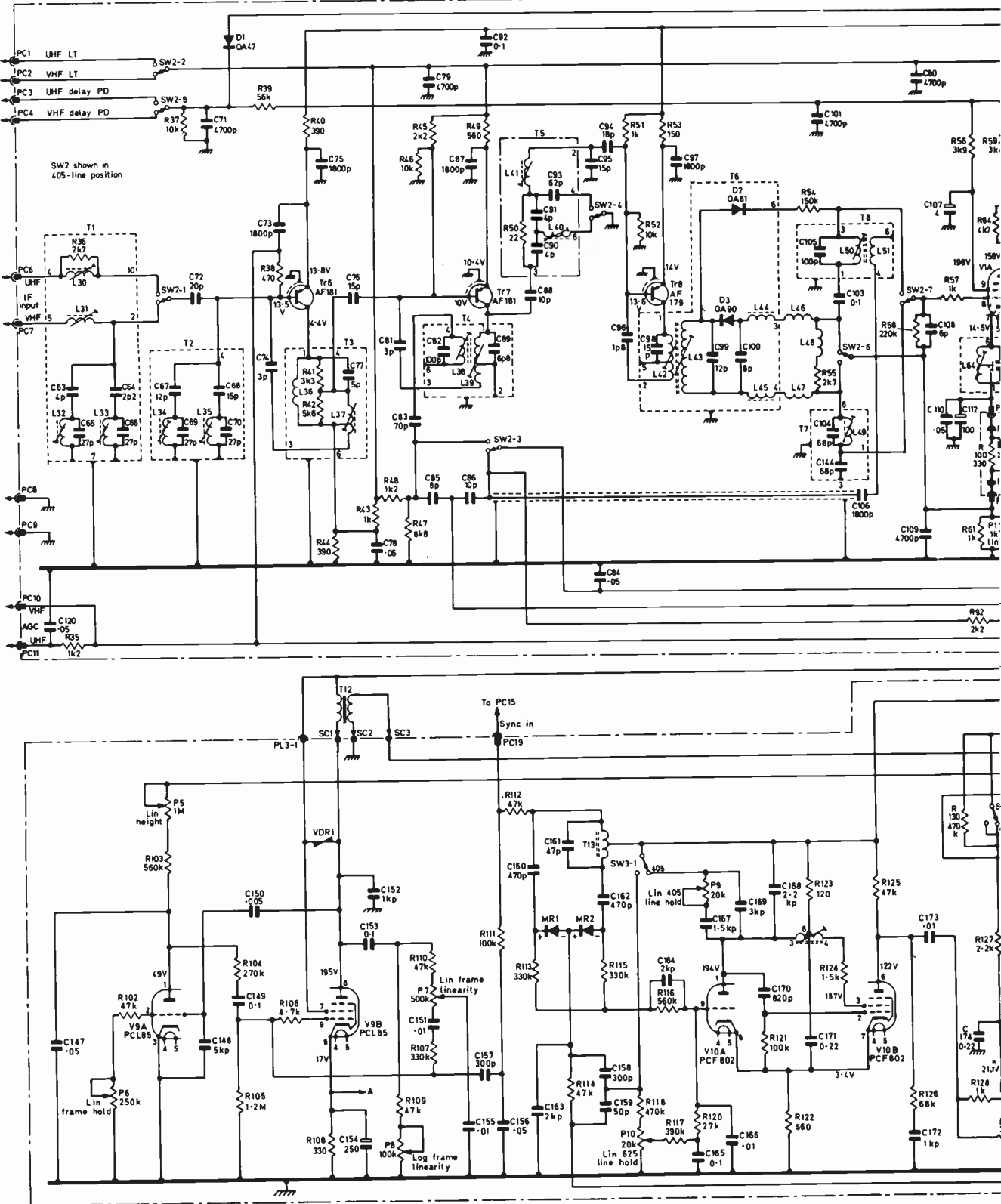
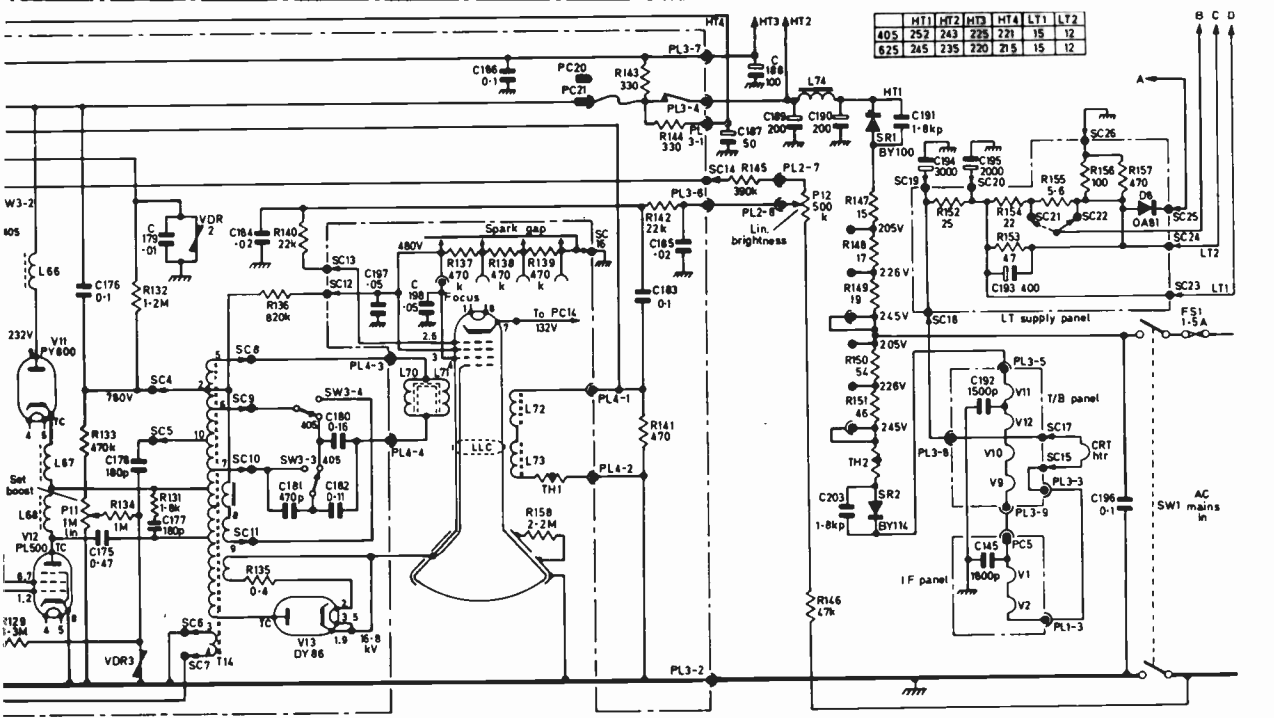
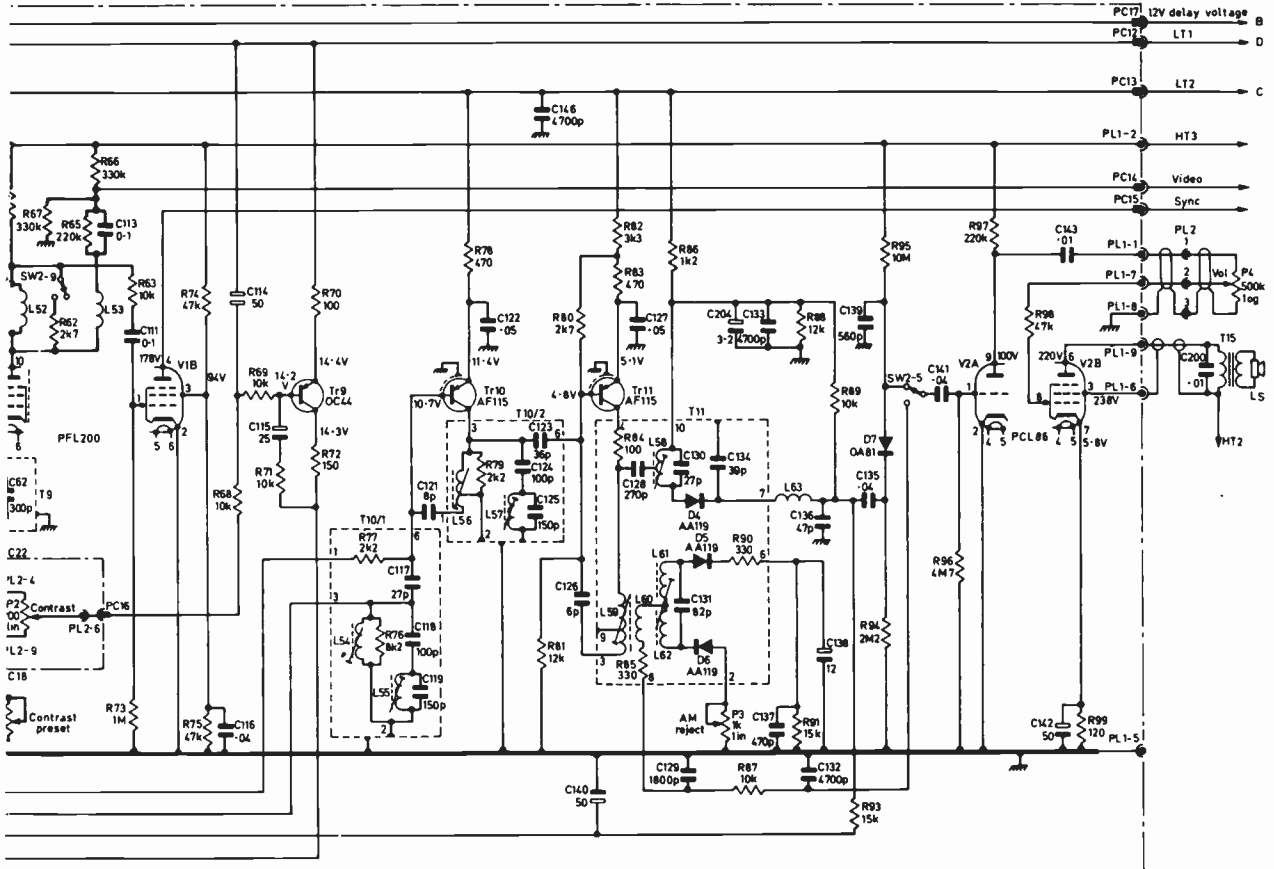


Fig. 5: Circuit diagram, GEC-Sobell 1212-1012 series. All voltages measured on 405 lines with 245V a.c. mains input. Transistor readings taken on 25V range of 20k Ω /V meter with no signal and contrast control at maximum. V1A and V2 readings taken under similar conditions, other valve voltages measured with signal to just lock the timebases.



LONG-DISTANCE TELEVISION

ROGER BUNNEY

FEW complaints this month! Excellent Sporadic E conditions have been maintained throughout May with sustained periods of activity for hours at a time. There seems at the time of writing no lull in these conditions. Possibly we are in for the best season for some years—I hope so! As there have been so many openings I propose to give details of my log on the most active days only in order to save space for the considerable number of news items this time.

- 3/5/71 NRK (Norway) E4; Sweden E4; USSR R1, R2; Czechoslovakia R1, R2; ORF (Austria) E2a.
- 7/5/71 CT (Czechoslovakia) R1; Sweden E2; TVE (Spain) E3; also unidentified signals.
- 11/5/71 CT R1; also many unidentified stations on R1, R2.
- 15/5/71 RAI (Italy) 1B; TVE E2, E3, E4.
- 19/5/71 Sweden E2, E3; WG (West Germany) E2, E3; DFF (East Germany) E2, E3; TVE E2; RAI 1A, 1B; ORTF (France) F2; JRT (Yugoslavia) E3; TVP (Poland) R1, R2; USSR R1, R2; Rumania R2, R3.
- 20/5/71 TVE E2, E3, E4; CT R1; USSR R1, R2; also unidentified signals.
- 22/5/71 TVE E2.
- 23/5/71 RAI 1A, 1B; JRT E3, E4; TVE E3; ORTF F2; also unidentified signals.
- 24/5/71 JRT E3, E4; RAI 1A; ORF E4; WG E2; also unidentified signals.
- 26/5/71 USSR R1, R2, R3; TVP R1, R2; TVE E2, E3, E4; also unidentified signals.
- 28/5/71 RAI 1A, 1B; JRT E3; ORF E2a, E4; TVE E2, E3, E4; also unidentified stations on R1, R2.

These loggings were solely via SpE and unfortunately many of the openings were already in progress when I switched on. Good openings reported by other enthusiasts were on 10/5/71; 14/5/71; 17/5/71; 21/5/71; 27/5/71.

The opening on May 3rd allowed the first detailed examination of the mystery test pattern on R1 noted in last month's column. Consisting of frequency response gratings, various black/white squares, contrast scales, etc. and with a circle, it carries the identification CS U 01 and originates in Czechoslovakia. It is interesting to note that only one Czechoslovakian transmitter uses this pattern, the others still using the normal test card. The new pattern has been seen floating over the old test card.

On May 19th the excellent opening presented me with a new station Krakow TVP-2 Poland—at only 1kW! At 18.45 I noted on R2 a weak signal amongst numerous other stronger stations, a caption carrying the identification—TVP-2, the figure 2 being very prominent. This caption was replaced with a female announcer, the TVP-2 identification appearing at the right-hand side of the picture. Incidentally earlier in this opening TVP-1 had been noted with *different* programmes on R1 and R2. At 18.14 the R1 transmitter carried the caption Telewizja Gdansk depicting a warrior brandishing a trident while the R2 transmitter at the same time showed the familiar Telewizja Warszawa caption. They then combined to a common news programme. I assume that regional news programmes are being featured on appropriate transmitters prior to 18.15 and this could lead to problems with identification.

Maurice Opie (Ringwood) has noted both the Finnish TV1 and TV2 transmitters on E2 during the month using

the new electronic test card mentioned recently. On May 20th Maurice also noted the EBU test pattern in use by Hungary on R1. Apparently they are using both the plain type and another carrying the identification MT Budapest. With Poland and Rumania both using this pattern our problems seem to be mounting!

News

Yugoslavia: We noted recently that Italian programmes are being radiated from Yugoslavia and now have full information. A 400kW ch. E27 transmitter located at Nanos (near Ljubljana) is now testing and broadcasting news bulletins and other programmes in Italian and Yugoslavian. These transmissions—in colour—cover a wide area along the Adriatic coast as far south as the Italian town of Ancona and a considerable part of the inland zones. Following this news I have just heard that Tele-Monte-Carlo is planning a projected high-power colour TV transmitter, its coverage to include Northern Italy, using SECAM.

Belgium: A new 1000kW transmitter is being constructed at Egem, South of Bruges, and will operate on ch. E43.

Luxembourg: As from September 1st, 1971 CLT-Tele Luxembourg will cease 819-line transmissions on E7, changing to 625 lines with positive image (similar to ORTF-2). The station is planning colour transmission (SECAM) on ch. E7, but later new and higher aerials will be in use for both E7 and E21 u.h.f. with both transmitters radiating similar programmes. At present we have no details regarding power but Luxembourg has always been a problem for DX enthusiasts. Possibly this will now become an easier signal.

Sunspots: Predictions of smoothed monthly counts: May 69, June 67, July 64, August 61, September 59, October 57. Courtesy of the Swiss Solar Observatory.

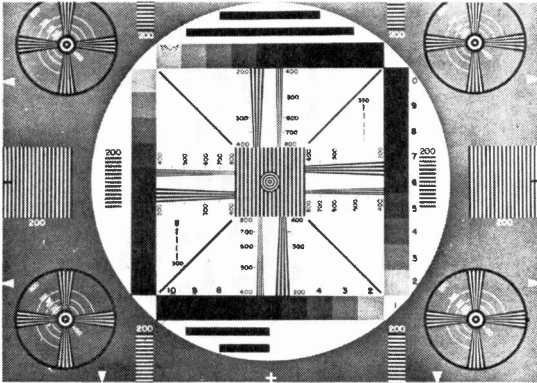
From our Correspondents

Last month I mentioned that Doug Bowers (Saltash) had received TVE-Spain via tropospheric reception in Band III. Doug has since kindly sent us the full information: ch. E7 23.45-24.15 BST on 18/12/70; a quiz programme followed by the news and the usual close down sequence. The signals were fairly strong with a characteristic slow fade. The station is located in the South of Spain at Sierra de Lujar-Granada and uses 200kW. This at almost 880 miles is extremely good going—our congratulations on this achievement! Some of the longer established DXers may recall Doug's reception of Madrid ch. E24 some years ago.

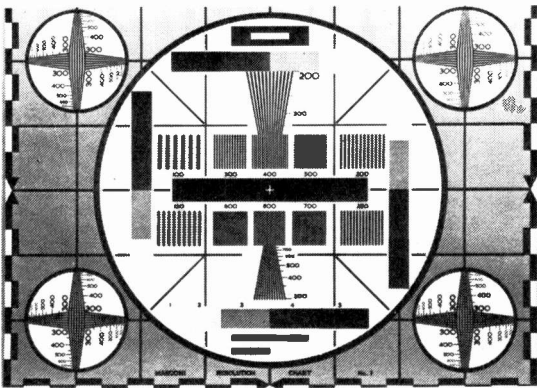
Paul Gardiner (Aldershot) has written to tell us of reception in his area including Bergen ch. E9 via tropospherics on January 11th this year, using the new type NRK pattern. This Norwegian Band III transmitter is often received on the East Coast but rarely so far south. He has also been active with colour DX, using his HMV-BRC 3000 chassis, and has noted ch. E27, E29 and E32 colour signals from NOS Holland. Whilst on the subject of colour, Paul has logged USSR ch. R2 with an interesting caption which when translated said "colour programme". I wonder who will be the first to receive SECAM colour signals from the USSR!

Keith Hamer (Derby) has written with an interesting list of stations received during the recent (and current) good conditions. He too has noted the new Czechoslovakian test pattern on ch. R1 and also the rather

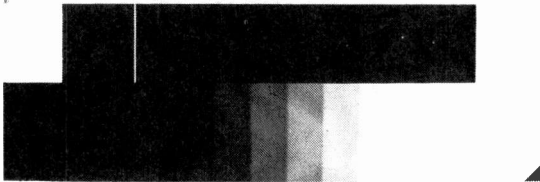
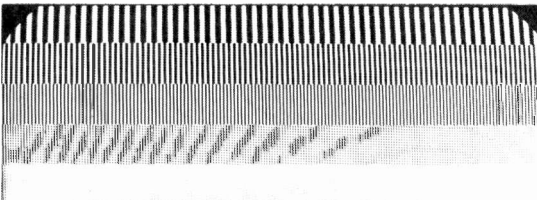
DATA PANEL 1—2nd series



RETMA Test Card

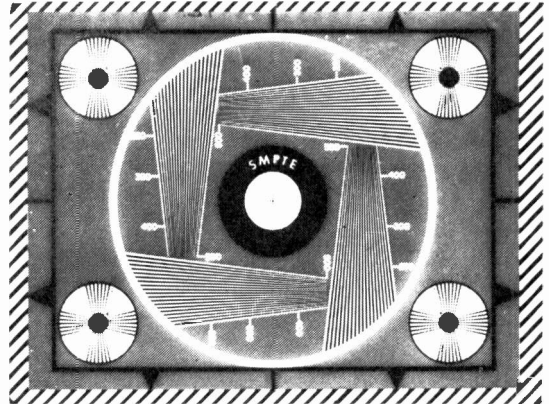


Marconi Resolution Chart No. 1

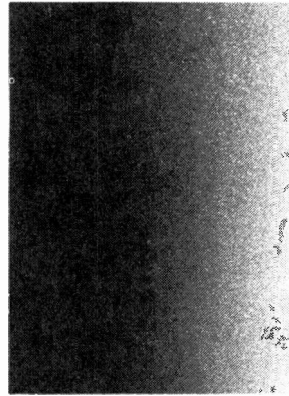


EBU test pattern—courtesy EBU, Brussels. Variations include superimposition of a black or white circle, inclusion of transmitter location or originating organisation in a black rectangle

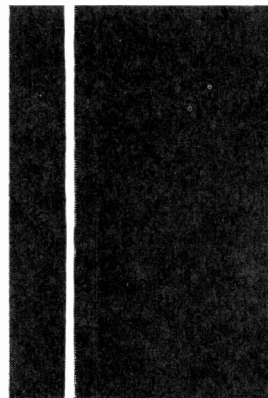
STANDARD PATTERNS



SMPTE Test Card



Line sawtooth pattern—courtesy S. Wedge



Pulse and bar pattern—courtesy S. Wedge (Southampton)

difficult Danmarks Radio transmitter on ch. E3 at Fyn.

