

# TELEVISION

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

20p

OCTOBER  
1971

## 20MHz (IC) PULSE SCALER/SIGNAL GENERATOR



**ALSO** - TROUBLE-TRACING CHART  
- SECRETS OF THE SONY COLOUR RECEIVER  
405 SOUND IF AND GATED AGC CIRCUITS FOR  
THE CONSTRUCTOR

# STEPHENS

**ELECTRONICS,  
24 PARTON ROAD,  
AYLESBURY, BUCKS.**

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## GUARANTEED VALVES BY THE LEADING MANUFACTURERS BY RETURN SERVICE 1 YEAR'S GUARANTEE ON OWN BRAND, 3 MONTHS' ON OTHERS

AZ31 50p	ECF80/2 47p	EL803 85p	PCC85 42p	FY88 50p	UL41 57p	6AR5 32p	6EJ7 35p	68K7 32p	12BE6 32p	30PL1 77p
AZ50 60p	ECH85 55p	EL180 75p	PCC88 70p	FY88 41p	UL84 50p	6AR6 52p	6EW6 60p	68L7GT 32p	12BH7 32p	30PL13 90p
CHL1 80p	ECH85 55p	EL180 75p	PCC88 70p	FY88 41p	UL84 50p	6AR5 35p	6E1 70p	68N7GT 30p	12BY7 50p	30PL14 85p
CHL31 85p	ECH42 68p	EM34 80p	PCC189 81p	PZ30 80p	UY41 40p	6A87G 80p	6PS 40p	68R7 40p	12K35 50p	35A3 55p
CY31 35p	ECH81 51p	EM71 62p	PCF80 51p	QQU02-622-10 80p	UY85 34p	6AT6 45p	6P6G 25p	68R7 37p	12K7GT 35p	35A5 65p
DAF91 41p	ECH83 40p	EM80 40p	PCF82 52p	QQU03-10 21-25	U26 75p	6AU6 29p	6F11 32p	6T8 32p	12Q7G 25p	35B5 65p
DAF96 41p	ECH84 47p	EM81 42p	PCF84 47p	QV03-12 85p	U91 72p	6BA6 47p	6F12 22p	6T4GT 62p	12SC7 25p	35C5 35p
DF91 40p	ECL80 40p	EM84 37p	PCF86 61p	QV03-12 85p	U191 41p	6BE6 40p	6F13 35p	6U8 35p	12SH7 35p	35D5 85p
DF96 45p	ECL82 45p	EM87 65p	PCF200/1 81p	R19 85p	U193 41p	6BE6 42p	6F15 55p	6V6GT 32p	12SHT 25p	35L6GT 47p
DK91 57p	ECL83 57p	EM91 32p	PCF801 61p	R20 75p	U301 85p	6BH6 42p	6F18 40p	6X3GT 27p	12SHT 25p	35W4 25p
DK96 57p	ECL86 40p	EY51 40p	PCF802 61p	SU2150A 75p	W729 55p	6BL6 42p	6F18 40p	6X3GT 27p	12SHT 25p	35Z3 55p
DL92 37p	ECLL800 40p	EY80 45p	PCF805 65p	TT21 22-40	Z759 21-22p	6BK7A 50p	6F22 32p	6X8 50p	12SL7GT 40p	35Z4G 25p
DL94 37p	EY10 51-50	EY81 40p	PCF806 61p	TT22 22-50	OA2 32p	6BL8 35p	6F23 77p	6Y6G 60p	12SN7GT 40p	35Z5GT 37p
DL96 40p	EF39 22-50	EY83 55p	PCF808 67p	U18/20 67p	OA3 45p	6BN5 42p	6F24 67p	7Y4 60p	12SN7GT 40p	50A5 65p
DM70 32p	EF80 40p	EY86 40p	PCP200 70p	U20 67p	OB2 32p	6BN6 40p	6F25 75p	9PW6 42p	12SR7 32p	50B5 35p
DY967 40p	EF83 50p	EY87 42p	PCL82 51p	U25 75p	OB3 50p	6BN5 42p	6F26 35p	10C2 50p	1487 50p	50C5 35p
E7802 42p	EF85 41p	EY88 42p	PCL83 61p	U26 75p	OC3 35p	6BR7 75p	6F28 70p	10D1 40p	20D1 45p	50L6GT 40p
E55L 22-75	EF86 60p	EZ35 27p	PCL84 51p	U31 45p	OD3 32p	6BR8 82p	6F29 32p	10D2 40p	20L1 51-00	85A1 80p