George Sharples (Malta) has sent a most interesting letter about the conditions in his part of the Mediterranean. Egyptian and Libyan transmitters are often received. The Libyan test card apparently resembles the ORTF French card: the main difference appears to be the inclusion of an eagle in the centre, with Arabic writing above and below, and originates from Tripoli ch. E6. Once again our friend A. Papaeftychiou (Cyprus) has forwarded useful information which we are pleased to pass on. He mentions four stations—which can be

termed "exotics"—that may just be possible via multiple-hop SpE in the UK: Jordan E3 (the test card was shown in November 1970 TELEVISION); Lebanon E4 (see accompanying photograph); Tehran—Iran ch. A3; Dahrán—Saudi Arabia ch. A2. The last two are 525-line signals. We are most grateful for this information: who will be the first to receive one of these exotics, I wonder?

Finally Michele Dolci (Italy) has reported some remarkable happenings in his area of Bergamo, Northern Italy. An Italian firm has built a series of relay stations

—continued on page 469

THE RAINBOW REVOLUTION!

1951-1971 TWENTY YEARS OF COMPATIBLE COLOUR TV

PART 2

I. R. SINCLAIR

WE have seen that the NTSC specification of November 1951 was well on the way to the modern standard but specified colour phase alternation (CPA) in line with the principle of the PAL system of the mid-sixties. During 1952 RCA became dissatisfied with this standard because of visible flicker at high luminance levels and the effect later to be known as "Hanover Blind", though it was admitted that the system could produce very good pictures. To avoid crosstalk and so enable them to dispense with CPA the RCA engineers concentrated on reducing the bandwidth of the colour signal so that the colour response was as closely as possible trimmed to the response of the human eye. They ended up with a system (first tried in mid-1950) which used the full bandwidth for the luminance signal, a fairly wide-band signal (I) of "mixed highs" which could distinguish orange-red from blue-green and a narrowband colour mixture signal (Q) for large areas only which could distinguish such colours as green from purple. The different bandwidths of the I and Q signals were based on the fact that the eye has maximum colour sensitivity—and can thus distinguish finer colour detail—along the orange-cyan axis and has minimum sensitivity to colour detail in the green-purple range.

The wider band mixed-highs signal was modulated as a vestigial sideband on to the subcarrier but the narrowband signal was modulated as a double-sideband signal. Because the signals overlapped very little in frequency response and sideband use the crosstalk was very much lower than in previous systems, making the use of CPA unnecessary. This development was demonstrated to the NTSC in the summer of 1952 and as a result the NTSC published a "Revised Specification for Field Test of NTSC Compatible Colour Television" on February 2nd 1953.

The whole specification of the NTSC signal occupies some four pages and we shall look only at the sections which are of particular interest. The specification gave the composition of the colour signal E_M as:

$$E_M = E'_Y + [E'_Q \sin(\omega t + 33^\circ) + E'_I \cos(\omega t + 33^\circ)]$$

E'_Y being the monochrome signal and the prime signifying that the signal is gamma corrected—a process which causes some errors to appear later in the colour signal.

E'_Q is defined as $0.41(E'_B - E'_Y) + 0.48(E'_R - E'_Y)$ and is the narrowband signal while E'_I is defined as $-0.27(E'_B - E'_Y) + 0.74(E'_R - E'_Y)$ and is the wideband signal.

The white signal $E'_Y = 0.30E'_R + 0.59E'_G + 0.11E'_B$.

The numbers used to multiply the colour signals sometimes cause confusion. They are not arbitrary but arise from the measurements on vision made earlier. For example the proportions of red, green and blue shown as 0.30, 0.59, and 0.11 make up 1.00 exactly and are in such ratio as to give standard white. The situation is the same for the numerical parts of the E'_Q and E'_I signals. These are chosen to give colours which match as closely as possible the range corresponding to narrow and wide bandwidth respectively, all of which depends on the sensitivity of the human eye. In these cases the numbers do not add up to 1.00 because their total is not a white signal. The sum is in fact chosen to give a convenient depth of modulation for the chroma signal.

Field Trials and Survey

RCA, now certain that they had a workable colour system, then started a final set of field trials which lasted from 2nd-5th June 1953. Questionnaires were handed out to each audience in the lounge of the Cantor Theatre, West 49th Street, New York. The audiences were composed of members of the public who were touring the NBC studios. 763 questionnaires were received back and analysed in remarkable detail. Separate figures were taken of those connected with the industry and those unconnected and the total number was sifted into ranks according to sex, age group, educational background, previous experience of TV and home location. To allow for receiver differences the number of each receiver watched was noted and also the time and date of the show and whether it was a closed circuit, microwave relay or coaxial cable relay transmission.

Summing up the detailed results 85% thought colours much more enjoyable as compared with 13% who were more cautious. 50% rated the overall quality as excellent, 37% as very good; 46% thought the clearness of detail excellent, 39% very good.

About 24% of the non-industry audience mentioned defects in the pictures but few of these said this interfered with their enjoyment of the pictures and there was little agreement about what marred them. As might be expected from the variation of colour vision from one person to another the largest single complaint was that the colours were "not true to life". This amounted to about 5% of the 24% who mentioned defects. In this respect it is interesting to note that a test made later—not by RCA but by the psychology department of a University—found that people made the same complaints about colour when they were looking at an *actual scene* framed in a

window which had been made to look like a cinema screen!

The earlier field trials mentioned in Part 1 had indicated complete approval of the black-and-white reception of the colour signals so that another link had now been forged in the strong chain of evidence in favour of the RCA colour system.

Display Tubes

The ingenuity spent on the development of methods of coding the colour signal would have been wasted without the development of a suitable method of display and a full-scale programme was also being undertaken by RCA on this side of colour TV. By 1940 mechanical systems using a monochrome c.r.t. in conjunction with a colour scanning disc as described in Part 1 had been developed to their apparent limit but there were severe limitations in the size and the speed at which the disc could be rotated. Early in 1940 RCA demonstrated to the FCC a system using three c.r.t.s whose coloured images—using different phosphors—were combined on to one screen by projection, thus cutting out all mechanical moving parts, while in 1942 Baird had shown a c.r.t. which produced two colour images which were combined optically in the tube. His patent applications in 1942 and 1943 showed other developments such as two-sided phosphor screens which he demonstrated in 1944 (Fig. 1).

The actual building of a three-colour tube did not take place until improvements in e.h.t. generation, deflection (particularly line) and better phosphors became available after the war. RCA engineers then worked intensively on these problems so that by early 1950 it was possible to demonstrate what is now known as the shadowmask tube.

On the way to this nearly every scheme known for colour presentation was considered. There was the beam deflection tube in which a single electron beam (Fig. 2) scans a tube face on which parallel horizontal lines of phosphors are laid in an RGB sequence. As the beam scans a line it can be deflected to R or B or left at G according to the colour required or the scanning can be continuous to produce white. This required an impossible scanning accuracy. Beam sensing tubes were also considered, with the beam now scanning across a set of RGB lines and a sensing

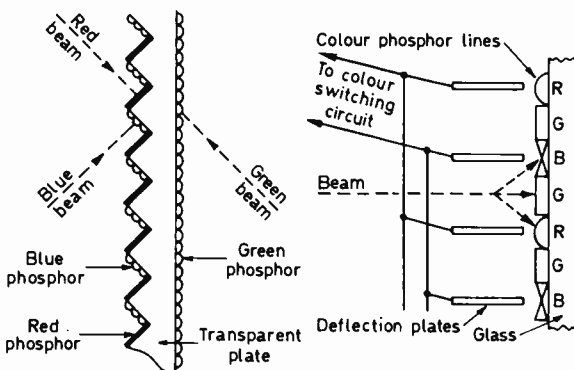


Fig. 1 (left): Principle of the Baird three-colour "non-planar" screen.

Fig. 2 (right): Principle of deflection switching, used with a screen having different colour phosphors deposited in horizontal stripes across the screen.

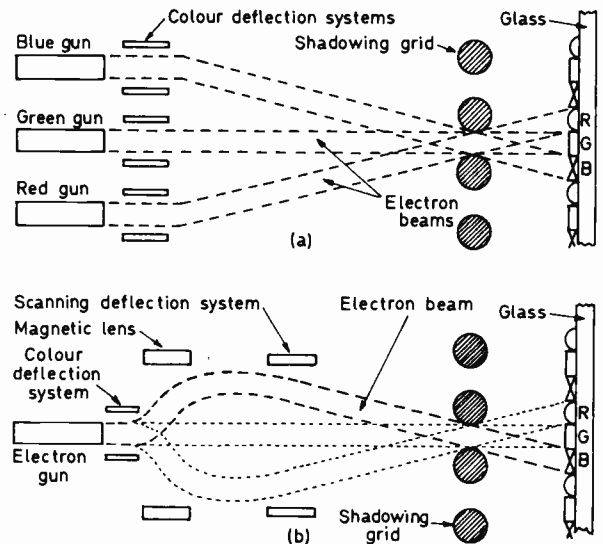


Fig. 3: The screen shadowing principle originally proposed by Flechsig. The phosphors are deposited on the screen in horizontal stripes shadowed by a wire grid. (a) Three-beam version with three electron guns, (b) version with a single beam deflected at the gun end of the tube.

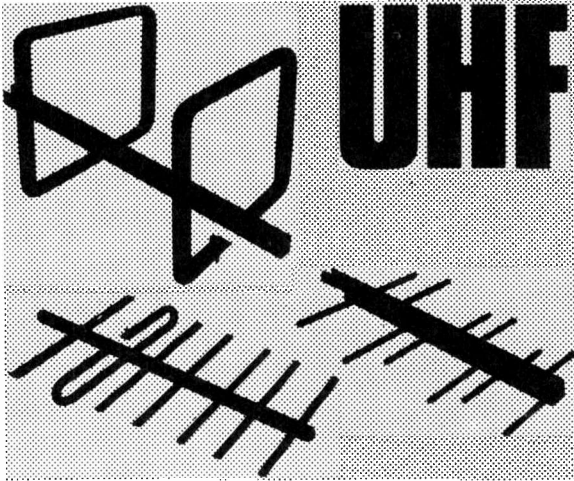
device incorporated to indicate the position of the beam (on R, G or B) and thus establish which colour signal should be fed to the cathode at any instant. This was abandoned because in the late 40s no sensing device available seemed suitable. Later developments of this and other tubes were covered in *Tubes for Colour TV*, PRACTICAL TELEVISION September 1970.

Adjacent image tubes which presented three separate pictures in primary colours on one tube face with the three combined by a prism were tried but the snag here was registering the three images together. Baird's system of two-colour operation with phosphors of different colour on the two sides of a mica sheet scanned by two separate electron guns was rejected because of its limited colour range. Electron velocity tubes seemed attractive: they used three layers of phosphor on the screen the idea being that a low-velocity beam would excite the first layer to produce one colour, faster electrons would penetrate to the next layer so changing the colour while the fastest electrons would penetrate to the third layer. The electron velocity could be changed by using one gun with variable e.h.t. or three separate guns with different e.h.t.s. Pure colour could not be obtained with this system while single-gun e.h.t. switching or the registration of three guns with different e.h.t.s proved extremely difficult.

The Origin of the Shadowmask Tube

The method which seemed more promising than all the others was electron shadowing (Fig. 3). W. Flechsig had proposed in 1938 the use of a screen with lines of colour phosphor shadowed by a wire grid so that the colour of the phosphor struck by an electron beam would depend on its direction of approach to the screen. This principle could be used for simultaneous colour display by arranging for

—continued on page 465



AERIALS

for the constructor

K.E.G. Pitt B.Sc.

techniques are used in all three and the following introductory notes should be read before attempting to build any of them.

Constructional Notes

The construction of an outside aerial must be much more robust than that of a set-top or loft one. An outside aerial must withstand wind and corrosion and one of the greatest problems for the home constructor is to provide adequate insulation for the terminals and their protection from the weather. Aluminium was chosen for construction because it is both light and strong. One of the aerials uses half-round strip and channel, another tubing and channel and the third strip and tube. In all cases the mounting bracket is thick sheet aluminium.

All nuts and bolts should be cadmium-plated steel if available. If not steel can be used but should be treated with an antirust compound such as Jenolite. The exposed ends of the cable where they join the elements should be covered with a good thick coat of Bostik White Seal and this compound should also be put over all unplated nuts and bolts after assembly to reduce still further the risk of corrosion. If brass nuts and bolts are used they must also be covered with Bostik to avoid electrochemical reaction with the aluminium. Brass was not used in the construction of these outside aerials because of its weight, cost and brittleness: constant flexing in the wind could lead to metal fatigue over a long period.

Bisquare Aerial

The use of aluminium strip and channel gives a rigid outside version of the popular indoor bisquare aerial. This is extremely light and small and can be used where the seven-element Yagi described later is considered to be too obtrusive. The elements are made from $\frac{1}{2}$ in. half-round aluminium strip, the cross boom is cut from $\frac{1}{2}$ in. aluminium channel and the

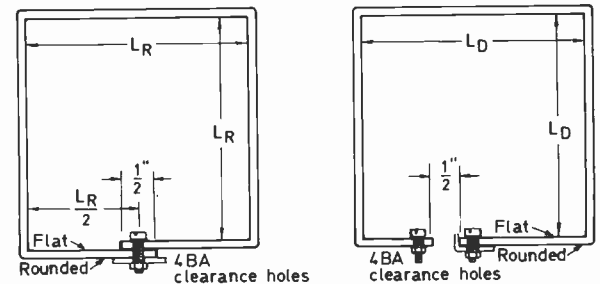


Fig. 1: Bisquare reflector. Fig. 2: Bisquare dipole.

A NUMBER of set-top u.h.f. aerials made from tinned copper wire or brass rods were described in the August and September issues last year. These all suffer from the limitations of indoor installations at u.h.f. The building materials used absorb and deflect u.h.f. signals so that the picture quality obtained is often poor. In many cases transfer of the aerial to the loft gives no better results. Signal fluctuations due to the presence of people and objects in a room are then eliminated but many roofing materials are particularly absorbent at u.h.f. This attenuation increases with increasing frequencies and is particularly noticeable in Band V.

An example which illustrates the difficulties with indoor aerials at u.h.f. was an attempt by the author to receive the Heathfield Band V transmitter in Burgess Hill at a distance of 15-20 miles. A bisquare set-top aerial gave a low-contrast picture. Its most effective position was by a window, about a foot above the sill: no other part of the room gave anywhere near usable results. An attempt was therefore made to use a loft aerial. Since Heathfield is a Group D transmitter a log-periodic aerial for channels 49-68 was constructed. Holding it outside the window gave an extremely good grain-free picture but when it was put into the roof space above the set using the same short length of low-loss cable only a very poor picture could be obtained. In fact at no position was the picture as good as had been obtained with the set-top bisquare. The loss of signal through the roof was extremely marked. In order to receive BBC-2 at this site without adding to the ironmongery already on the roof the only remaining alternative was an outside wall-mounted aerial. A seven-element Yagi was therefore constructed and mounted just under the eaves: the results were first rate and this small, unobtrusive wall-mounted aerial solved the problem.

Many flatdwellers can use only a set-top or loft-mounted aerial and have to put up with inferior pictures. The only satisfactory set-top aerial found by the author for relatively weak signal strength areas was a log-periodic type. An outside version however mounted perhaps on the windowsill or just alongside will in many cases produce a marked improvement, particularly in eliminating the effects of people moving about in the room. In this article three u.h.f. aerials designed for outdoor use are described, a bisquare, the Yagi just mentioned and a rather more complex log-periodic type. Similar construction

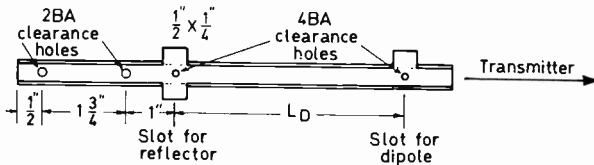


Fig. 3: Bisquare cross boom viewed from top. Two vertical flaps 1/2 in. deep and 1/2 in. wide are cut out of the vertical side of the boom and bent out at right angles to support the reflector. The element should be a tight fit in its slot and at 90° to the boom. For the dipole only one supporting flap is cut.

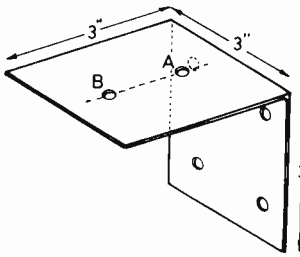


Fig. 4: Bisquare mounting bracket. All six holes are 2BA clearance. Hole A is used as a pivot for mounting the aerial while the direction of the transmitter is found by experiment. Hole B is then drilled using the second mounting hole in the cross boom as a template

wall mounting bracket may be either 14 or 16 s.w.g. aluminium sheet. Details of the elements are given in Table 1 and Figs. 1 and 2. The cross bar is shown in Fig. 3 and the mounting bracket in Fig. 4.

The reflector is fitted into a locating slot as shown in Fig. 3 and secured by a 4BA screw. The dipole is supported on one side only in a similar slot and is also held in place by a 4BA nut and bolt. This bolt also carries the washers and nut for connecting the screen of the coaxial cable. The inner conductor of the cable is secured by a 4BA nut, bolt and washers to the floating end of the dipole. After assembly the cable is taped to the boom to minimise strain on the connections and a thick coat of Bostik White Seal is put over the whole of the electrical connections and over all exposed parts of the nuts and bolts to reduce the risk of corrosion.

The bisquare is a low-gain aerial and should only be used where the signal strength is high or where other considerations veto any other approach.

Table 1: Bisquare aerial element details.

Aerial Group	Dipole side length LD (in.)	Reflector side length LR (in.)
A	5.5	5.75
B	4.3	4.6
C	3.6	3.75

The spacing between the elements is the same as the dipole side length.

For Groups D and E the bandwidth of this design will probably be inadequate to cover all the channels allocated.

Seven-element Yagi

The seven-element Yagi for Group C channels weighs 9 1/2 oz. and is less than 2ft. long. The dimensions were derived experimentally by comparing two cosited transmissions on channels 50 and 66. It may be used for Groups C and D as it stands or the dimensions given in Table 2 multiplied by 1.5 for Group A or by 1.2 for Group B. It is not recommended for Group E transmitters (for these the log-

periodic aerial to be described next is likely to be more satisfactory). The Yagi may be used for either vertical or horizontal polarisation.

The cross bar is cut from 1/2 in. aluminium tubing and all the elements including the folded dipole are made of 1/2 in. half-round aluminium strip. Only seven elements were included in the design in order to make a reasonable compromise between the gain and weight of the aerial.

The five directors and the reflector are cut from the strip and a 4BA clearance hole is drilled at the middle of each. This should not be countersunk. (The prototype lost three directors in high winds due to the use of countersunk holes which weakened the metal.) Cheesehead bolts with washers are used to attach these elements to the boom. The folded dipole, also cut from strip, is made as shown in Fig. 5. The dipole is spaced from the boom at its locating side by a 1/8 in. long piece of 1/2 in. aluminium tubing. A curved groove is filed in the top of the spacer to locate the dipole in position at 90 degrees to the boom.

Small grooves are also filed in the boom at the appropriate places for the other elements to prevent them twisting in the wind. Details are shown in Fig. 6. Fig. 7 shows the cross bar assembly. Holes X and Y are 2BA, all the others 4BA clearance. If the polarisation required is vertical then X and Y are drilled at right angles to the direction shown.

The assembled aerial is mounted on a 10 or 12 s.w.g. aluminium bracket which should be Rawl-plugged and screwed to the wall. Holes X and Y are used to fix the cross bar to the bracket. Details are shown in Fig. 8. Hole A acts as a pivot for a 2BA

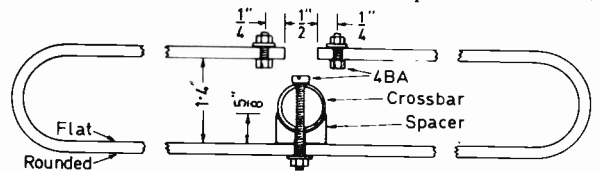


Fig. 5: Yagi folded dipole details.

Fig. 6: Method of mounting the directors and reflector on the cross boom.

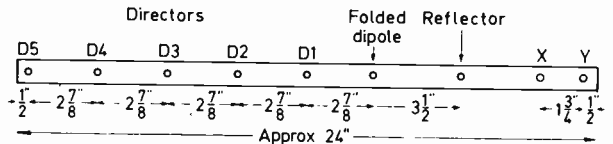
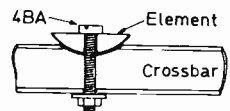
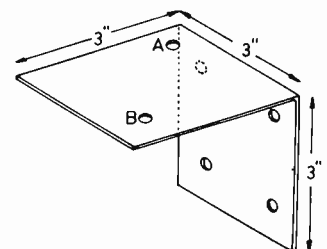


Fig. 7: Cross boom assembly for the Yagi aerial. All holes except X and Y are 4BA clearance. X and Y are 2BA clearance for mounting on the wall bracket. For horizontal polarisation X and Y are drilled as shown above; for vertical polarisation they should be drilled at right angles to the positions shown above.

Fig. 8: Wall mounting bracket for the Yagi aerial. Holes A and B are 2BA clearance, the others of clearance suitable for screws for No. 10 Rawlplugs. For positioning see caption to Fig. 4.



bolt through Y. A trial run will indicate the direction of the best signal and using X as a template hole B is drilled to lock the aerial in place. The version shown here is left hand: it may be necessary to move A to the other side for a right-hand version depending on the direction of the transmitter. Four screws at least 1½ in. long and No. 10 Rawlplugs should be used for the wall mounting.

The cable should be fixed to the retaining bolts on the folded dipole and taped to the cross bar to avoid strain on the connections. A thick coat of Bostik White Seal should be put over the whole of the end of the cable and the joints. All nuts and bolts should also be covered to reduce the risk of corrosion. This Yagi aerial will often be effective up to about 20 miles from a main transmitter. A larger version is not recommended because of size and weight considerations. The aerial can be sited under the eaves where regulations forbid the use of an outside aerial. If the room in which the set is installed is at the opposite side of the house to the direction of the transmitter, low-loss cable must be used if a long run from the aerial is needed. Poor quality cable is likely to reduce the extra signal gained from an outside aerial to below that obtained in the room using a set-top aerial.

Table 2: Yagi element lengths and spacings.

Element	Size (in.)	Spacing (in.)
Reflector	7.5	3.5
Folded dipole	7.0	2.9
Director 1	6.4	2.9
Director 2	6.1	2.9
Director 3	5.7	2.9
Director 4	5.6	2.9
Director 5	5.5	2.9

Log-Periodic Aerial

A previous article (PRACTICAL TELEVISION, September 1970) described the principles and practice of log-periodic aerials with details for the construction of a set-top model. The version described here is suitable for outside use in fairly sheltered positions.

The coverage of the u.h.f. transmitters is planned to give a minimum usable signal strength in a service area of 70dB above a microvolt (3mV). At these high frequencies the scatter of signal strength around a median value is very great and this means that it is quite possible to find near "dead spots" very close to good receiving sites. Very careful aerial siting at u.h.f. is therefore necessary.

The best aerial for use in difficult conditions is a log-periodic. It has very good directional properties and is capable of laying "ghosts" very effectively and suppressing co-channel interference. It also has extremely wide bandwidth, giving virtually even gain over a preselected group of channels. The version described here was built by the author for use in an area of very high signal strength but many ghosts. For this purpose it gives grain- and ghost-free pictures from a loft-mounting position. Dimensions are also given for a Group E version for channels 39-68 which

is rather too broad a bandwidth to be covered adequately by most of the conventional models suitable for home construction.

To the uninitiated the log-periodic aerial at first sight looks like an ordinary Yagi array. More detailed examination however shows several marked and important differences. First there are two parallel cross bars about ½ in. apart instead of one. They are shorted together by a conventional single reflector at the rear end. Secondly, cable connections are made at the front, the inner of the low-loss coaxial cable to one boom and the outer to the other. Thirdly, all the elements apart from the reflector are active and contribute to the total output from the aerial. Each dipole has one element on either boom and this arrangement alternates along the aerial. Starting from dipole one, this might have its left-hand element on the top boom and its right-hand one on the bottom. The next would therefore have its right-hand element on the top boom and its left-hand one below and so on alternately. The lengths and spacings of the elements are in logarithmic relationship with one another, becoming shorter towards the front of the aerial.

Since all the elements are active, all those at or near resonance at any given frequency contribute to the output. This means that the bandwidth is extremely broad and this was originally the prime interest in log-periodic aerials. However, it was found that the polar diagram was extremely good and that they thus had excellent anti-ghost properties. For both these reasons this type of aerial is well worth considering in difficult reception areas.

To maintain the polar response, it is necessary to mount the aerial at the rear of the reflector and not to put any support along the booms. Similarly the cable must be brought back along one of the booms before being taken down to the set. Log-periodic aerials are suitable for both vertical and horizontal polarisation. For rigidity an insulator such as a nylon screw with locking nuts is used to hold the two cross bars parallel.

One disadvantage is that with a log-periodic aerial designed for the full u.h.f. bandwidth only a few elements are at or near resonance at any given frequency. Consequently a 20-element log-periodic aerial for channels 21-68 would be equivalent to only an 8- or 9-element Yagi. Its polar response however is much superior and ghosts are greatly attenuated. For

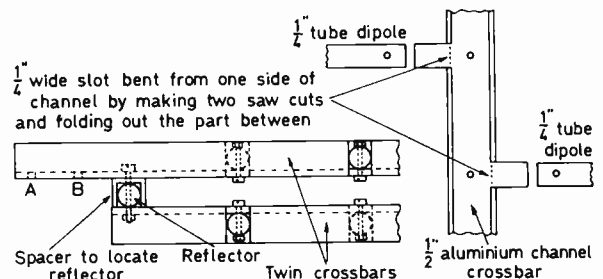


Fig. 9: Log-periodic aerial assembly details. All holes except A and B are 4BA clearance. The slots in the cross booms serve to secure the dipole halves in position. One half of each dipole is on each boom, alternating between top and bottom. The spacer to hold the reflector is cut from 1 in. of channel. The upper boom extends 2 in. behind the reflector to take two 2BA mounting bolts through holes A and B.

Table 3: Element lengths and spacings for a log-periodic aerial.

Element	Group A		Group E	
	Length (in.)	Spacing (in.)	Length (in.)	Spacing (in.)
Reflector	11.5		10	
Dipole	2 × 5.5	3.6	2 × 4.5	3.0
Dipole	2 × 5.2	3.5	2 × 4.1	2.7
Dipole	2 × 5.0	3.3	2 × 3.7	2.4
Dipole	2 × 4.7	3.1	2 × 3.4	2.2
Dipole	2 × 4.4	2.9	2 × 3.1	2.0
Dipole			2 × 2.8	1.8

specialist purposes such as Group E use, a log-periodic aerial can be designed to give uniform gain over a predetermined bandwidth. Details of the calculation of element sizes for any frequency were given in the September 1970 issue of PRACTICAL TELEVISION.

Constructional Details

Both cross bars are cut from $\frac{1}{2}$ in. aluminium channel. The upper one extends two inches behind the lower one to provide a means of fixing to the wall mounting bracket. This bracket is made from 12 s.w.g. aluminium sheet and is of the same type as used with the other aeriels described in this article. Two 2BA clearance holes are drilled to take the fixing bolts. All elements are cut from $\frac{1}{2}$ in. aluminium tubing.

Figure 9 shows how slots are cut in the side of the channel just wide enough to accommodate the dipole rods. The channel wall is then bent out horizontally to support each dipole rod. 4BA clearance holes are drilled through the rod and channel to lock each element in place.

The reflector is mounted in a $\frac{1}{2}$ in. long spacer of the same channel material and a bolt joins it to the two booms. For additional strength extra bolts are required farther down the cross bars. These must be made of insulating material and should if available be nylon. Lock nuts are then positioned on the bolts so as to keep the bars parallel. If nylon bolts are not available a wood block secured by screws may be used instead.

For weather protection all steel nuts and bolts should be rust proofed and finally protected with a thick coat of Bostik White Seal. The same material must also be put liberally over the cable joints. The cable is connected to the front pair of elements by means of a second nut and two washers on the securing bolt of each one, put on after the first locating nut is fully tightened. The cable is taped to the lower boom and brought back to the reflector before being taken away.

The model constructed by the author is a six-element one for channels 21-34 (Group A). Table 3 shows the dimensions for this and for a seven-element version for channels 39-68 (Group E).

In the event of difficulty in obtaining any of the materials required for these aeriels most are usually obtainable from the Metal Department of Bennett's Ltd., North Road, Brighton. They are willing to fulfil orders by post. ■

THE RAINBOW REVOLUTION

—continued from page 461

beams from three guns to reach the screen from different directions or for sequential display by deflecting a single beam so that it could point at each of the three phosphors in turn. It is worth noting that alternatives to the three-gun shadowing display require the colours to be displayed in sequence. At the time of Flechsig's proposal the techniques were not available to construct such a tube though a similar principle is now used in the Sony Trinitron tube.

RCA rejected the wire-shadowing scheme because of the difficulties of making a large-screen version (16in. was thought to be a suitable size to aim at) and instead studied a method which used a screen of tiny glass pyramids (Fig. 4) each side of which was coated

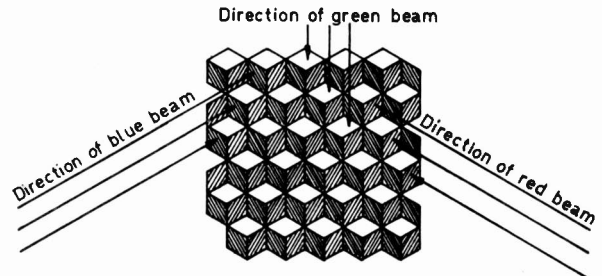


Fig. 4: The cubical-pyramid nonplanar colour screen: the sides of the cubes facing in different directions are coated with different colour phosphors.

with a phosphor of different colour. The difficulty here was in getting the scanning beams to approach the screen at angles such that they would strike only one colour: with wide-angle pyramids scanning was almost impossible while with narrow angles most of the light from the phosphors was lost sideways—as was the case with other geometrical shapes tried.

Printed circuits were at this time under development and the techniques for reproducing patterns in metal by photographic means had been greatly refined. The work being done by RCA in this field became of interest to the colour tube team because it showed the possibility of perforating metal plates with large numbers of accurately located holes which could be used to guide electron beams to colour phosphor dots on the face of the screen. Studies showed that tubes could be made in which a variation of one degree in the angle of approach of the electron beam could change the display from one primary colour to another. It would of course be necessary to use a large number of holes and colour dots to avoid coarse resolution but the photographic printing techniques which were being developed seemed perfectly suited to doing just that.

The tube using the shadowmask—as it was called—could be built in either three- or single-gun versions. The single-gun version used deflectors to move the beam so that it approached the shadowmask from different angles. For some reason this version does not appear to have been developed, possibly because of the extra circuitry needed to change the simultaneous NTSC signal to the sequential signal required by a single-gun tube. It is intriguing however to speculate on what might be made of such a system now.

CONCLUDED NEXT MONTH

Montreux

'71

J. I. SIM



MONTREUX differs considerably from its London counterpart (the International Broadcasting Convention) on which we reported in January. Undoubtedly the technical papers presented are poorer in quality and content while the exhibition is much broader—in fact the exhibition has rather begun to run wild.

The afternoon session of the first day consisted of seven country reports—from Canada, France, Germany, Italy, the UK, the USA, and a surprise one from the USSR.

World-wide Reports

It was the first time that Canada has described her television system at Montreux. The nationally owned Canadian Broadcasting Corporation (CBC) has adopted the policy of extending television coverage to every community and viewer: in the southern, populated areas this presents little difficulty but the extension to the less populated northern territories via microwave links is very uneconomic. This difficulty was not eased when the whole system was converted in 1966 to colour operation. Apart from the coast-to-coast English service there is also a French language network from Montreal eastwards. In addition there are privately owned stations and a private commercial network. It is planned to overcome these problems with a satellite and a large number of earth receiving stations which are due to become operational in 1973. Until the satellite service begins programme distribution to the more remote areas will continue on the present basis—weekly aircraft delivery of videotapes, which is hardly immediate television!

It was of surprise to many delegates that Italy had still not officially started a colour service. In fact the Italian government has not only not given RAI the go-ahead for colour but has not officially decided on the colour system to be used. This is confidently expected to be PAL and Italian programmes and OBs have been seen over the Eurovision network emanating from the present four colour studios and three OB units. All distribution as well as programme transmission and origination is handled by RAI from their Rome master control. The programmes themselves originate in four television centres at Turin, Milan, Rome and Naples. Transmission of the two programme services is currently from 37 main stations and 748 relays for the first service and 326 relays for the second service (which is still being built up). The large number of relays is necessitated by the mountainous geography of the country—everywhere the population seems to be concentrated in long, narrow valley regions. There are also some surprising unofficial TV activities as Roger Bunney mentions elsewhere.

Howard Steele, Director of Engineering of the ITA, represented the UK, on behalf of both the ITA and the BBC. Because the last report at Montreux was in 1969 when there were under 40 hours a week of colour—from BBC-2 only—he had to explain the massive jump to over 140 hours a week with the introduction of colour on the two majority audience channels—BBC-1 and ITV. That this changeover—undoubtedly the largest in the

world to date—occurred overnight obviously impressed the delegates, but Mr. Steele was guilty in this respect of creating rather the wrong impression of how it took place. The slant given was that all studio centres overnight converted all their equipment from 405-line operation to 625 lines in colour. What in fact happened was that the studios had been operating on 625 lines for some time anyway and merely removed the 625-405 line-store converters from their outputs. In their place converters were introduced at the 405-line transmitting stations.

Howard Steele also gave details of colour receiver deliveries in the UK since the beginning of the colour services. With the start of colour on BBC-1 and ITV there was a receiver sales boom which outstripped supplies from the manufacturers. Sales subsequently settled down to a steady climb and we have certainly escaped the horrible 10-year stagnation that was experienced in the US. It is estimated that $\frac{1}{4}$ million receivers will be supplied this year and 1 million in 1972. At the current rates—and it is difficult, as the manufacturers have already found, to be even approximately right about these things—half the receivers in the UK will be colour by 1980.

A rather surprising statement from Mr. Steele—which he emphasised was mainly his own view—was that he expected that the 405-line duplication of services on v.h.f. would have to continue until 1990 or so rather than the originally estimated 1980. This is of considerable financial concern to both the BBC and the ITA because it will almost certainly mean that a number of v.h.f. transmitters will have to be re-equipped in order to maintain a reliable service. It does however offer some financial support for the large investment of both the BBC and the ITA in their development of digital line-store standards converters: the present generation of converters is inherently unreliable and not suitable for unattended station operation.

For one of the first times the USSR felt able to report on its technical progress in television. It was a little politically biased—the nature of the animal?—and this was a pity because much has been achieved in a few years. Their new Moscow TV centre has taken six years to build and equip and now produces about 2000 programme hours a year. This is not a large total but the main problem is the distribution of the three services. One, local around Moscow, is fairly standard but the other two require 24-hour operation because of the existence within the USSR of *ten* time zones. These two services cover the Eastern Territories (VOSTOK) and the rest of the Republic (ORBITA). The VOSTOK service is transmitted six hours earlier than the main service whilst the ORBITA programme utilises a satellite and a number of earth v.l.f. stations to overcome the time-zone problems. At the moment it is said that there are five-six hours of colour a day (SECAM of course) and 100% colour programming is expected in about five years. The figures given do not tie up when compared to the total transmission hours so it must be assumed that the five-six hours of colour actually means one-two hours *per service*.

It has been noticed that EMI videotape is commonly used in the USSR and another UK product, the Vinten pneumatic camera pedestal, has also been sold there. A number of firms have tried to copy the Vinten design incidentally but none of them have ever worked as well. A long conversation with a Russian delegate also showed that their present use of semiconductors is pretty limited and that such things as i.c.s are virtually unknown to them.

Audio-Visual Systems

I was surprised that the Montreux programme committee almost deliberately started a minor war, the occasion being a full-day of the symposium devoted to audio-visual systems such as EVR, Philips VCR, Teldec.

etc. These systems cannot be compared directly: each has its own advantages and disadvantages. Unfortunately financial considerations seem to prevail and the arrangements made at Montreux which allowed the protagonists of the various systems to face one another in a "round-table discussion" merely led to a slanging match. Quite apart from this it was distressing to find that a group of quite sensible men appeared to know little of what they regard as their immediate market—education.

Programme Origination

There was not much new in the symposium papers in the line of studio equipment and techniques. The whole industry in this field is standing still, awaiting the next generation of studios which will be required in perhaps five years' time, most of the European market having dried up after the initial colour equipment boom.

Philips and the English Electric Valve Company (EEV) presented papers on developments in Plumbicon camera tubes and their equivalents. The latest series of 1in. tubes from Philips uses a light-pipe bias on the rear of the target to reduce photoconductive lag (a system first used on very early orthicon tubes) and a system of reducing the effects of picture highlights and the smears or comet tails that result from overloads. The system was originally known as Flyback Highlight Discharge (FHD) but has now become known as the Anti-Comet Tail tube (ACT). The idea is that any charge voltage on the target above a previously set level is stripped off, or discharged, during the line flyback period by pulsing the cathode of the tube during this period. The new 1in. tubes are at present only being used in the new Philips LDK5 colour camera channel which we will mention later.

Also described was a system to enable an operator to write or draw directly into any television picture. Using an electronic stylus on a position-sensitive surface mounted above a monitor displaying the transmission picture, the X and Y co-ordinates of the drawing or writing positions are fed to a scan converter and used to derive a source of video which can be added to the original picture source. The system is manufactured by a firm known as Telestrator and we hope to describe it at a future date in TELEVISION.

Computer-type applications are beginning to abound in television—videotape editing and the like—and two more were described at Montreux. The first, by Marconi, was an automatic presentation system. This has been designed mainly to reduce the inevitable operator errors that occur during periods of large numbers of switches of video and sound sources—e.g. during the complicated commercial breaks. The information for the autoswitching is inserted into the equipment through a preprepared paper tape or directly on a keyboard. The stored instructions are displayed on a monitor fed from a television character generator. Instructions can be modified up to just a few seconds before a change is to take place.

The second computer-type application came up in a discussion by I. R. Young of Evershed on the remote control of cameras. Evershed systems are world famous in this field and although remote cameras can now be programmed in advance little use of them has been made in drama or OB work—principally because the composition of pictures cannot be that accurately dictated. One idea put forward has an exciting germ in it—particularly for the very small studio or financially difficult productions—that is to have a remote camera slaved to a master, manned camera which has the various artists under shot against a blue background. The slave camera would be looking at a miniature version of the required set and as the master camera moves the slave would move in sympathy. Using chroma-key quite authentic results could be achieved. Another possibility lies in the recently developed areas of colour pattern recognition. This could



Shown for the first time at Montreux the EMI mobile solid-state TV microwave link type ML7A is continuously tunable over the 7.1-7.45 GHz frequency range, has a nominal output of 1W and an effective range of over 65km.

be used for example to follow a character around a set, although this would be less acceptable to production staff because it would allow little freedom for picture composition.

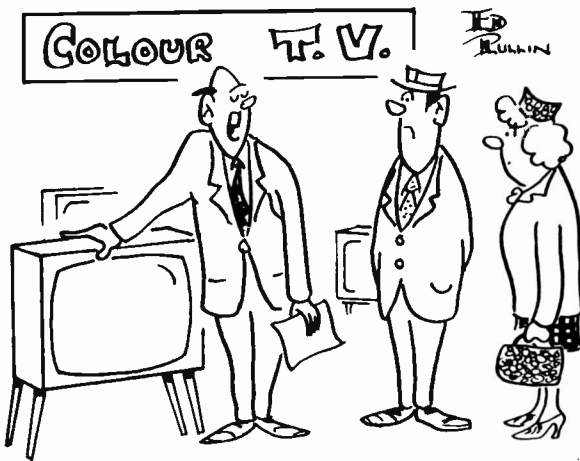
The only BBC paper read at Montreux was given by Mr. C. B. Wood. It was a pity therefore that this was one of the many *non-papers* at Montreux. Mr. Wood talked about the use of colour negative film in telecine apparatus. This is something which has been discussed for a long time—the positive print which has been used up to now for both television and cinema causes about 9dB loss at 5MHz. The difficulty has always been the design of suitable telecine apparatus to handle colour negative film and Mr. Wood did not reveal any new developments.

Transmission and Distribution

Gates Radio described the largest power u.h.f. transmitter known to be operational anywhere in the world. This is a 220kW transmitter installed at station WDCA-TV in Washington, D.C. The very high transmitter power was necessary at this site because aerial gain was limited and yet a particular coverage was required. The power was achieved by paralleling two 55kW transmitters with a duplicate pair. The problem of correct phasing between the transmitters was neatly solved by Gates in a very simple way. The transmitter is unattended and all the logic control circuitry and monitoring facilities are remote. The solid-state drive uses i.f. modulation rather than modulation at the final output frequency, a technique which has been steadily growing in popularity (it is expected that the next Phase of ITA u.h.f. transmitters will also employ i.f. modulation).

A large amount of interest is developing in the UK over transmission in Band VI (12GHz). This has arisen because of Band IV/V allocation problems. In some areas—South Wales for example—the very large number of u.h.f. relays necessary will quite early exhaust the number of channels available if co-channel and adjacent channel interference problems are to be kept at an acceptable minimum. The use of Band VI would certainly ease this problem and would be in addition to the already planned "active reflectors" developed by the BBC (these stations suffer from a number of limitations, particularly in the number of really suitable locations).