E88CC 40p	EF89 40p	EZ40 45p	PCL85 52p	U37 21-50	Q34 40p	6BRW6 82p	6F30 35p	10F1 90p	20P1 50p	85A2 37p
E130L 24-50	EF91 42p	EZ41 45p	PLC86 51p	U50 30p	384 35p	6BW7 89p	6J4 47p	10F9 50p	20P3 60p	90AU 22-40
E180F 40p	EF92 50p	EZ40 27p	PD500 21-52p	U52 30p	3V4 40p	6BX6 25p	6J5GT 30p	10F18 40p	20P4 21-00	90C1 60p
EA BC80 52p	EF93 47p	EZ41 27p	PFL200 74p	U76 25p	5R4GY 55p	6BZ6 32p	6J7 42p	10L1 40p	20P5 21-00	90C2 21-25
EA BC90 40p	EF94 47p	EZ40 30p	PL82 61p	U78 25p	5U4G 30p	6C4 30p	6K7 50p	10L1D11 55p	25C5 45p	807 47p
EBC33 55p	EF95 62p	GS10C 25-00	PL83 61p	U91 40p	5Y3GT 37p	6C4R 21-50	6CGT 32p	10P14 55p	25G2GT 37p	811A 21-50
EBC41 47p	EF183 55p	GY501 80p	PL81 51p	U201 35p	5V4G 40p	6CD6G 21-50	6K8G 32p	10P14 55p	25G2GT 37p	812A 32-25
EBC51 32p	EF184 35p	GZ30 30p	PL81A 51p	U281 40p	5Y3GT 30p	6CA4 27p	6K23 50p	12AB5 50p	25Z6GT 50p	86A 23-75
EBC90 47p	E280F 22-10	GZ31 30p	PL82 38p	U282 40p	5Z3 45p	6CA7 52p	6K25 75p	12AC6 37p	30A5 40p	86A4 70p
EBF80 40p	EF800 50p	GZ32 47p	PL83 51p	U301 57p	5Z4GT 40p	6CBC 27p	6D6GT 45p	12AD6 37p	30A6 40p	86A5 60p
EBF83 40p	EF804 21-00	GZ33 60p	PL84 41p	U403 50p	6B03L2 75p	6CD9GA 21-50	6L7 32p	12AD6 37p	30A7 40p	86A6 60p
EBF89 40p	EF811 75p	GZ34 40p	PL85 41p	U404 32p	6B4R 32p	6D6 41p	6L8 30p	12A15 40p	30A8 40p	86A7 60p
EB91 28p	EL34 52p	HK90 32p	PL86 85p	U404 32p	6B4R 32p	6D6 41p	6L9 30p	12A15 40p	30A9 40p	86A8 60p
EC53 50p	EL36 47p	HL92 35p	PL505 21-45	UAB080 52p	6A67 37p	6C6L 50p	6N7GT 35p	12AT6 25p	30F5 75p	86A9 60p
EC86 60p	EL41 55p	HL94 40p	PL508 21-00	UBF89 40p	6A66 50p	6CW4 62p	6P1 60p	12AU6 75p	30FL1 75p	86B4 60p
EC88 80p	EL42 57p	K766 21-37	PL509 21-54	UBC41 49p	6A78 29p	6CY5 40p	6P25 21-05	12AV6 30p	30FL2 92p	86B5 60p
EC90 30p	EL41 50p	K788 21-68	AW53-88 21-00	UCC85 46p	6AK5 57p	6C0 40p	6P28 60p	12AV6 30p	30FL3 50p	86B6 60p
EC92 32p	EL43 41p	N78 60p	AW39-96 21-00	UCH42 69p	6AK6 57p	6Q7 37p	6Q7 37p	12AV7 45p	30FL4 77p	86B7 60p
EC93 47p	EL85 42p	PABC80 40p	Y33 82p	UCH81 54p	6AL3 48p	6D6 41p	6R7G 35p	12AX7 30p	30FL5 75p	86B8 60p
EC98 40p	EL86 42p	PC86/8 51p	Y80 32p	UCL82 51p	6AL5 16p	6DK6 48p	6S2 40p	12AX7 30p	30FL6 75p	86B9 60p
EC98/2 42p	EL90 32p	PC95 38p	Y81 41p	UCL83 61p	6AM5 25p	6D6B 60p	6S4 55p	12AY7 67p	30FL7 85p	86C0 60p
EC98/3 42p	EL91 35p	PC97 38p	Y800 41p	UF41/2 51p	6AM6 25p	6DS4 75p	6S4 55p	12BA4 50p	30FL8 85p	86C1 60p
EC98/4 52p	EL95 35p	PC97 41p	Y801 41p	UF80/5 37p	6AQ5 32p	6EA8 55p	6S7 37p	12BA6 32p	30FL9 85p	86C2 60p
EC98/5 52p	EL96 31-15	PCC84 46p	Y82 35p	UF89 41p	6AQ6 50p	6EH7 32p	6S7 37p	12BA7 32p	30FL10 85p	86C3 60p