Although a number of organisations have done exploratory work in Band VI the most significant results have come from field tests in Berlin by FTZ. Field strength measurements over a period of two years using three test transmitters were made from different sites



"Plus free life insurance—against explosions."

and using differing aerial heights—ranging from 56m to 200 m. It would appear from the results that satisfactory coverage can be guaranteed for a radius of about 10km. At greater distances the signal strength falls off very rapidly due to attenuation by buildings, etc. There are however possibilities of using a duplicate or even triplicate coverage service to offer practical field strengths at about 25km. Perhaps a more practical possibility is the use of a community aerial system with an s.h.f./u.h.f. converter, feeding standard receivers via a cable network. With the receiving aerials at a height of 40m or more a coverage of 50km can be gained. Band VI certainly offers a practical extension from u.h.f. coverage and it may well be that this development will take place before the use of satellites in this country (the International Telecommunications Union—ITU—has not at the time of writing legalised the use of space broadcasting).

Cable television also featured high in the Montreux programme and it was interesting to note that all the major operators in the US and Europe are now greatly regretting the poor interference isolation that is obtained with their standard 320Ω twin-feeder aerial inputs. Many of the recent developments in the CATV field relate to the extension of the number of channels that can be received in the home. It is now practical to receive 80 channels in the US over cable (75 European channels). This is by using a set-top converter (with coaxial input!). You would have to be a bit of a masochist to want to receive 80 television channels but the ideas under consideration in this field are to use unwanted channels for return information—such as readings of the subscriber's electricity meter?—and for providing additional services—e.g. library channels.

Receivers

Five receiver papers were presented at Montreux. One given by Thomson-CSF described a system of large screen projection using a standard lamp source. The amount of light reaching the screen is determined by the transparency of a photoconductive layer upon which the picture source, in the form of an electron beam, is focused.

Erik Langer gave a brief summary of the work that has recently taken place in the field of selective networks—e.g. for i.f. strips—covering developments in crystal filters and active RC filters. The use of crystal techniques has been stimulated by the discovery of the two new principles of energy-trapping and the surface wave whilst the active RC filter has received a boost from modern semiconductor and thin-film techniques.

At least two UK setmakers are working on these techniques and a ceramic filter has been incorporated in the latest BRC colour chassis, the 8000 chassis used in their new 17in. colour receiver.

The susceptibility of v.h.f./u.h.f. receivers to electromagnetic interference was discussed in a paper by T. Dvorak of ETH-Zurich. This problem is again one that stems from the continental use of 320Ω aerial feeder where extremely good screening of the tuner and the interconnections in the receiver is required. In UK receivers the recommended rejection of 35dB is achieved with very little problem.

Undoubtedly the most interesting receiver paper was presented by Charles Rhodes of Tektronix who have developed a new series of black-and-white and colour picture monitors. It is the small-screen colour monitors which are most interesting because Tektronix are making use of the Sony Trinitron—the first professional use of this tube. The small screen is of immediate advantage for equipping an area where colour picture quality can only be gauged and not cured—e.g. videotape recording, radio links. Like their Trinitron receiver counterparts the monitors give an exceptionally bright picture the structure of which is most noticeably different. Tektronix are making these monitors available in RGB form or with either or both NTSC and PAL decoders fitted, making the range truly multistandard.

One difference between the use of the Trinitron in domestic sets and its professional use in the Tektronix monitors lies in the convergence arrangements. Although the tube uses a horizontal-plane electron gun assembly the standard of vertical convergence is still not really good enough for professional use. Tektronix have therefore added some vertical convergence adjustment. This still gives a simple convergence panel with only five controls for each field standard.

The Exhibition

As mentioned at the beginning the exhibition has run rather wild and could do with hefty pruning. In the following notes we have space to mention only those exhibitors and products which particularly caught our attention. The biggest UK representation at Montreux was presented by EMI with Marconi not very far behind. Nothing very new on either stand although the EMI 2005 and the Marconi Mk VIII colour cameras were again being shown. The Marconi camera has recently been ordered by Canada but otherwise both it and the EMI channel are doing very slow business. Of more interest on the EMI stand was the new auto-centring unit for fitting to their camera. This is a very great improvement on both their original and on many other units of this sort. If EMI can demonstrate that this unit can be fitted to other channels they could be in line for a great deal of business.

Philips were demonstrating just about every bit of broadcasting and CCTV equipment that they manufacture or hope to manufacture. Star of the show was intended to be the new LDK5 camera channel which was first announced two years ago. This camera uses a double-screened coaxial cable (triax) for the camera cable and is self-contained in being provided with its own coder. It receives power down the coax as well as telemetry sync commands and timing commands. The coax also distributes video, talk-back etc. All this is done by modulating the information sent down the cable. The advantage is gained in the low-cost camera cable which can be of long runs. It is also possible to operate the camera with two radio links instead of using cable or if required standard camera cable can be used. Unfortunately the camera is not really ready for comment. Philips managed to get one operational by the fifth day of the exhibition but the picture quality was poor and there were numerous timing errors present. We must assume therefore that this was a laboratory prototype

There is no objection to this because at least we can assume that something better will come but I personally get very hot under the collar when a firm like Philips is willing to give a quotation for such a camera!

Nothing impressed me very much about the Thomson-CSF equipment. They too have a triaxial camera in operation and again there were timing errors etc. on the pictures. All the Thomson colour monitors seem designed with pincushion distortion as well. In the Thomson pavilion was the little Paris firm of Laboratoire General des Telecommunications (LGT) who will later this year be supplying the first consignment of u.h.f. transposers to the ITA. They are a small and very friendly organisation.

Gates Radio gave their first automated radio station demonstration in Europe and again—as we noted at the IBC—this could be a real money-spinner for local commercial radio. Five hours of programming can be set up from a number of tape and cartridge sources and the station will then run itself, giving even time announcements.

The principal attraction shown by Link Electronics was a camera tube test channel for making accurate spectral and performance figures for Plumbicon camera tubes. Rupert Neve and Company of Royston have established themselves in only a few years as one of the only manufacturers of high-quality sound desks for both television and sound recording studios.

RCA always make a good showing and pride of place on their elaborate stand was their TCR100 tape cartridge recorder. The recorder can handle up to 22 three-minute cassettes and its usefulness is in the automation of programme breaks on commercial TV networks. The idea would be to dub all advertisements, programme trailers and announcements on to cassettes. This can only really succeed in this country with the co-operation of all the programme companies and the advertising agencies. It will undoubtedly come in time and the situation will then be that the advertising agencies will merely post cassettes around the country instead of the present film stock. It will require at least one of the major facilities companies to acquire cassette recording arrangements

before the advertising world as a whole is going to be taken by the idea. To start the ball rolling so to speak the RCA machine was leaving Montreux for Yorkshire Television for evaluation. It will be interesting to see whether they retain it after their testing. Meanwhile the equivalent machine from Ampex has still not made its debut in Europe.

Pye TVT shared their parent company's stand (Philips). Their major display was the series produced OB unit which was minute compared to the Philips equivalent standing alongside. The same facilities were included however and it was obvious that a number of people were interested in the vehicle and the others like it which are now virtually "off the shelf". The one on display had in fact just returned from South Africa where it had covered the S. African Grand Prix. Just about as soon as it had been loaded for return to Europe the announcement was made that S. Africa is to start television operations—in colour right from the beginning—in about four years' time. Also on display by Pye was their commercial version of the BBC sound-in-syncs system. The system is to be employed in the new Post Office conference television system starting on a trial basis this summer between London, Bristol, Birmingham, Manchester and Glasgow. Using sound in syncs not only means an economy in the provision of intercity circuits but also offers a degree of secrecy on the sound channel.

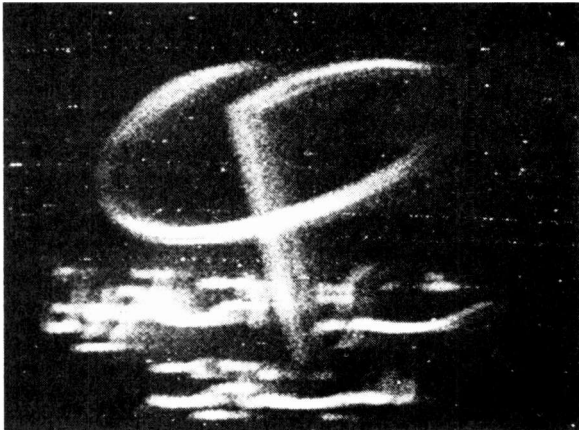
Summary

UK representatives this year did not seem too pleased with the event. Although it is invidious to make comparisons with the IBC it is nevertheless inevitable because the two now appear to be competing for the star exhibits and papers. I will confine myself to saying that unless I see a very definite indication of improvement in the standard of the papers—and this means a very hefty reduction in their number as well as more careful choice by the selection committee—I doubt whether I will bother to make the journey again. All this even though the whole atmosphere of Montreux is far more pleasant than that of London. ■

LONG-DISTANCE TELEVISION

—continued from page 459

transmitting the Swiss 1st programme to parts of Northern Italy on channels *outside* the normal broadcast allocations, usually between 250-350MHz and on ch. 38 vertically polarised. The firm apparently markets converters for the reception of these out-of-band channels. The Carabinieri—the rural police—have recently closed down



Station identification, Lebanon ch. E4, courtesy M. Dolci. Signal actually received in Sicily.

the transmitter on Monte Maddalena, Turin but it seems the situation has become more confused as another independent network has started transmitting the Swiss 1st programme (which is in Italian) on channels within the conventional Band III and V limits, thus opposing the monopoly initially set up in the sale of converters, amplifiers and aerials by the first network. All very puzzling but at least this is now on record should any DXer receive the Swiss programme on an unusual channel!

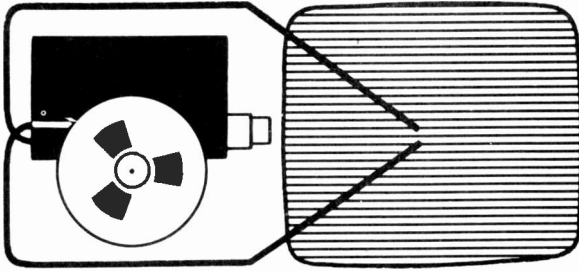
Data Panels

Starting with this issue we are starting a new series of test cards and patterns. For the first two issues we will concentrate on standard patterns and then go on to individual countries. I feel we should cover all types of patterns in order to make the series as comprehensive as possible, and thus of benefit to readers both at home and overseas.

European Broadcasting Union

A letter has come to us from Mr. G. Hansen, the director of the EBU in Brussels. With the increasing interest in long-distance television it seems that the EBU are receiving an increasing number of queries relating to station identification. They would like to stress that they are unable to assist with such problems but suggest that the List of Television Stations mentioned last month in this column will facilitate identification. If anyone does have identification problems we at TELEVISION are pleased to assist where possible.

VIDEO



MONITOR

KEITH CUMMINS

SHORTLY after the Single-Standard 625-line Receiver for the Constructor was published as a constructional series commencing in March, 1970, interest was expressed in its potential use as a video monitor. There are two ways of setting about this. One involves the incorporation of an optional video preamplifier circuit while retaining the original off-air reception facility of the receiver as originally designed. The second approach is to use the original video, time-base and power supply circuits only, leaving out the tuner and i.f. sections. The sound circuits may be retained if required.

Monitor Requirements

When closed-circuit television is used the normal method of distribution is via coaxial cable carrying a 1V peak-to-peak positive-going video signal. Monitors and videotape recorders are designed to accept such a signal. A camera channel likewise produces this type of signal at the output of its sync mixer where the video from the camera has the locally generated sync pulses added to it.

It will be realised that unlike most domestic receivers the chassis of a monitor has to be isolated from the mains supply since the outer connection of the coaxial cable has to be earthed to chassis. As the

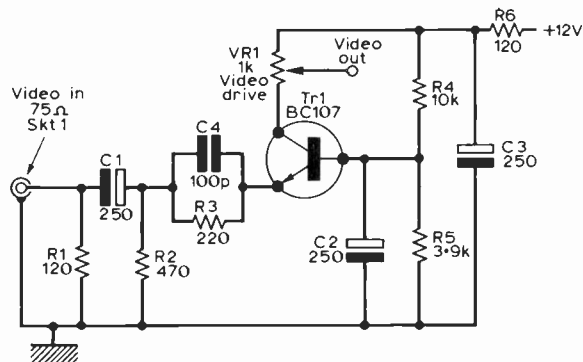


Fig. 1: Circuit of the video preamplifier developed for monitor use. If used permanently with the main chassis shown in Fig. 3 the smoothing components R6 and C3 above may be omitted and the i.t. supply taken from the junction of R5 and C5 in Fig. 3.

video signal contains low- as well as high-frequency components isolation by capacitors is not feasible. The Constructor's 625-line Receiver employs an isolated power supply—as well as preserving the black level—and so is potentially attractive for use as a monitor.

The 1V peak-to-peak video signal mentioned above is inadequate to drive the video amplifier stage directly and a video preamplifier is therefore necessary. The video amplifier stage needs a positive-going signal so the preamplifier must not invert the phase of the video signal. Since the closed-circuit video signal is presented at an impedance of 75Ω it is possible to use a common-base video preamplifier transistor. The low-impedance input signal is fed to the low-impedance emitter circuit of the transistor whose base is effectively grounded so far as signals are concerned. The amplified video signal is then taken, in the same phase as the emitter signal, from the collector.

Video Preamplifier Circuit

The circuit which has been developed for this purpose is shown in Fig. 1. The video input is introduced via Skt1 and coupled via C1 to the emitter circuit of Tr1, a BC107 transistor. The signal is introduced part-way up the emitter resistance which consists of two parts R2 and R3. The presence of R3 introduces an impedance in series with the video feed to Tr1 emitter. Since the emitter-current of Tr1 is very nearly the same as its collector current the ratio of R3 to VR1 determines the stage gain to a first-order approximation. High-frequency boost is achieved by placing C4 100pF across R3, thereby increasing the video drive as the frequency increases.

The bias for Tr1 is obtained from the network R4 and R5 with C2 providing a.c. decoupling to earth the base signalwise. VR1 forms the collector load resistor and the required amount of signal is tapped off to drive the main video amplifier. VR1 in fact forms the contrast control for the monitor. Care should be taken to avoid excessive stray capacitance around VR1 and it is suggested that a skeleton potentiometer is used in this position and preset. If a variable facility is required a plastic shaft should be employed, attached to VR1 by Araldite or other suitable adhesive.

R1 is included to lower the input impedance of the circuit to 75Ω . Failure to pay attention to detail here can result in mismatching to the coaxial cable with the attendant problems of reflection and poor response.

The preamplifier takes its supply from the +12V line provided in the Constructor's 625-line Receiver (Fig. 3, junction R5, C5). If the i.f. and tuner stages are not fitted R5 should be increased in value to 470Ω .

A.C. coupling is permissible in the preamplifier

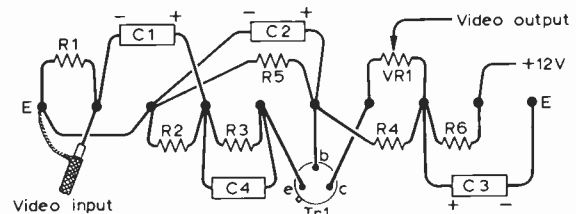


Fig. 2: Suggested video preamplifier layout on tagboard. The tagboard can be attached to the side plate of the 625-line receiver, on the opposite side to the i.f. strip and the tuner unit.

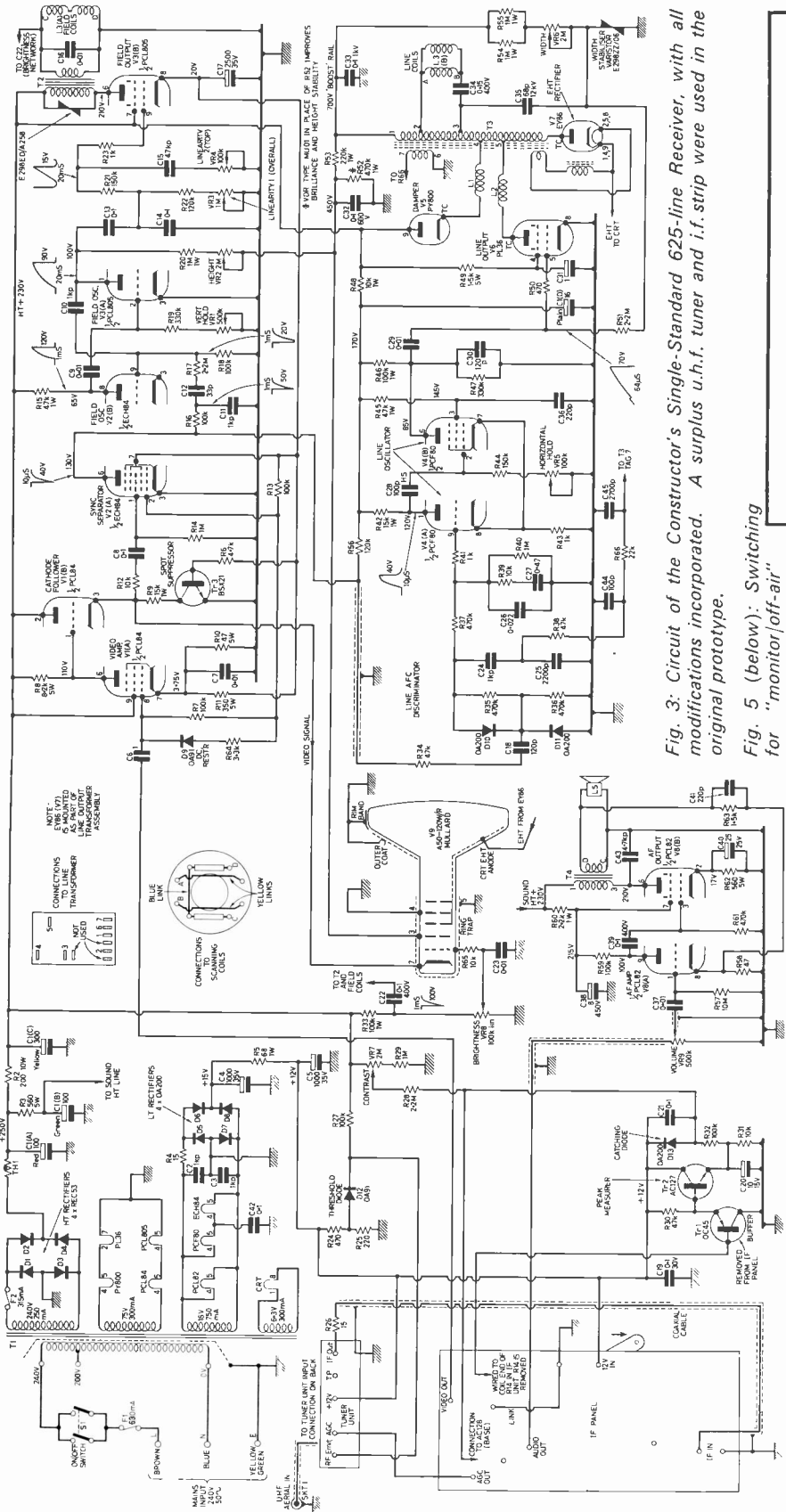


Fig. 3: Circuit of the Constructor's Single-Standard 625-line Receiver, with all modifications incorporated. A surplus u.h.f. tuner and i.f. strip were used in the original prototype.

Fig. 5 (below): Switching for "monitor/off-air" use.

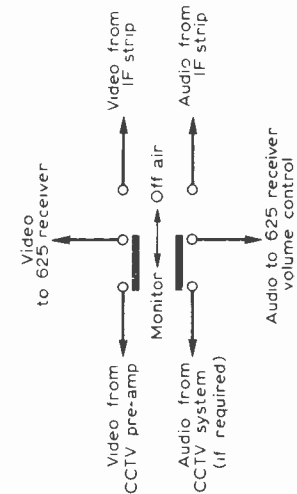
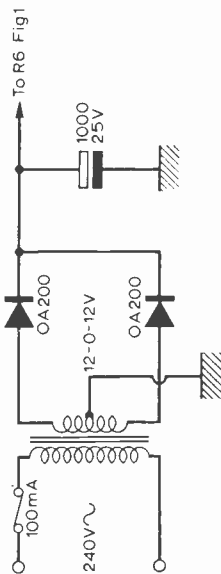


Fig. 4: Simple power supply which may be needed for some applications of the video preamplifier.



★ components list

Resistors:

- R1 120Ω
- R2 470Ω
- R3 220Ω
- R4 10kΩ
- R5 3.9kΩ
- R6 120Ω
- All 1/2W
- VR1 1kΩ
- Skeleton preset

Capacitors:

- C1 250µF 6V Electrolytic
- C2 250µF 6V Electrolytic
- C3 250µF 15V Electrolytic
- C4 100pF mica

Miscellaneous:

- Coaxial socket, tagstrip, etc.

since d.c. restoration is employed in the main video stage. Where no off-air facility is required the slider of VR1 can be connected directly to C6 in the main circuit. If the equipment is to perform a dual role however switching is necessary. A small low-capacitance slide switch is best, fitted to the rear of the receiver. The switch can handle both audio and video signals, the arrangement being shown in Fig. 5.

There is no reason why the video preamplifier circuit should not be used with receivers other than the Constructor's 625-line Receiver but care should be taken to ensure that the chassis is isolated. In the majority of cases this will involve fitting a 1:1 mains isolation transformer. Also there may be no suitable power supply available for the preamplifier. This problem can be overcome by building a power supply circuit along the lines shown in Fig. 4.

The whole of the basic video preamplifier can be constructed on one piece of tagstrip laid out as shown in Fig. 2. No particular points need to be noted except that the leads should be kept short to avoid excessive stray capacitance and inductance.

Tests

Tests on the preamplifier using a Sony 625-line camera and a test card have been very satisfactory. It was under these test conditions, with a Sony CVC2100ACE camera and Marconi Resolution Chart No. 1, that the value of C4 was optimised. A small but noticeable improvement in definition is achieved without introducing overshoot. If the preamplifier is to be used with equipment other than that for which it was originally designed the value of C4 may need to be changed. Apart from this component the preamplifier should operate correctly under any conditions using the components specified.

The tests carried out indicated that the horizontal resolution of the set-up described above was about 450 lines and good pictures were obtained indoors in a room illuminated by a 125W fluorescent lamp. Subject matter included natural subjects, pages from books, the earlier part of this article in its draft form and an interesting calendar. Stable pictures were obtained under all conditions with the video drive set about three-quarters of the way up. Beyond this point the contrast was excessive and occasional picture pulling occurred.

The conclusion to be drawn is that the Constructor's 625-line Receiver is eminently suitable for use as a monitor, with or without the normal receiver facility.

Main Chassis Modifications

Now some final notes concerning the receiver. The writer has received some letters indicating that hum, in the form of a vertical weaving of the picture, is sometimes troublesome. The problem showed up on the prototype during the power dispute last year. It can be cured by removing R1 and increasing R2 to 200Ω 10W. By this means extra smoothing is achieved without significant loss of h.t. voltage. It was also found on the prototype that black streaking through highlights occurred if the brightness was slightly over-advanced. This effect can be removed by adding a 10kΩ ¼W resistor (R65) between C23 and the c.r.t. grid pin at the tube base to limit grid current in the c.r.t. The circuit of the main chassis with all modifications incorporated is shown in Fig. 3. ■

SERVICING TV RECEIVERS

—continued from page 457

If there is no line whistle check the line timebase valves and associated components in the usual way.

Poor Picture

If the screen is illuminated and is fully scanned but the picture is weak—that is to say it is of poor contrast although not grainy—it can be assumed that the trouble is not in the early stages. First note the effect or lack of effect of the contrast control. If this merely fades out the already weak picture it is likely that the fault is in the video stage and attention should be directed to the PFL200 and its associated components.

If the contrast control has no effect at all it will be necessary to first check the cathode voltage of the PFL200 (about 14V) and the action of the preset contrast control. It is this voltage which is used to operate the a.g.c. circuit, as drive to the base of the a.g.c. amplifier Tr9. If the control voltage is present (which it should be if the PFL200 is functioning) but there is no variation of contrast Tr9 (OC44) should be checked together with the associated electrolytics. Note that when the PFL200 is replaced it is advisable to reset the preset control P1 to obtain the correct range of the contrast control. Turn P2 to minimum, switch to a 405-line channel transmitting a test card or a picture with roughly equal proportions of black and white, adjust P1 for a locked picture with weak contrast and then adjust P2 for a normal picture.

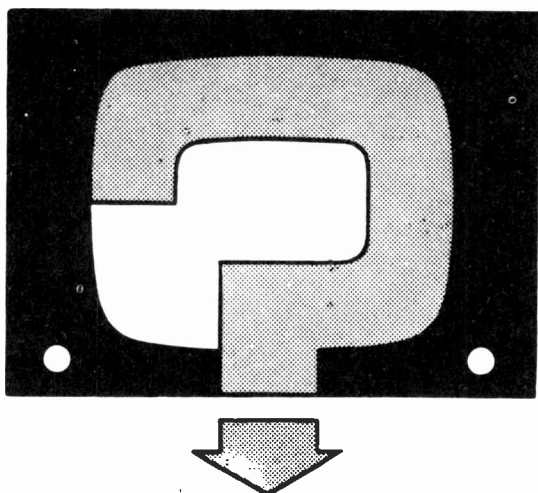
If there are no sound or vision signals at all although the screen is illuminated first ensure that the l.t. voltage is correct on the supply panel (SC23 and SC24) as it is not uncommon for one of the smoothers (C194, C195) to short. Having made sure that the supply is present at its source it is then a matter of checking that it is getting to the tuners and i.f. stages (approximately 12V to the tuners, 14V to the i.f. stages).

Audio Circuits

A PCL86 is used in the audio output stage. One of two defects can be expected as a general rule. The first is a total loss of sound which can sometimes be restored by tapping the PCL86 (to indicate that this is the culprit). The other is when the sound is low and distorted with the PCL86 overheated. This is usually due to the valve developing internal leakage and although replacing the valve may restore apparently normal conditions it is essential to check the condition of the bias resistor R99. This can often be damaged by a faulty valve and change value (going low) and if left in circuit will cause the new valve to overheat thereby necessitating another early replacement. R98 should also be checked for correct value.

Very weak sound has often been traced to R97 (220kΩ) going high. C142 will often be found open-circuit causing a drop in output but as this is not drastic it may not be noticed.

The messy one is when the PCL86 becomes faulty and burns up the bias resistor causing it to become open-circuit. This leaves the cathode voltage high and the electrolytic C142 can then sometimes explode depositing silver foil, waxed paper etc. all over the place which takes a bit of clearing up before the valve, the resistor and the capacitor are replaced.



YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by a 10p postal order (made out to IPC Magazines Ltd.), the query coupon from page 474 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.

BUSH TV125

The raster cannot be resolved on 625 lines though the sound is OK. When switched to 625 the line whistle is faint and ragged before fading altogether. I have replaced the preset 625-line hold control and the feed resistor from the h.t. line to the main line hold control without improving matters.—T. Humm (Rochester).

The fact that the line whistle can initially be heard at all suggests that the line hold is a long way out. Check 3R11 in series with the preset 625-line hold control, the PCF80 line oscillator valve and the fly-wheel sync discriminator diodes.

HMV 2635

This set uses the Thorn 950 chassis and has two faults, first poor sound when the volume control is turned down and secondly lack of width on 625 lines.—T. Bristow (Chelmsford).

The poor sound could be due to a defective audio output valve or a leaky coupling capacitor associated with it but in several instances with this chassis we have found the loudspeaker to be at fault. The poor width should lead to a check on the PL504 (PL500) line output valve and the width circuit resistors. Also check the 0.1 μ F capacitor C98 in series with the line coils on this standard.

KB RV20

The set originally had a tendency to field slip after it had been in operation for some time. This was cured by replacing the ECC83 sync separator valve and the h.t. rectifier (as the h.t. voltage was low). Now however the picture lacks interlace—the scanning lines are thick with wide spacing. All voltages are correct and the PCL82 field timebase valve has been replaced without any improvement being obtained. There is also about 1½in. foldover on the left of the picture.—R. Stuart (Dudley).

Interlace problems on older receivers are fairly common and are usually due to small changes in component values and poor design. The second section of the ECC83 acts as a field sync pulse amplifier with the grid biased by a potential divider consisting of R99 2.2M Ω to h.t. and R100 120k Ω to chassis. To improve the interlace replace R99 with a 1M Ω resistor in series with a 1M Ω potentiometer and

use this as a variable control to set up for best interlace. If this fails to give adequate range replace R98 1M Ω from the potential divider to the grid with a potentiometer as well. If neither of these gives any great variation in interlace there is almost certainly a component value change and the following components should be checked: C83 sync pulse feed to the PCL82, C84 sync pulse feed to the sync amplifier section of the ECC83, R97 the anode load of the latter and R107 in series with the field hold control. For the line foldover fault check the S-correction capacitor C60 and the harmonic tuning capacitor C62. If these are OK check the line output and boost diode valves. If these are OK the line output transformer is probably faulty.

GEC 2028

This colour receiver is suffering from lack of width. The line output valve has been replaced without improving matters.—R. Olwyn (Gloucester).

The usual cause of lack of width in the GEC/Sobell dual-standard colour receiver chassis is change of value of R704 5.6M Ω in series with the e.h.t. stabilising VDR701. Use a 2W type if this has to be replaced.

PHILCO 1036

When switched on from cold the picture breaks up immediately on both channels but after about ten minutes the fault corrects itself and the trouble is not experienced again until switching on from cold the following day. The tuner and video amplifier/sync separator (PCL84) valves have been replaced.—F. Smales (Torrington).

The probable cause of the picture breaking up before the set reaches normal operating temperature is low h.t. on switching on. Check at the output of the h.t. rectifier valve (PY32). If a rectifier change is necessary we would suggest the use of a silicon rectifier such as the BY127 with a 5 Ω 5W resistor in series and bridged by a 1,000pF capacitor—also short-circuit the heater pins on the base of the PY32 valveholder. If this should not happen to be the cause of the trouble check the second sync separator valve used in this set (V13 ECC82) and the line multi-vibrator valve (V12 ECC82).

PYE CTM17/S CONTINENTAL

The set has good sound but there is severe picture cramping in the form of a $\frac{3}{4}$ in. band across the centre of the screen. The PCL82 field timebase valve has been replaced without remedying the fault.—J. Crouch (Barnes).

The fault you describe is almost certainly due to a faulty capacitor and it is as well in this model to replace all those associated with the PCL82 as they are liable to become leaky giving rise to further trouble. The principal suspect is the coupling capacitor C53 (0.25 μ F) to the pentode output section but those associated with the linearity controls—C54 0.01 μ F and C55 0.1 μ F—may also be found to be at fault.

SOBELL ST196

The screen goes blank with the sound still present. If the set is switched off and allowed to cool down for about five minutes and then switched on again the picture comes back. The set may then be all right for a few hours or even several days but eventually the picture goes once more. The DY86 and PY800 have been replaced.—D. Newell (Doncaster).

If the line whistle stops completely when the fault occurs and the PL500 overheats replace the PCF80 line oscillator valve. If the PL500 does not overheat check that its screen feed resistor is correctly contacting (one end may be improperly contacting the panel) and check the PL500 (PL504) itself.

PHILIPS 19TG190A

There is an intermittent fault in the field timebase. After about twenty minutes a single white line appears across the screen though with the back off the fault takes about an hour to develop. The picture can be restored by pressing or rocking the EF80 on the timebase panel. This EF80 glows red when the white line appears.—F. Salmon (Carlyle).

The EF80 forms one half of the field multivibrator with the triode section of the PCL85. It will therefore overheat if the PCL85 stops working due to the removal of the working bias on it. Thus the fault could be in the PCL85, in the cross-coupling capacitors C427 and C429 or in the boost supply to the triode section of the PCL85. As far as the latter is concerned check the supply via the height control to pin 1 of the PCL85—the decoupler C414 to the h.t. line may be faulty here. Also check C428 the coupler to pin 2 of the PCL85 and the tracks between these various components.

QUERIES COUPON

This coupon is available until August 20, 1971 and must accompany all Queries sent in accordance with the notice on page 473. Don't forget the 10p postal order!

TELEVISION AUGUST 1971

TEST CASE



104

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.

? Symptoms of abnormally high hum level, mild bending of picture verticals and poor field lock on a Marconiphone Model 4603 led to the field technician setting out complete with a replacement main electrolytic. In spite of the replacement clearing the hum and picture bending however the field lock remained in error. After trying a new PCL85 and other valves which might affect the field lock, all to no avail, the set was brought into the workshop for more detailed investigation.

Here it was discovered that once the field was correctly locked on one channel it held without error until the channel was changed. To restore the lock careful readjustment of the hold control was then necessary after which the lock held again.

This alteration in field locking conditions with channel change could not be immediately related so tests of the smaller components of the field timebase

were made in an endeavour to find a clue. During this testing the anode of the field oscillator triode was inadvertently shorted to chassis while the set was running. This instigated the symptom, this time without channel changing but with the added symptom of reduced picture height. The height gradually increased to its original value but it was then found that the height control was almost fully advanced.

What component in the field circuit is most likely to be responsible for this effect and how could the symptom be affected by channel changing? See next month's TELEVISION for the solution and for a further Test Case item.

SOLUTION TO TEST CASE 103

Page 426 (last month)

Often overlooked is the voltage across the heater of the oscillator valve or indeed across the heaters of other valves in affected circuits. In the case in question the technician discovered that the heater voltage across the line oscillator valve was only about 4V for a while after the set had warmed up, gradually increasing with further rise in temperature.

It was this changing heater current effect which was responsible for the line frequency drift, but in some instances a valve further along the series-connected line might be responsible—not the valve of the stage in trouble!

The heater of course controls the electron emission, so in all obstinate cases an early test should be that of heater voltage with a good a.c. meter to check for a "slow" or partially shorting heater.

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

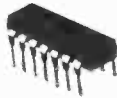
AC107 15p	AFI15 17p	BCI40 35p	BCY31 22p	BF272 80p	EC403 15p	ORP60 40p	2N918 30p	2N2714 25p	2N3704 15p
AC113 20p	AFI16 17p	BCI41 35p	BCY32 25p	BF273 30p	GE280 27p	ORP61 40p	2N929 22p	2N2904 25p	2N3705 12p
AC115 23p	AFI17 17p	BCI42 45p	BCY33 17p	BF274 30p	MAT100 15p	ST140 17p	2N930 25p	2N2904A 30p	2N3706 12p
AC125 17p	AFI18 30p	BCI43 40p	BCY34 20p	BF308 35p	MAT101 17p	ST141 17p	2N1131 20p	2N2905 25p	2N3707 13p
AC126 17p	AFI24 21p	BCI45 45p	BCY70 15p	BF309 37p	MAT120 15p	TIS43 40p	2N1132 22p	2N2905A 30p	2N3708 8p
AC127 17p	AFI25 20p	BCI47 17p	BCY71 30p	BF316 75p	MAT121 17p	UT46 27p	2N1302 17p	2N2906 25p	2N3709 8p
AC128 17p	AFI26 50p	BCI48 12p	BCY72 15p	BFW10 55p	MPF102 43p	V405A 25p	2N1303 17p	2N2906A 27p	2N3710 10p
AC141K 17p	AFI27 20p	BCI49 17p	BCZ11 20p	BFX29 27p	MPF105 43p	V410A 45p	2N1304 20p	2N2907 25p	2N3711 10p
AC142K 17p	AFI39 33p	BCI50 17p	BD121 85p	BFX84 20p	OC19 30p	2G301 19p	2N1305 20p	2N2907A 30p	2N3819 40p
AC151 15p	AFI78 50p	BCI51 20p	BD123 85p	BFX85 27p	OC20 50p	2G302 19p	2N1306 22p	2N2923 13p	2N3820 21p
AC154 15p	AFI79 50p	BCI52 17p	BD124 75p	BFX86 22p	OC22 30p	2G303 19p	2N1307 22p	2N2924 13p	2N3903 25p
AC155 17p	AFI80 50p	BCI53 27p	BD131 80p	BFX87 25p	OC23 33p	2G304 20p	2N1308 27p	2N2925 13p	2N3904 27p
AC156 17p	AFI91 50p	BCI54 30p	BD132 80p	BFX88 22p	OC24 45p	2G306 35p	2N1309 27p	2N2926 13p	2N3905 25p
AC157 17p	AFI86 45p	BCI57 20p	BDY20 21p	BFY50 20p	OC25 25p	2G308 35p	2N1613 17p	(G)	2N3906 27p
AC165 17p	AF239 37p	BCI58 17p	BF115 22p	BFY51 20p	OC26 25p	2G309 35p	2N1711 20p	2N2926 12p	2N4058 15p
AC166 17p	AFZ11 37p	BCI59 20p	BF117 45p	BFY52 15p	OC28 40p	2G339 17p	2N1889 35p	(Y)	2N4059 10p
AC167 20p	AFZ12 45p	BCI67 13p	BF118 60p	BFY53 17p	OC29 40p	2G339A 15p	2N1890 45p	2N2926 11p	2N4060 12p
AC168 20p	AL102 85p	BCI68 13p	BF119 70p	BSY19 15p	OC35 33p	2G344 15p	2N1893 25p	(O)	2N4061 12p
AC169 14p	AL103 85p	BCI69 13p	BF152 35p	BSX20 15p	OC36 40p	2G345 15p	2N2160 60p	2N3010 80p	2N4062 12p
AC176 23p	ASY26 25p	BCI70 12p	BF153 35p	BSY25 15p	OC41 20p	2G371 13p	2N2147 75p	2N3011 20p	2N5172 12p
AC177 20p	ASY27 30p	BCI71 13p	BF154 35p	BSY26 15p	OC42 22p	2G371B 10p	2N2148 60p	2N3053 20p	2N5459 43p
AC187 30p	ASY28 25p	BCI72 17p	BF157 45p	BSY27 15p	OC44 15p	2G374 17p	2N2192 30p	2N3054 50p	25304 75p
AC188 30p	ASY29 25p	BCI73 13p	BF158 25p	BSY28 15p	OC45 15p	2G377 15p	2N2193 30p	2N3055 6p	25301 25p
AC17 25p	ASY50 25p	BCI74 13p	BF159 30p	BSY29 15p	OC70 15p	2G378 15p	2N2194 27p	2N3391 17p	25302A 45p
AC18 20p	ASY51 25p	BCI75 22p	BF160 30p	BSY38 15p	OC71 9p	2G382 15p	2N2217 20p	2N3391A 20p	25302 45p
AC19 22p	ASY52 25p	BCI77 17p	BF162 30p	BSY39 15p	OC72 12p	2G401 30p	2N2218 25p	2N3392 17p	25303 60p
AC20 20p	ASY54 25p	BCI78 17p	BF163 35p	BSY40 30p	OC74 12p	2G414 30p	2N2219 27p	2N3393 15p	25304 11 10
AC21 20p	ASY55 25p	BCI79 17p	BF164 35p	BSY41 12p	OC75 15p	2G417 30p	2N2220 22p	2N3394 15p	25305 60p
AC22 19p	ASY56 25p	BCI80 20p	BF165 35p	BSY95 12p	OC76 15p	2N388 30p	2N2221 22p	2N3395 20p	25306 11 10
AC27 18p	ASY57 25p	BCI81 22p	BF167 22p	BSY95A 12p	OC77 25p	2N388A 50p	2N2222 27p	2N3402 22p	25307 11 10
AC28 19p	ASY58 25p	BCI82 10p	BF173 22p	BU105 15p	OC81 15p	2N404 22p	2N2268 17p	2N3403 22p	25321 60p
AC29 30p	ASY59 25p	BCI82L 10p	BF176 35p	CI75E 60p	OC81D 15p	2N404A 30p	2N2369 15p	2N3404 32p	25322 50p
AC30 20p	ASZ21 40p	BCI83 13p	BF177 35p	C400 30p	OC82 15p	2N459A 17p	2N2369A 15p	2N3405 45p	25322A 45p
AC31 25p	BC107 10p	BCI83L 10p	BF178 45p	C407 25p	OC82D 15p	2N527 60p	2N2411 50p	2N3414 50p	25323 60p
AC34 18p	BC108 10p	BCI84 13p	BF179 50p	C424 17p	OC83 20p	2N696 12p	2N2412 50p	2N3415 20p	25324 11 20
AC35 18p	BC109 11p	BCI84L 13p	BF180 30p	C425 40p	OC84 20p	2N697 15p	2N2616 55p	2N3417 7p	25325 11 20
AC36 30p	BC113 25p	BCI86 27p	BF181 30p	C426 30p	OC139 15p	2N698 24p	2N2711 22p	2N3425 74p	25326 11 20
AC40 15p	BC114 30p	BCI87 23p	BF182 30p	C428 20p	OC140 17p	2N699 55p	2N2712 22p	2N3702 12p	25327 11 20
AC41 18p	BC115 30p	BC207 11p	BF183 30p	C441 37p	OC170 15p	2N706 15p	2N2714 15p	2N3703 17p	
AC44 35p	BC116 35p	BC209 11p	BF184 25p	C442 35p	OC171 15p	2N706A 8p			
AD140 40p	BC117 35p	BC209 11p	BF185 30p	C444 37p	OC200 25p	2N708 12p			
AD142 40p	BC118 25p	BC212L 11p	BF188 30p	C450 17p	OC201 27p	1N709 45p	AA119 8p	BY130 15p	OA10 22p
AD149 43p	BC119 30p	BC219 11p	BF194 23p	C470 12p	OC202 37p	1N711 40p	AA120 8p	BY210 35p	OA17 7p
AD161 35p	BC125 35p	BC213L 11p	BF195 24p	C722 25p	OC203 25p	2N417 42p	BA116 22p	BY211 32p	OA70 7p
AD162 35p	BC126 35p	BC214L 12p	BF196 30p	C740 25p	OC204 25p	2N718 24p	BA126 22p	BY212 30p	OA79 8p
AD161 162(MP) 63p	BC132 25p	BC225 25p	BF197 35p	C742 17p	OC205 35p	2N718A 50p	BY100 15p	BY213 25p	OA81 7p
AD1740 50p	BC135 30p	BC226 35p	BF200 45p	C744 17p	OC309 35p	2N726 27p	BY101 12p	BY216 35p	OA85 7p
ADZ11 41	BC136 35p	BC317 12p	BF201 80p	C760 10p	P346A 17p	2N727 27p	BY105 15p	BY217 35p	OA90 6p
ADZ12 42 10	BC137 35p	BC318 12p	BF257 25p	C762 17p	P397 45p	2N743 17p	BY114 12p	BY218 30p	OA91 7p
AF114 17p	BC139 45p	BCY30 20p	BF270 25p	C764 60p	OCP71 43p	2N744 17p	BY126 15p	BYZ19 25p	OA95 7p
			BF271 17p	EC401 15p	ORP12 43p	2N914 17p	BY127 17p	OAS 17p	OA200 6p

DIODES & RECTIFIERS

74 Series T.T.L. I.C-s NOW LOWER THAN EVER PRICES GREATER RANGE

BI-PAK Semiconductors offer you the largest and most popular range of I.C.s available at these EXCLUSIVE LOW PRICES. TTL Digital 74N Series fully coded, brand new. Dual in-line plastic 14 and 16 pin packages.

BI-PAK Order No.	Similar Types to:-	Description	Price and qty. prices		
			1-24	25-99	100 up
BP00 = 7400		Quadruple 2-input NAND gate	5p	8p	5p
BP01 = 7401		Quadruple 2-input positive NAND gate (with open collector output)	0.23	0.20	0.15
BP02 = 7402		Quadruple 2-input positive NOR gates	0.23	0.20	0.15
BP03 = 7403		Quadruple 2-input positive NAND gates (with open-collector output)	0.23	0.20	0.15
BP04 = 7404		Hex inverters	0.23	0.20	0.15
BP10 = 7410		Triple 3-input positive NAND gates	0.23	0.20	0.15
BP13 = 7413		Dual 4-input Schmitt trigger	0.35	0.32	0.29
BP20 = 7420		Dual 1-input positive NAND gates	0.23	0.20	0.15
BP30 = 7430		8-input positive NAND gates	0.23	0.20	0.15
BP40 = 7440		Dual 4-input positive NAND buffers	0.23	0.20	0.15
BP41 = 7441		BCD to decimal nixie driver	0.87	0.77	0.67
BP42 = 7442		BCD to decimal decoder (4-10 lines, 1 of 10)	0.87	0.77	0.67
BP47 = 7447		BCD seven-segment decoder/drivers (15x outputs)	1.40	1.30	1.20
BP50 = 7450		Expandable dual 2-input and-or-invert	0.23	0.20	0.15
BP51 = 7451		Dual 2-wide 2-input and-or-invert gates	0.23	0.20	0.15



BP53 = 7453	Qual 2-input expandable and-or-invert	0.23	0.20	0.15
BP54 = 7454	4-wide 2-input and-or-invert gates	0.23	0.20	0.15
BP60 = 7460	Dual 4-input expander	0.23	0.20	0.15
BP70 = 7470	Single-phase J-K flip-flop	0.35	0.32	0.29
BP72 = 7472	Master-slave J-K flip-flop	0.35	0.32	0.29
BP73 = 7473	Dual master-slave J-K flip-flop	0.43	0.40	0.37
BP74 = 7474	Dual D type flip-flop	0.43	0.40	0.37
BP75 = 7475	Quad latch	0.47	0.45	0.43
BP76 = 7476	Dual J-K with pre-set and clear gated full adders	0.47	0.45	0.43
BP80 = 7480	16-bit read/write memory	0.87	0.77	0.67
BP81 = 7481	2-bit binary full adder	1.35	1.25	1.15
BP82 = 7482	Quad full adder	0.87	0.77	0.67
BP83 = 7483	Quad 2-input exclusive-or gates	0.80	0.70	0.60
BP86 = 7486	BCD decade counter	0.87	0.77	0.67
BP90 = 7490	x-bit shift registers	1.21	1.00	0.87
BP92 = 7492	Divide-by-two counters	0.87	0.77	0.67
BP93 = 7493	4-bit binary counters	0.87	0.77	0.67
BP94 = 7494	Dual entry 4-bit shift register	0.87	0.77	0.67
BP95 = 7495	4-bit up-down shift register	0.87	0.77	0.67
BP96 = 7496	5-bit parallel in parallel out shift register	1.10	1.00	0.90
BP100 = 74100	8-bit bistable latches	1.75	1.65	1.55
BP118 = 74118	Hex set-reset latches	1.30	1.20	1.00
BP121 = 74121	Monostable multivibrators	0.87	0.77	0.67
BP145 = 74145	BCD-to-decimal decoder/drivers	0.87	0.77	0.67
BP151 = 74151	BCD-to-decimal decoder/drivers	1.80	1.70	1.60
BP153 = 74153	8-bit data selectors (with strobe)	1.40	1.30	1.20
	Dual 4-line-to-1-line data selectors/multiplexers	1.40	1.30	1.20
BP191 = 74191	Binary counter reversible	3.50	3.25	3.00

PRICES-MIX. Devices may be mixed to qualify for quantity prices.
PRICE for quantities in excess of 500 pieces mixed, on application.
Data is available for the above Series of Integrated Circuits in booklet form, price 13p.

ANOTHER BI-PAK FIRST!

THE NEW S.G.S. EA 1000 AUDIO AMPLIFIER MODULE
* Guaranteed not less than 3 Watts RMS.

Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA/621 providing unlimited applications for the enthusiast in the construction of radios, record players, Audio and Stereo units. Also ideal for intercom systems, monitoring applications and phone answering machines. **OTHER USES:** portable applications where supply rails as low as 9V are of prime importance.

- Sensitivity 40 mV for 1 watt. VOLTAGE GAIN 40 dB but can be varied up to 73 dB for low applications.
- Signal to Noise Ratio 86 dB
- Frequency response better than 50 Hz to 25 KHz for -3 dB.
- Normal supply Voltage 9-24V.
- Suitable for 8-16 Ohm loads.
- Overall Size 2 in. x 3 in. x 4 in.

- Typical Total Harmonic distortion at 1 watt less than 1%
 - * Supply Voltage (Vs) = 24V 15 ohm load. Modular Tested and Guaranteed.
 - Qty. 1-9 10-25 Price each £63 £2.28
- Larger quantities quoted on request. Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.



All prices quoted in new pence Giro No. 388-7006
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE - HERTS

Postage and packing add 7p.
Overseas add extra for airmail.
Minimum order 50p. Cash with order please.

Guaranteed Satisfaction or Money Back

TELEVISION CLASSIFIED ADVERTISEMENTS

The pre-paid rate for classified advertisements is 4p a word (minimum 12 words), box number 7½p extra. Semi-display setting £2.50 per single column inch. All cheques, postal orders, etc., to be made payable to TELEVISION and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post*. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, TELEVISION IPC Magazines Ltd., Fleetway House, Farringdon Street, London, EC4A 4AD, for insertion in the next available issue.

EDUCATIONAL

TRAIN FOR SUCCESS WITH ICS

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

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

ICS, DEPT. 560, INTERTEXT HOUSE, STEWARTS ROAD, LONDON S.W.8.

ENGINEERS—get a technical certificate. Exam and Certificate Postal Courses in all branches of Engineering, Electronics, Radio and TV. Computers, Draughts, Building, etc. Write for helpful **FREE BOOK: BIET** (Dept. 171K), Aldermaston Court, Reading, RG7 4PF.

BECOME "Technically Qualified" in your spare time, guaranteed certificate and exam Home Study courses in Radio, TV, servicing and maintenance. R.T.E.B., City & Guilds, etc., highly informative **FREE Guide**.—Chambers College (Dept. 858K), Aldermaston Court, Reading, RG7 4PF.

RADIO AND TV Exams and Courses by Britain's finest home study School. Coaching for Brit.I.R.E., City and Guilds Amateur's Licence, R.T.E.B., P.M.G. Certificate, etc. Free brochure from British National Radio School, Russel Street, Reading.

MEN! You can earn £50 p.w. Learn Computer Operating. Send for **FREE** brochure—London Computer Operators Training Centre, C98 Oxford House, 9-15 Oxford Street, London, W.1.

FULL TIME COURSES in ELECTRONICS and TELEVISION. These are nine-month courses, starting next September, which lead to City and Guilds certificates. Extensive laboratory work is included, and there are, in most cases, no fees for those under 18 at enrolment. Full details from Section 48, Electrical and Electronic Engineering Department, Southall College of Technology, Beaconsfield Road, Southall, Middx.

LADDERS

VARNISHED TIMBER LADDERS from manufacturer, **LOWEST PRICES** anywhere: 15½ ft ext. £6.20; 17 ft ext. £6.50; 20 ft ext. £7; 21½ ft ext. £7.75; 24½ ft ext. £8.90; 29 ft ext. £10.25; 31½ ft triple ext. £12.25; 36 ft triple ext. £16. Carr. 80p. Free Lists. Also Aluminium Ext. and Loft Ladders. **CALLERS WELCOME.** Dept. PTT, HOME SALES, BALDWIN ROAD, STOURPORT, WORCS. Phone 02-993 2574/5222. Placing order on C.O.D.

FOR SALE

625/405 VHF/UHF IF Panels. B.R.C. 850 series. Ideal for components, IF transformers and switching, P/C Valve bases or repairs to this Thorn receiver. £1.75 each plus 22½p p.p. **WILLOW VALE**, 4 The Broadway, Hanwell, W.7.

"METRIX" WOBULATOR Type 210. 5 to 220 MHz. Sweep width 1 to 20MHz, full instruction manual, £30.00. **HAYTER**, 149 Valley Road, Solihull, Warks. Tel. 021 743 5684.

TWO Labgear Transistorised crosshatch Generators Type E.5180.A. As new, in good working order. Cost £75 each—£50 o.n.o. Box Number 90.

MISCELLANEOUS

RECORD TV sound using our loud-speaker isolating transformer. Provides safe connection to recorder. Instructions included. 70p plus 10p P&P. **Crowborough Electronics (T)**, Eridge Road, Crowborough, Sussex.

"MULLARD 25" A63-11X Colour Tube. Perfect £45. One only. **LES-MAR**, 15 Conholt Road, Andover, Hants.

17" BBC/ITV TELEVISIONS £5

Working Perfectly.
Plus P. & P. £1 CWO.

Suitable for any area.

3 Channel 19" D/S TVs. ITV, BBC 1, BBC2, £25 inc. carriage. 17" 13 Channel, Complete but untested £1.50 each plus £1 P. & P. CWO.

SPEAKERS

6" x 4", 7" x 4" 3Ohm, 20p plus 8p P. & P. each, CWO.

Regular deliveries throughout England & N. Ireland

TRADE TV'S

407 Thornton Road, Gillington, Bradford 8, Yorks.

WANTED

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

SERVICE SHEETS purchased. **HAMILTON RADIO**, 54 London Road, Bexhill.

WANTED! Bush TV set between model TV 66 and 95—17" with 13 channel tuner, set used 30L15 RF amp. and had 3 vis. IF stages. **EDGOOSE**, 8 Sandringham Road, Walton, Peterborough.

WANTED. Radio and TV Servicing 64-65. **GOOD PRICE PAID.** Mackenzie, P.O. Buildings, Lochinver, Sutherland.

WANTED (continued)

100 PYE TV11 or similar urgently required complete in clean cabinets. Write Box 89.

NEWNES R. & T. Servicing, 1963-64, 1964-65. Also Valve Tester. Cash. 4 Cavendish Place, Bath.

TOP PRICES PAID

for new valves, popular TV & Radio Types

KENSINGTON SUPPLIES

(A), 367 Kensington Street
Bradford 8, Yorks

SERVICE SHEETS

RADIO, TELEVISION, over 3,000 models. **JOHN GILBERT TELEVISION**, 1b Shepherds Bush Road, London, W.6. SHE 8441.

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

TRADER SERVICE SHEETS

30p each plus postage

We can supply Trader Service Sheets for most makes and types of Radios, Tape Recorders and Televisions—Manuals for some.

Cheques and open P.O.s returned if sheets not available.

OAKFIELD ENTERPRISES

LIMITED
29 CHURCH ROAD,
TUNBRIDGE WELLS, KENT

Make	Model	Radio/TV

1971 List now available at 10p plus postage

If list is required indicate with X

From.....

Address.....

enclose remittance of.....

(and a stamped addressed envelope)

s.a.e. with enquiries please

MAIL ORDER ONLY (May T)

SERVICE SHEETS (continued)

Service Sheets & Manuals

LARGE RANGE OF MODELS AVAILABLE FOR RADIO, TELEVISION, TAPE RECORDERS, R PLAYERS, ETC.

FROM 25p EACH S.A.E. WITH ENQUIRIES PLEASE 1971 LISTS ARE AVAILABLE 13p

MULLARD TRANSISTOR AUDIO AND RADIO CIRCUITS	PRICE £1-63p	} Post free
T.V. FAULT FINDING BOOK by DATA PUBLICATIONS LTD	55p	
MULLARD VALVE & SEMI CONDUCTOR DATA BOOK	23p	
MAZDA VALVE & PICTURE TUBE DATA BOOKLET	23p	
BRIMAR VALVES & TELE TUBE DATA LIST	23p	
RESISTOR COLOUR CODE INDICATOR DISC	13p	

Sets of Brand New Valves supplied for most makes of Radio T.V. etc. Prices on request.

BELL'S TELEVISION SERVICES
 Albert Place Harrogate Yorkshire Tel 0423-86844

LARGE SUPPLIER of SERVICE SHEETS

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

Only 25p each. Manuals from 50p

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

Otherwise cannot be attended to.

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

C. CARANNA

71 BEAUFORT PARK,
LONDON, N.W.11

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

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

MAIL ORDER ONLY

SERVICE SHEETS

(1925-1971) for Radios, Televisions, Transistors, Radiograms, Car Radios, Tape Recorders, Record Players, etc. By return post with

FREE FAULT FINDING GUIDE

PRICES FROM 5p

Over 8,000 models available.
Catalogue 13p.

Please send stamped addressed envelope with all orders and enquiries.

Hamilton Radio

54 London Road, Bexhill, Sussex

QUICK, EFFICIENT, UNIQUE SERVICE SHEET SERVICE

Very Large Stock

TVs, Radio, Amps, Test Gear.

Special Telephone Service available to

Trade Customers.

Colour TV and Test Gear Circuits.

Exchange Service.

Full details and List Free with first order.

State Make and Model Number.

Large S.A.E. and 25p unfilled P.O.

Mail Order Only.

**A.L.S., 111 Dudden Hill Lane,
London, N.W.10.**

SERVICE SHEETS with Free Fault Finding Chart 35p, plus stamped addressed envelope. LESMAR, 15 Conholt Road, Andover, Hants.

AERIALS

BAKER and BAINES

UHF AERIALS—BBC, ITA, BBC2 all from one aerial

All aerials come complete with tilt clamp and will fit up to a 2 inch mast.

POSTAGE PAID INLAND

8 element £1-90 — 10 element £2-10

14 element £2-35 — 18 element £3-25

22 element £3-75

UHF Pre-Amps, high gain, low noise, completely self contained with 9 volt battery. Group A, B and C available. Battery model £3-75. Mains £5-87½.

Postage 12½p.

Low loss co-ax 625 type 11p per yard. Aerial lashing kits — poles — diplexers, etc., SAE will bring full lists

11 Dale Crescent, Tupton, Chesterfield

ABSURD REDUCTIONS

UHF AERIALS AT COST

EG. 9ele. £1-00

21ele. £2-00

Orders for £20-00 and over Delivered

Free. Otherwise plus postage 32½p.

Terms: CWO, COD

Please state channel

HIGHCLIFFE ELECTRONICS,

48 Highcliffe Road, Tamworth, Staffs.

Phone 021 743 2395

Direct from the
Manufacturers

U.H.F. AERIALS

in
EASY ASSEMBLY KITS

10 Element **SAVE 40%**
£1-25 on normal retail price

14 Element 18 Element
£1-50 £1-75

Ready assembled add 20p.
allow 32½p. carriage and packing.
Please state which channels or group

APEX AERIALS (T.V.)

ALBAN WORKS, MARY ST., JOHNSTONE, RENFREWSHIRE



SETS & COMPONENTS

TOP 20 TV Valves, 10p; PL504, PL36, PY33, 15p. P&P 4p per valve, over 12 valves post free. Guaranteed tested ex-equipment, individually boxed. Resistors and capacitors all values and sizes. Leading manufacturers components and hi-fi equipment, 10% or more off. 13A plugs, 12p. Mains fuses, 20p for 10. Tools, etc., P&P extra on all items. Trade enquiries welcomed, discount for quantity. S.A.E. for list. L & D Components Ltd., 71 Westbury Avenue, Wood Green, N.22. 01-888 2701.

120 NEW ASSORTED Capacitors, Electrolytic, Mica, etc., and Resistors, 1/20W, 85p. Post Free. Whitsam Electrical, 33 Drayton Green Road, London, W.13.

TELEVISION TUBE SHOP

BRAND NEW TUBES AT
REDUCED PRICES

A28-14W (A28-13W) ..	£12-75
A31-18W	£12-50
A47-11W	£9-95
A47-13W	£12-50
A47-14W	£7-75
A47-26W	£10-75
A50-120WR	£12-50
A59-11W	£12-95
A59-13W	£13-50*
A59-15W	£9-95
A59-16W	£13-50*
A59-23W	£14-75
A61-120WR	£16-00
AW36-20, 36-21	£5-75
AW36-80	£5-75
AW43-80	£6-50
AW43-88, 43-89	£6-75
AW47-90, 47-91	£7-50
AW53-80	£7-50*
AW53-88, 53-89	£8-25
AW59-90, 59-91	£9-00
C17LM, 17PM, 17SM ..	£6-50
CME1101	£12-00
CME1201	£12-50
CME1402	£5-75
CME1601	£10-50
CME1602	£12-00
CME1702, 1703	£6-75
CME1705	£7-75
CME1901, 1903	£7-50
CME1906	£12-50
CME1908	£7-75
CME2013	£12-50
CME2101, 2104	£8-25
CME2301, 2302	£9-00
CME2305	£14-75
CME2306	£13-50*
CME2308	£9-95
CME2413R	£16-50
CRM93	£5-50*
CRM124	£5-50
CRM141, CRM142	£5-50
CRM171, CRM172	£6-50
CRM211, CRM212	£7-50*
MW36-24, 36-44	£5-50
MW43-69	£6-75
MW43-80	£6-75
MW53-20, 53-80	£7-5*
TSD217, TSD282	£14-00†
13BP4 (Crystal 13) ..	£14-00†

†Rebuilt tubes also, at £7-00

*These types are FULLY rebuilt.

ALL TUBES ARE TESTED AND GUARANTEED FOR A MINIMUM OF 12 MONTHS

ADD 75p FOR CARRIAGE AND INSURANCE

COLOUR TUBES

19 in. and 22 in. having slight marks or scratches at £35 each

TELEVISION TUBE SHOP

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

AERIAL BOOSTERS £2-95 EACH

We make four types of transistorized aerial pre-amplifiers. These take only seconds to install.

1. **L45 625 TELEVISION (U.H.F.).**

2. **L12 405 TELEVISION (V.H.F.).**

Please state channel numbers.

3. **L11 V.H.F. F.M. RADIO.**

4. **L10 WIDEBAND RADIO.**

This covers M/W and S/W to 20 MHz.

PRICE EACH

L45, L12 and L11 £2-95; L10 £1-95.

S.A.E. FOR DETAILS

MONEY BACK GUARANTEE

P. & P. 10p

VALVE BARGAINS

Any 1—10p, 5—45p, 10—70p.

EB91, EBF89, ECC82, EY86, ECL80, EF80, EF85, EF183, EF184, PCC84, PCC89, PCC189, PC97, PCF80, PCF86, PCF800, PCL82, PC97, PCL84, PCL85, PL36, PL81, PL83, PY32, PY33, PY81, PY82, PY800, PY801, 30FL1, 30F5, 30L15, 30C15, 6F23, 6-30LZ.

TESTED, WITH 3 MONTH GUARANTEE VALVES 20p EACH

BY100 TYPE RECTIFIERS with Surge-resistor on bracket, 12½p each.

MAINS DROPPERS 3 SECTIONS 33z-33z 33z 9p each.

VELCO ELECTRONICS

62 Bridge Street, Ramsbottom, Bury, Lancs. Tel. 3036

T.V. SPARES

OIL FILLED MURPHY LOFT's U26 type. Model number not known. £1-25 each plus 25p p.p.

BAIRD/FERGUSON V.H.F. TUNERS. Uses PC97 and 30C18 valves. Fits 620 to 650 series models, complete with all coils, supplied less valves, £1-75 each plus 25p p.p.

BRC 960 I.F. PANELS. Complete and unused, less valves. Dual standard V.H.F./U.H.F. 405/625. Absolute bargain at £2-50 plus 25p p.p.

FERGUSON/EKCO PLUG IN MAINS LEADS. Moulded two-pin connector type. 6 for £1-50 plus 25p p.p.

LATE G.E.C./SOBELL 625 405, etc. Dual Standard 405/625 I.F. Panels, complete with switching for direct replacement in this popular Radio and Allied receiver. £1-75 plus 25p p.p.

TIMEBASE PANELS to fit Sobell 195, 282, 283, 284, 285, 286, 287, 288 (and DS models), McMichael 111762, 763, 765, P405. Complete and new for direct replacement, £1-75 each plus 25p p.p.

V.H.F. ROTARY TUNER UNITS to fit McMichael, Sobell, G.E.C. New and unused, £1-75 each plus 25p p.p.

FERGUSON 800/850 series TIMEBASE PANELS, complete and unused in original packing. £2-25 each, plus 25p p.p.

SCAN COILS, 110° type will fit most makes, after modification. Originally manufactured for Pye but we have used them in BRC, Philips, etc. with good results. £1-50 plus 25p p.p.

WILLOW VALE ELECTRONICS LTD.

4 & 5 The Broadway
Hanwell, London, W.7

Tel: 01-567 2971 and 5400
01-579 3582

Terms cash with order or C.O.D. 27½p extra
S.A.E. all enquiries. Catalogue 20p

WITWORTH TRANSFORMERS LTD.

Dept. P.T., 236 SANDYCOMBE ROAD,
RICHMOND,
SURREY.

Telephone: 01-940 8146. 9 a.m. till 5 p.m.

TELEVISION LINE OUTPUT TRANSFORMERS

PRACTICALLY ANY MAKE OR MODEL
SUPPLIED OR REWOUND

EKCO, FERRANTI, DYNATRON
Replacement cases £1-00 each, please state model.

S.A.E. for return of post quotation.
TERMS: Cash with order or C.O.D., please add 20p for postage.

C.O.D. orders will be charged 30p extra.
Transformers fully guaranteed. (98)

NEW! Continuous range High-Gain Pre-Amplifier 40-900 mHz. Television, Radio, Stereo all bands including colour! Precision made in neat case. Fixed in seconds, no modifications. aerial connection only. Suberb value at £7-75p. Post paid to anywhere in U.K. S.A.E. for Leaflet. Johnsons (Radio), St. Martin's Gate, Worcester.

NEW MOSTLY BVA VALVES! Huge range by post service well known to the trade. Brief list of television types herewith, full list S.A.E. All types ex stock!

DY86/7	43p	PCF86	63p	PY82	50p	20L1	95p
EB91	25p	PCF801/2	62p	PY800/1	50p	20P4	£1-00
ECC82	42p	PCF805	87p	R19	85p	30C15	90p
ECL80	50p	PCF808	85p	U25	95p	30C17	95p
EF80	42p	PCL82	51p	U26	95p	30F5	95p
EF85	45p	PCL83(S)	60p	U37	75p	30FL1 & 2	65p
EF183/4	57p	PCL84	60p	U191	90p	30L15	95p
EH90	55p	PCL805/85	66p	U193	48p	30L17	90p
EY51	60p	PCL86	66p	U251	95p	30P12	95p
EY86/7	43p	PL36/8	87p	U301	90p	30PL1	90p
PC86 & 8	75p	PL81	80p	U801	£1-25	30P4MR	£1-25
PC97	45p	PL83	85p	6/30L2	90p	30P19	87p
PC900.	55p	PL84	65p	6AT6	55p	30PL13	£1-00
PCC84	50p	PL50	90p	6BW7	82p	30PL14/5	£1-10
PCC89	62p	PL504	90p	6CD6G	95p	etc., etc.	
PCF80	52p	PY81	50p	6F23	95p	Trade prices	

POST FREE OVER £3-00, 2½p PER VALVE BELOW £3-00

LATEST NEW BY100/127 type silicon rectifier 15p, 33Ω res 5p!

Large bulb Imported PCF80 32p! **Note.** Ask for separate component and Philips PCL805/85 57p!

LOOK! Nearly every type in stock now !!

NEW TELEVISION TUBES!

TWO YEAR FULL REPLACEMENT GUARANTEE

SEE THE DIFFERENCE A NEW TUBE CAN MAKE TO YOUR VIEWING—
LATEST SCREENING TECHNIQUES INCLUDING TINTED SCREENS ON
MOST 19" and 23" TYPES

Large stocks by British leading manufacturers, why buy cheap rebuilds. Two year warranty!

COLOUR! FOUR (yes 4) years guarantee: 19" £49-00; 22" £53; 25" £57.
Enquiries welcomed.

Special offer! 19" mono rebuilds, 2 year guarantee £5-50! 23" £7-50
12" £3-00 (not 110°) 20" 14" to 16" (not 110°) £4-75
17" £5-87 A50/120W £10-50

19" mono tubes—all £6-87. Carriage all 60p. All 21" mono tubes—£7-87
23" mono tubes £9-50. Carriage 75p, also 24" and 25" available.

Prices on application. Quality before price!

RIMBANDS, 19" £8-50; 23" £11-50 } Carriage

TWIN PANELS, 19" & 23" £10-12 & £15-00 } 75p

Bulk enquiries welcomed. GIRO 34.361.4006

PHILIP H. BEARMAN

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

6 POTTERS ROAD, NEW BARNET, HERTS.

Closed Thurs. & Sat. afternoons
(Adjacent to Post Office)

TEL. 01-449/1934 & 1935
(Robophone)

SETS & COMPONENTS (continued)

SOUTHERN VALVE COMPANY (Valve specialists)

44 Earls Court Road, London, W.8

ALL valves boxed and brand new, some BVA1 Send s.a.e. for free lists.

DY87 37p	PC868 50p	PCL805 44p	U193 35p	30L17 75p
DY802 45p	PC97 40p	PCL86 37p	U251 62p	30P12 70p
EB91 15p	PCF80 32p	PL36 52p	6/30L2 60p	30PL1 60p
ECC81 37p	PCF86 52p	PL81 46p	6BW7 60p	30P4MR 95p
ECC82 30p	PCF801 50p	PL84 55p	6CD6G 90p	30P19 70p
ECL80 40p	PCF802 50p	PL500/4 65p	6F23 75p	30PL13 75p
EF80 27p	PCF805 50p	PY81 35p	6F28 48p	30PL14 75p
EF183 37p	PCF808 60p	PY800 35p	20L1 85p	etc., etc.
EF184 37p	PCL82 37p	PY801 35p	20P4 90p	
EH90 45p	PCL83(s) 50p	U25 65p	30C15 70p	
EY51 50p	PCL84 37p	U26 60p	30FL12 75p	
EY86/7 37p	PCL85 44p	U191 65p	30L15 75p	

Post free £2.00 and over. Mail order only.

[932]

VALVES, VALVES, VALVES

Any ten of your choice 72½p, post 5p.
100 £5.50, post paid.

EF85, EF80, EB91, EBF89, ECL80, EF183, EY86, PCF80, PCC84, PL36, PY81, PCL82, PCL83, PCC89, PY33, PY82, PY800, PY801, PY88, PCL84, 30F5, 6BVV7, PY801.

BOB'S,

2 St. James Street, Rawtenstall
Rossendale, Lancs.
Mail order ONLY.

PORTABLE TELEVISIONS

Battery or Mains. We stock over eleven different models. BIG Money Saving Offers. Trade supplied with Full Trade Discounts. All enquiries with S.A.E. please.
Ross Electrics,
1 Church Street, Ainsworth, Bolton.
21408 51956.

TELEVISIONS. Fantastic Reductions. 100 Guaranteed Sets £5 to £10. New Portables BAT/MAINS £48-£50 (Save £21). New UHF 23" £55! Transistor Radios, Record Players at Trade Prices! All Eagle Equipment—Huge Discounts. T.V. Bargain Centre, 47 Goldhawk Road, Shepherd's Bush, W.12. 01-743 3050. Open till 7 pm.

TOWERBY LTD

For Line Outputs and Deflector Coils

We have the Country's largest stock of Manufacturer's Original (or Authorised Replacement) Line Output Transformers for many "difficult" makes, including Ambassador, Baird, Cossor, Decca, Dynatron, Ekco, Ferguson, G.E.C., H.M.V., K.B., Masteradio, Peco-Scott, Philips, Regentone, RGD, Sobell, Ultra, etc. Also deflector coils output and oscillator transformers, inc. Alba, Bush, Murphy, Examples, L.O.P.T. Murphy 350/410/540/659/759, £7.35; Bush, TV80, TV95, TV96, £7.35; Cossor 950, £3.87; Ferguson 306/308, £3.97; Philips 1768U L.O.P.T. assembly, £6.75; Ultra 1984-200c, £5.06. Rewind most L.O.P.T., £4.50.

SPECIAL OFFER

Ekco improved type for Models T221, 231, 310, all at £2.25; Ferranti 14T4 series inserts, £1.25; Philco 1019/1021, £2.62. Terms: C.W.O. or C.O.D. (17½p), post-packing 30p; 2 or more L.O.P.T.s post-packing free.
All enquiries answered but regret no lists available. Same day delivery on most types.

TOWERBY LTD

MAIL ORDER DIVISION OF T.C.S. LTD.
70 STREATHAM HILL, LONDON, SW2
Tel.: 01-674 2185.

EX RENTAL T.V.s.

17" Semi-Slim (90 degree tube).....	£2
17" 21" Slimline (110 degree tube).....	£5
19" Slimline.....	£8
19" 3-channel sets.....	£15

All T.V.s. sold complete but unserviced, 12-channel tuners, good cabinets, plus carriage £1.

PERFECT SPEAKERS EX T.V.

PM 3 ohm (minimum order two) 5" round, 8" by 2" rectangular—12½p each. Add 7½p per speaker postage and packaging.

VALVES EX EQUIPMENT

EB91 5p	30L15 12½p	PCL82 17½p	6F23 17½p
EBF89 12½p	30P4 12½p	PL36 22½p	30P12 20p
ECC82 12½p	PC97 17½p	PL81 17½p	30F5 10p
EF80 12½p	PCF86 17½p	PY81 15p	30L17 17½p
EF85 12½p	PC84 7½p	PY800 15p	30FL1 12½p
EF183 12½p	PCF80 7½p	PY82 7½p	30P19 20p
EF184 12½p	PCC89 12½p	PY33 22½p	
EY86 17½p	PCL85 22½p	U191 17½p	

Add 2½p per valve P. & P. Orders over £1 P. & P. free.

UHF TUNERS

TO SUIT FERGUSON 850 900 CHASSIS
£2.50 p. & p. 50p

SLOT METERS

Smiths 6L2p Switchmaster Mk. II £1 including P. & P. £8 for 10 delivered.

Dept. T.S.

THORNBURY TRADE DISPOSALS

Thornbury Roundabout, Leeds Rd., Bradford.
Telephone 665670

SPARES

available from second-hand TVs. Transformers, Valves, etc. S.A.E. your enquiries. Complete 19-in. TVs, untested, from £5 plus £1.50 carriage.

LINAVALLE RADIO LTD.,

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

LARGE quantities of used TV spares for most models, 1952-64. Lopts, Tuners IF Strips, Time Base Panels Scan Coils, Frame Transformers, Knobs, cabinet Trim, etc. New manufacturers replacement parts, can be supplied, for more modern sets on receipt of an order deposit. S.A.E. for quotations. C.W.O. to TV Dismantlers, Foxhole, Whitstone, Holsworthy, Devon.

R & R RADIO

51 Burnley Road, Rawtenstall

Rossendale, Lancs

Tel.: Rossendale 3152

TESTED VALVES—
3 MONTHS' GUARANTEE

EBF80 15p	PCC84 15p	PY800 17½p
EBF89 17½p	PCF80 15p	PY801 17½p
ECC82 15p	PCL82 20p	U191 22½p
ECL80 15p	PL36 25p	30C15 25p
EF80 10p	PY33 25p	PCF86 25p
EF85 15p	PY81 17½p	PCL85 25p
EY86 20p	PY82 15p	PCL84 25p

Copper Laminate Board, for etching, 1p per sq.in. Double sided 1½p per sq.in. Any size cut, min. order 50p plus 10% P. & P.

Postage on Valves: one valve 4p, up to 6 2½p, over 6 post paid.

LOW NOISE HI-STABS

½ watt 5%, all E24 values 3 for 2p plus p. & p. 6p up to 30 resistors — 1p for each additional 5p.

POWER SECTIONS

7 to 20Ω	22 to 36Ω	at 7A
40 to 100Ω	120 to 270Ω	at 15A
—	720Ω	at 15A
300 to 500Ω	—	at 12A
1KΩ	—	at 1A
—	2KΩ	at 0.7A
20p ea.	25p ea.	

p. & p. 3p per section.

REPLACEMENT DROPPERS

37 — 31 — 97 — 26 — 168Ω	50p
14 — 26 — 97 — 173Ω	50p
30 — 125 — 2.85KΩ	50p

p. & p. 7p ea.

FREE CATALOGUE p. & p. 3p

CHROMASONIC ELECTRONICS

56 Fortis Green Rd., London, N10 3HN

THE SHORT CUT TO SMOOTHER MOTORING

Are you proud of your car? Can you keep her looking and behaving like new? Can you rely on her on your travels, shopping trips, holidays, summer outings?

PRACTICAL MOTORIST is the magazine with all the answers. Helps you keep your car in good working order and get maximum pleasure from your days at the wheel. Helps to save you £££ by showing you how to do most of the routine maintenance and simple repairs yourself.

PRACTICAL MOTORIST 15p

Britain's widest-read motoring monthly

BENTLEY ACOUSTIC CORPORATION LTD.

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

0A2	0.30	6B36	0.40	6SA7GT	0.35	12BA6	0.30	30P12	0.89	ACU/PEN-38	DL96	0.38	RCC86	0.40	EL81	0.50	KT76	0.63	PCH200	0.62	Q875/20	0.63	UY1N	0.50
0B2	0.30	6BQ5	0.38	6SA7	0.35	12BB6	0.30	30P16	0.31	AC2/PEN7	DL99	0.30	RCC88	0.35	EL83	0.38	KT81	2.00	PCL82	0.33	Q8150/15	0.63	UY21	0.55
0Z4	0.23	6BQ7A	0.38	68G7GT	0.33	12D17	0.27	30P18	0.31	D. D. 93	DM71	0.38	RCC189	0.48	EL84	0.23	KT88	1.70	PCL84	0.35	Q8150/15	0.63	UY31	0.38
1A3	0.23	6BR7	0.79	68H7	0.79	12E1	0.85	30P19	0.31	AC/PEN7	DM4	0.38	RCC190	0.57	EL85	0.40	KTW61	6.30	PCL84	0.35	Q8150/15	0.63	UY45	0.27
1A3GT	0.35	6BR8	0.63	68LA7	0.35	12J1GT	0.33	30P4	0.60	0.98	0.98	0.98	RCC191	1.35	EL86	0.40	KTW62	0.62	PCL80/85	0.85	Q8150/15	0.63	UY47	0.83
1A5GT	0.35	6BR8T	1.25	68K7GT	0.23	12K3	0.50	30PL1	0.61	AC/TH1	0.50	DY86	7.08	EL87	0.50	LN119	0.34	PCL86	0.40	R10	0.75	U12/14	0.38	
1D5	0.38	6BW6	0.72	68Q7GT	0.23	12K7GT	0.34	30PL12	0.33	AC/TP	0.98	DY802	0.48	EL88	0.32	LN152	0.33	PCL88	0.67	R11	0.85	U16	0.75	
1D6	0.48	6BW7	0.57	6U4GT	0.60	12Q7GT	0.28	30PL13	0.78	AL60	0.78	DY807	0.50	EL89	0.40	LN189	0.60	PCL800	0.78	R17	0.88	U18/20	0.75	
1FD1	0.35	6BZ6	0.33	6U7G	0.57	12S7GT	0.43	30PL14	0.67	ARF3	0.35	DY808	0.38	EL90	0.32	LN199	0.60	PCL801	0.61	R18	0.50	U19	0.75	
1G6	0.30	6C6	0.19	6V6G	0.17	12S7GT	0.43	30PL15	0.89	ARF3	0.35	DY809	0.38	EL91	0.32	LN219	0.29	PEN43	0.35	R20	0.59	U25	0.65	
1H3GT	0.33	6C9	0.73	6V6GT	0.31	12S7GT	0.23	35A3	0.50	ATP4	0.12	DY810	0.30	EL92	0.38	LN219	0.29	PEN43	0.35	R21	0.59	U25	0.65	
1L4	0.13	6CDH6	1.09	6X4	0.32	12S7GT	0.23	35A3	0.75	AZ1	0.40	E1R0F	0.95	EL93	0.35	LN219	0.29	PEN43	0.35	R22	0.59	U25	0.65	
1LD5	0.40	6CH6	0.43	6X6GT	0.25	12S7GT	0.15	35A3	0.70	AZ1	0.48	E1R0F	1.13	EL94	0.35	LN219	0.29	PEN43	0.35	R23	0.59	U25	0.65	
1LN5	0.40	6CL6	0.43	6Y6G	0.55	12S7GT	0.23	35L6GT	0.42	B36	0.33	E1R0F	0.95	EL95	0.35	LN219	0.29	PEN43	0.35	R24	0.59	U25	0.65	
1N5GT	0.37	6CW4	0.63	6Y7G	0.63	12S7GT	0.23	35Z3	0.50	B39	0.17	E1R0F	0.95	EL96	0.35	LN219	0.29	PEN43	0.35	R25	0.59	U25	0.65	
1R5	0.27	6D6	0.19	7B6	0.58	12S7GT	0.23	35Z4GT	0.24	B39	0.31	E1R0F	0.95	EL97	0.35	LN219	0.29	PEN43	0.35	R26	0.59	U25	0.65	
1R4	0.24	6E1	0.57	7B7	0.58	14H7	0.48	35Z5GT	0.30	B39	0.31	E1R0F	0.95	EL98	0.35	LN219	0.29	PEN43	0.35	R27	0.59	U25	0.65	
1R5	0.29	6E8	0.83	7C6	0.30	14H7	0.15	30B5	0.35	B39	0.31	E1R0F	0.95	EL99	0.35	LN219	0.29	PEN43	0.35	R28	0.59	U25	0.65	
1U4	0.29	6E8G	0.25	7H7	0.28	14H7	0.15	30B5	0.35	B39	0.31	E1R0F	0.95	EL100	0.35	LN219	0.29	PEN43	0.35	R29	0.59	U25	0.65	
1U5	0.48	6F6	0.33	7H7	0.28	19A4Q5	0.44	30C5	0.32	B39	0.31	E1R0F	0.95	EL101	0.35	LN219	0.29	PEN43	0.35	R30	0.59	U25	0.65	
2D21	0.35	6F14	0.44	7R7	0.25	19H11	2.00	30C6	0.17	B39	0.31	E1R0F	0.95	EL102	0.35	LN219	0.29	PEN43	0.35	R31	0.59	U25	0.65	
3A4	0.20	6F26	0.63	7V7	0.25	20D1	0.65	30L6GT	0.45	B39	0.31	E1R0F	0.95	EL103	0.35	LN219	0.29	PEN43	0.35	R32	0.59	U25	0.65	
3B7	0.25	6F28	0.45	7Z4	0.50	20F2	0.68	35A2	0.43	CY6	0.53	E1R0F	0.95	EL104	0.35	LN219	0.29	PEN43	0.35	R33	0.59	U25	0.65	
3D6	0.19	6E25	0.70	8A4	0.50	20L1	0.98	35A3	0.40	CY6	0.53	E1R0F	0.95	EL105	0.35	LN219	0.29	PEN43	0.35	R34	0.59	U25	0.65	
3Q4	0.38	6P24	0.68	8B6W	0.50	20L1	0.98	35A3	0.40	CY6	0.53	E1R0F	0.95	EL106	0.35	LN219	0.29	PEN43	0.35	R35	0.59	U25	0.65	
3Q6GT	0.35	6E25	0.60	9D7	0.78	20P1	0.88	30A6	0.38	CY1	0.32	E1R0F	0.95	EL107	0.35	LN219	0.29	PEN43	0.35	R36	0.59	U25	0.65	
3R4	0.27	6E28	0.70	10C1	1.25	20P3	0.84	30A7	0.38	D77	0.11	E1R0F	0.95	EL108	0.35	LN219	0.29	PEN43	0.35	R37	0.59	U25	0.65	
3V4	0.32	6E32	0.15	10C2	0.20	20P4	0.91	30B3	0.20	D77	0.11	E1R0F	0.95	EL109	0.35	LN219	0.29	PEN43	0.35	R38	0.59	U25	0.65	
3V4GT	0.53	6H6GT	0.13	10C14	0.31	20P5	1.00	30C7	1.68	DAC2	0.33	E1R0F	0.95	EL110	0.35	LN219	0.29	PEN43	0.35	R39	0.59	U25	0.65	
3Y4G	0.38	6Z4	0.19	10I1	0.50	25A6G	0.29	30C1	0.59	DAC2	0.33	E1R0F	0.95	EL111	0.35	LN219	0.29	PEN43	0.35	R40	0.59	U25	0.65	
3Y6GT	0.28	6J54GT	0.29	10D2	0.75	25L6G	0.22	150B2	0.58	DAC2	0.33	E1R0F	0.95	EL112	0.35	LN219	0.29	PEN43	0.35	R41	0.59	U25	0.65	
5Z3	0.45	6J6	0.18	10P1	0.75	25Y5	0.38	150C2	0.30	PD4	0.53	E1R0F	0.95	EL113	0.35	LN219	0.29	PEN43	0.35	R42	0.59	U25	0.65	
5Z4C	0.35	6J7C	0.24	10P3	0.45	25Y5G	0.43	301	1.00	PD3	0.37	E1R0F	0.95	EL114	0.35	LN219	0.29	PEN43	0.35	R43	0.59	U25	0.65	
6B0L2	0.57	6J7GT	0.38	10P2	0.20	20P4	0.91	30K3	1.70	PD7	0.11	E1R0F	0.95	EL115	0.35	LN219	0.29	PEN43	0.35	R44	0.59	U25	0.65	
6A80	0.33	6K7C	0.10	10L11	0.53	20Z1G	0.30	302	0.63	PD9	0.35	E1R0F	0.95	EL116	0.35	LN219	0.29	PEN43	0.35	R45	0.59	U25	0.65	
6A87	0.15	6K7GT	0.23	10L13	0.54	20Z2G	0.43	303	0.83	PD9	0.35	E1R0F	0.95	EL117	0.35	LN219	0.29	PEN43	0.35	R46	0.59	U25	0.65	
6AK5	0.25	6K8C	0.18	10L14	1.10	30C1	0.29	306	0.65	PD6	0.30	E1R0F	0.95	EL118	0.35	LN219	0.29	PEN43	0.35	R47	0.59	U25	0.65	
6AK5	0.25	6L1	0.98	10L18	0.32	30C15	0.62	807	0.59	PD7	0.28	E1R0F	0.95	EL119	0.35	LN219	0.29	PEN43	0.35	R48	0.59	U25	0.65	
6AK6	0.30	6L6GT	0.39	12A6	0.63	30C17	0.79	1821	0.53	PD7	0.28	E1R0F	0.95	EL120	0.35	LN219	0.29	PEN43	0.35	R49	0.59	U25	0.65	
6AM6	0.17	6L7	0.63	12A6G	0.40	30C18	0.63	9763	0.53	PD8	0.28	E1R0F	0.95	EL121	0.35	LN219	0.29	PEN43	0.35	R50	0.59	U25	0.65	
6AQ5	0.24	6L18	0.45	12A16	0.40	30F3	0.70	6080	0.50	PD8	0.28	E1R0F	0.95	EL122	0.35	LN219	0.29	PEN43	0.35	R51	0.59	U25	0.65	
6AR6	1.00	6L17	1.38	12A26	0.48	30F11	0.62	7193	0.53	PD9	0.35	E1R0F	0.95	EL123	0.35	LN219	0.29	PEN43	0.35	R52	0.59	U25	0.65	
6AT6	0.30	6L20	0.48	12A76	0.23	30F12	0.75	7475	0.70	DK40	0.55	1.00	E1R0F	0.95	EL124	0.35	LN219	0.29	PEN43	0.35	R53	0.59	U25	0.65
6AV6	0.21	6N7GT	0.40	12A77	0.17	30F12	0.71	A1831	1.00	DK91	0.27	1.00	E1R0F	0.95	EL125	0.35	LN219	0.29	PEN43	0.35	R54	0.59	U25	0.65
6AV6	0.30	6P28	0.59	12A76	0.22	30F14	0.70	A2134	0.98	DK92	0.41	0.98	E1R0F	0.95	EL126	0.35	LN219	0.29	PEN43	0.35	R55	0.59	U25	0.65
6B8G	0.13	6Q7	0.43	12A77	0.20	30L1	0.31	A3942	0.78	DK96	0.36	1.00	E1R0F	0.95	EL127	0.35	LN219	0.29	PEN43	0.35	R56	0.59	U25	0.65
6B6A	0.21	6Q7G	0.30	12A76	0.28	30L13	0.80	AC244	1.18	DL33	0.35	1.00	E1R0F	0.95	EL128	0.35	LN219	0.29	PEN43	0.35	R57	0.59	U25	0.65
6B6B	0.22	6R7	0.55	12A77	0.28	30L17	0.71	AC2/PEN	DL92	0.27	1.00	E1R0F	0.95	EL129	0.35	LN219	0.29	PEN43	0.35	R58	0.59	U25	0.65	
6B6B	0.43	6R7G	0.35	12A77	0.68	30F4MR	0.98	0.98	DL94	0.32	1.00	E1R0F	0.95	EL130	0.35	LN219	0.29	PEN43	0.35	R59	0.59	U25	0.65	

Learn at home... First Class Radio and TV Courses



After brief, intensely interesting study—undertaken at home in your spare time—**YOU** can secure a recognised qualification or extend your knowledge of Radio and T.V. Let us show you how.

FREE GUIDE

Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. Chambers College provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & C. Telecoms., A.M.S.E. (Elec.). Guide also gives details of range of certificate courses in Radio/TV Servicing, Electronics and other branches of engineering, together with particulars of our remarkable terms of Satisfaction or refund of fee

Write now for your copy of this valuable publication. It may well prove to be the turning point in your career.

Founded 1885 Over 150,000 successes

CHAMBERS COLLEGE
(Incorp. National Inst. of Engineering)
(Dept. 844V) Aldermaston Court, Reading, RG7 4PF

NEW RANGE U.H.F. - TV - AERIALS

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

Loft Mounting Array: 7 element, £2.25; 11 element, £2.62; 14 element, £3.00; 18 element, £3.50. **Wall Mounting with Cranked Arm:** 7 element, £3.25; 11 element, £3.75; 14 element, £4.12; 18 element, £4.50. **Chimney Mounting Arrays, Complete:** 7 element, £4.11 element, £4.37; 14 element, £4.75; 18 element, £5.25

Complete assembly instructions with every aerial. Low loss co-axial cable, 8ip yd. King Boosters-Labgear U.H.F. Boosters from £3.75. Belling Lee 'Concord' all Band V.H.F./U.H.F. mains operated pre-amp., £7.50. State clearly channel number required on all orders. P.p.: Aerials, 40p; accessories, 15p. C.W.O. or C.O.D.

BBC - ITV - FM AERIALS

BBC (Band 1): Loft, £1.25; wall S.D., £1.02; 'H' array, £3.00. **ITV (Band 3):** 5 element loft array, £2.25; 7 element, £2.75; wall mounting, 5 element, £3.25. **Combined BBC/ITV:** Loft, 1+5, £2.75; 1+7, £3.37; wall mounting 1+5, £3.87; chimney mounting 1+5, £4.50. Pre-amps from £3.75. **Combined BBC/ITV BBC2 Aerials:** 1+5+9, £4.00; 1+5+9+14, £5.00. Available loft only.

FM Radio: Loft S/D, 97ip; 'H', £1.92; 3 element array, £2.87. Standard co-axial cable, 5p yd. Co-ax plugs, 8ip. Outlet boxes, 30p. Diplexer crossover boxes, 87ip. P.p.: Aerials, 40p; accessories, 15p; C.W.O. or C.O.D. (min. C.O.D. charge 17p). 5p for fully illustrated lists.

CALLERS WELCOMED.
OPEN ALL DAY SATURDAY.

K.V.A. ELECTRONICS (Dept. P.T.)
40-41 Monarch Parade
London Road, Mitcham, Surrey
01-648 4884

Vary the strength

T.V. TUBES "VIDEOCHROME" T.V. TUBES

FOR BRILLIANCE & DEFINITION



- 17" £5-00
- 19" £5-50
- 21" £7-00
- 23" £7-50

- 19" PANORAMA £6-25
- 23" PANORAMA £8-25

CASH OR CHEQUE WITH ORDER

TRADE SUPPLIED

ALL TUBES PRECISION REBUILT AT OUR OWN FACTORY BY SKILLED CRAFTSMEN ● EACH TUBE BENCH AND SET TESTED TO A VERY HIGH STANDARD BEFORE DESPATCH

2 YEARS GUARANTEE ● FREE DELIVERY ANYWHERE IN THE U.K.

VIDEOCHROME TUBES LTD.
25 BELLEVUE AVENUE
RAMSGATE, KENT. Tel. THANET 52914

REBUILT TELEVISION TUBES

STANDARD TYPES:

- 17" £5-00 21" £6-50
- 19" £5-50 23" £7-50

'PANORAMA' & 'RIMGUARD' TYPES:

- 19" £7-00 23" £9-00

TWIN PANEL or BONDED FACE TYPES:

- 19" £7-50 23" £10-00

Carriage & Insurance: 75p extra for standard tubes; £1-50 extra rimguard and twin panel types.

- ★ Complete new gun fitted to every tube.
- ★ Two years' guarantee.
- ★ Colour Tubes—please advise types for quotation.
- ★ Trade enquiries invited.
- ★ 14 years experience in tube rebuilding.

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

UHF. COLOUR AND TELEVISION SPARES

COLOUR PLESSEY SCAN COILS £5-75 p.p. 35p, CONVERGENCE COILS £3-80 p.p. 25p, BLUE LATERAL £1-25 p.p. 9p, or Complete Set £10 p.p. 50p, MULLARD TYPE SCAN COILS £3-50 p.p. 35p, CONVERGENCE COILS £1-75 p.p. 25p, LUMINANCE/CHROMINANCE PANEL £1 p.p. 25p, INTEGRATED TRANSISTORISED DECODER UNIT including Circuits £1-25 p.p. 10p, LINE OUTPUT TRANSFORMER including EHT and FOCUS ASSEMBLY £4-50 p.p. 35p. (Shop customers only, assortment Colour Panels of various makes). ALSO COLOUR TV CAMERA UNITS.

COLOUR TV MONITOR PANELS Designed to highest BBC standards. PAL filter & delay £8-00, Chrominance £8-00, Luminance £4-50, Encoded Video Input £2-50 incl. circuit, p.p. 30p. UHF 625 conversion kits and tuners available at reduced prices. Lists available.

UHF integrated transistd. 6 position push button tuners, leading British makers surplus £4-50 p.p. 35p. Transistd. IF panels (salvaged) £2-50 p.p. 25p.

MURPHY 600/700 series UHF conversion kits in cabinet plinth assembly can be used as separate UHF receiver £7-50 p.p. 50p. 625 IF amplifier incl. 5 valves and circuit £3 p.p. 35p.

SOBELL/GEC Dual 405/625 IF amp and o/p chassis incl. circuit £1-50 p.p. 30p. ULTRA 1980 C to 2384 625 IF amp & switch incl. circuit £1-50 p.p. 30p. PHILIPS 625 P/C IF panel incl. circuit £1 p.p. 25p. GEC 2015 Series Dual 405/625 IF Panel incl. circuit data £1-95 p.p. 30p.

UHF tuners transistd. incl. S/M drive or push button £5-25 Valve type, cyldon £1-75 p.p. 25p.

EKCO/FERRANTI UHF tuner kit, incl. valves, slow motion drive, knobs, leads, aerial panel £5-50 p.p. 30p.

TV SIGNAL BOOSTER UNITS Latest PYE/LABGEAR all station UHF/VHF transistd. "Set back" mains operated £5-90 UHF Masthead £4-25, Power Unit £3-25 pp. 25p.

FIREBALL TUNERS Ferg., HMV, Marconi, New £1-90 p.p. 25p. PUSH BUTTON Plessey, Ekco, Ferranti £1-50 pp. 25p.

TURRET TUNERS, AB Dual Standard Suitable Ferguson, Baird, KB etc. 75p, Cyldon C 75p, Ferguson MT7 £2-75, GEC 2018/9 £4-50 p.p. 25p. Large selection channel coils.

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

- | | | | |
|---|-------|------------------------|-------|
| MURPHY 470 to 530 (oilfilled) .. | £3-75 | Bush TV75/85 .. | £2-50 |
| MURPHY 849 to 939 .. | £4-50 | Bush TV95/99 .. | £2-50 |
| PHILIPS 17TG100 Range .. | £3-50 | BUSH 141, 148, 15KV .. | £2-50 |
| STELLA 1011/1029 .. | £3-50 | Murphy 149. .. | £2-50 |
| PHILIPS 1GTG11/12 .. | £4-00 | 159, 15KV .. | £2-50 |
| 121 to 155 .. | £4-50 | REG 10-6, 10-17 .. | £2-50 |
| PHILIPS 19TG170, 210 series .. | £4-50 | REG 191, 192, 17-18 .. | £2-50 |
| BUSH TV53 to 69 £1-75 105 to 135 .. | £4-50 | RGD 610, 711 .. | £2-50 |
| EKCO 221 to 331 (U25 or U26) .. | £3-50 | RGD 619, 620 .. | £2-50 |
| FERRANTI 1001/19 (U25 or U26) .. | £3-50 | | |
| EKCO 342 to 394, FERRANTI 1021 to 1065 .. | £3-75 | | |
| EKCO, FERRANTI 418, 1093 etc. DECCA DM17, 3, 4 (70); DR95, 101/606 .. | £3-50 | | |

- | | |
|--|-------|
| LOPT Inserts p.p. 15p | |
| Alba 655, 656 .. | £1-75 |
| Bush 125 to 135 (Round Tag Panel) .. | £2-50 |
| Cossor 933 to 950 .. | £1-75 |
| Ekco TP308 .. | £1-75 |
| Emerson 700/711 .. | £1-75 |
| KB, NF70, OV30, PV40, PVP20, QV10, 20, 30 .. | £1-75 |
| KB/RGD VCII .. | £2-50 |
| KB/RGD VC1-9 .. | £1-75 |
| Murphy 849 to 939 (Round Tag Panel) .. | £2-50 |
| Philco 1961, 1030 series .. | £1-75 |
| Philips 17TG100 range .. | £1-75 |
| Pye, VT4, VT7 .. | £2-15 |
| RGD D17, 590 to 619 .. | £1-75 |
| REG 10-4, 10-17 to 192 .. | £1-75 |
| Ultra 1770, 1780 .. | £1-75 |

PRACTICAL TV 625 RECEIVER Integrated push button transistorised tuner .. £4-50 p.p. 25p Transistorised IF panel .. £4-75 p.p. 25p 850 line output transformer .. £3-75 p.p. 25p 850 field output transformer .. £1-62 p.p. 15p 850 scan coils .. £3-90 p.p. 25p (p.p. on complete set of 5 items 50p)

VALVE BASES B9D for PL500 series and colour 121p p.p. 5p SPECIAL OFFER Leading British makers surplus 625 single standard 625 TV chassis, latest design, almost complete, includes transistorised IF stages, frame and line time bases, transformers, etc., incl. circuit £8-65 p.p. 50p.

MANOR SUPPLIES

172 WEST END LANE, LONDON, N.W.6
(Near W. Hampstead tube stn.; 28, 59, 159 Bus Routes) 01-794 8751
MAIL ORDER: 64 GOLDERS MANOR DRIVE, LONDON, N.W.11
Staff Holidays: Aug. 16th to 30th

In just 2 minutes, find out how you can qualify for promotion or a better job in Engineering . . .

That's how long it will take you to fill in the coupon below. Mail it to B.I.E.T. and we'll send you full details and a free book. B.I.E.T. has successfully trained *thousands* of men at home – equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost B.I.E.T. Home Study Course gets results fast – makes learning easier and something you look forward to. There are no books to buy and you can pay-as-you-learn on 'SATISFACTION – OR REFUND OF FEE' terms. If you'd like to know how just a few hours a week of your spare time, doing something constructive and enjoyable, could put you out in front, post the coupon today. No obligation.

WHICH SUBJECT WOULD INTEREST YOU?

Mechanical
A.M.S.E. (Mech.)
Inst. of Engineers
Mechanical Eng.
Maintenance Eng.
Welding
General Diesel Eng.
Sheet Metal Work
Eng. Inspection
Eng. Metallurgy
C. & G. Eng. Crafts
C. & G. Fabrication

Draughtsmanship
A.M.I.E.D.
Gen. Draughtsmanship
Die & Press Tools
Elec. Draughtsmanship
Jig & Tool Design
Design of Elec. Machines
Technical Drawing
Building

Electrical & Electronic
A.M.S.E. (Elec.)
C. & G. Elec. Eng.
General Elec. Eng.
Installations & Wiring
Electrical Maths.
Electrical Science
Computer Electronics
Electronic Eng.

Radio & Telecomms.
C. & G. Telecomms.
C. & G. Radio Servicing
Radio Amateurs' Exam.
Radio Operators' Cert.
Radio & TV Engineering
Radio Servicing
Practical Television
TV Servicing
Colour TV
Practical Radio & Electronics (with kit)

Auto & Aero
A.M.I.M.I.
MAA/IMI Diploma
C. & G. Auto Eng.
General Auto Eng.
Motor Mechanics
A.R.B. Certs.
Gen. Aero Eng.

Management & Production
Computer Programming
Inst. of Marketing
A.C.W.A.
Works Management
Work Study
Production Eng.
Storekeeping
Estimating
Personnel Management
Quality Control
Electronic Data Processing
Numerical Control
Planning Engineering
Materials Handling
Operational Research
Metrication

Constructional
A.M.S.E. (Civ.)
C. & G. Structural
Road Engineering
Civil Engineering
Building
Air Conditioning
Heating & Ventilating
Carpentry & Joinery
Clerk of Works
Building Drawing
Surveying
Painting and Decorating.
Architecture
Builders' Quantities

General
C.E.I.
Petroleum Tech.
Practical Maths.
Refrigerator Servicing.
Rubber Technology
Sales Engineer
Timber Trade
Farm Science
Agricultural Eng.
General Plastics

General Certificate of Education
Choose from 42 'O' and 'A' Level subjects including:
English
Chemistry
General Science
Geology
Physics
Mathematics
Technical Drawing
French
German
Russian
Spanish
Biology
B.I.E.T. and its associated schools have recorded well over 10,000 G.C.E. successes at 'O' and 'A' level.
WE COVER A WIDE RANGE OF TECHNICAL AND PROFESSIONAL EXAMINATIONS.

Over 3,000 of our Students have obtained City & Guilds Certificates. Thousands of other exam successes.

THEY DID IT— SO COULD YOU

"My income has almost trebled . . . my life is fuller and happier."—Case History G/321.

"In addition to having my salary doubled, my future is assured."—Case History H/493.

"Completing your Course meant going from a job I detested to a job I love."—Case History B/461.

FIND OUT FOR YOURSELF

These letters—and there are many more on file at Aldermaston Court—speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help you.

Free!

Why not do the thing that really interests you? Without losing a day's pay, you could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). We'll send you full details and a FREE illustrated book. No obligation and nobody will call on you . . . but it could be the best thing you ever did.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Dept B1 Aldermaston
Court, Reading RG7 4PF.

(Write if you prefer not to cut this page)



BIET

POST THIS COUPON TODAY

To: B.I.E.T., Dept B1, Aldermaston Court, Reading RG7 4PF
Please send me book and details of your Courses in

Name..... Age.....

Address.....

Occupation.....