### CATHODE RAY TUBES

New and Budget tubes made by the leading manufacturers. Guaranteed for 2 years. In the event of failure under guarantee, replacement is made without the usual time wasting forms.

Type	New £	Budget £	Type	New £	Budget £
MW36-20	24-50	24-50	A50-120W/R	CME2013	21-85
MW36-21	24-50	24-50	AW53-80	CME2101	22-93
MW43-69Z	CRM171	24-82	AW53-88	CME2101	22-93
	CRM172	24-82	AW39-96	CME22303	22-58
MW43-80Z	CRM173	24-82	AW59-91	CME22303	22-58
	CME1702	24-82	A59-15W	CME22301	27-20
	CME1703	24-82		CME22302	
	CME1706	24-82	A59-11W	CME22303	29-58
	C17A	24-82	A59-13W	CME22306	21-35
	C17AA	24-82	A59-16W	CME22306	21-35
	CME1705	24-82	A59-23W	CME22305	21-80
AW43-88			A59-23W/R	CME22401	21-80
AW47-90			A61-120W/R	CME22413	21-50
AW47-91	A47 14W	25-95	A62-11W	CME22501	21-50
AW47-94	CME1901	25-95	<b>COLOR TUBES</b>		
A47 14W	CME1902	25-95	A49-191X	19 inch	252-50
	CME1903	25-95	A56-120X	22 inch	257-50
	C19AH	25-95	A63-11X	25 inch	262-50
147 13W	CME1906	210-27	<b>PORTABLE SET TUBES</b>		
A47-11W	CME1905	28-96	TSD217	21-50	
A47-26W	CME1906	28-96	TSD282	21-50	
A47-26W/R	CME1913R	29-33	A28-14W	29-16	Not supplied
			CME1601	27-75	
			CME1602	28-00	

A discount of 10% is also given for the purchase of 3 or more tubes at any one time. All types of tubes in stock. Carriage and insurance 75p anywhere in Britain.

### TRANSISTORISED UHF TUNER UNITS NEW AND GUARANTEED FOR 3 MONTHS

Complete with Aerial Socket and wires for Radio and Allied TV sets but can be used for most makes. Continuous Tuning, 24-50; Push Button, 25-00.

### SERVICE AIDS

Switch Cleaner, 55p; Switch Cleaner with Lubricant, 55p; Frezza 62p. P. & 7p per item.

### PLUGS

Jack Plugs and Sockets Co-Axial Plugs  
Standard Plugs 19p Belling Lee (or similar type) 61p  
Standard Sockets 12p Add 2p per doz. p. & p.

### LINE OUTPUT TRANSFORMERS

G.E.C. BT454	24-75	G.E.C. 2028	24-75
G.E.C. BT456	24-75	G.E.C. 2041	24-75
G.E.C. 2010	24-75	G.E.C. 2000 Series	24-75
G.E.C. 2013	24-75	Philips 19TG	24-75
G.E.C. 2014	24-75	Pye Mod. 36	24-75
G.E.C. 2018	24-75	Pye Mod. 40	24-75
G.E.C. 2043	24-75	Thorn 800-850	24-75
G.E.C. 2048	24-75		

### STYLII-BRITISH MANUFACTURED

All types in stock.  
Single Tip "S" 13p Double Tip "S" 33p  
Single Tip "D" 37p Double Tip "D" 47p  
"S" = Sapphire "D" = Diamond

## CARTRIDGES

Inc. P.T.	each	B.S.R.	Inc. P.T.	each	RONETTE	Inc. P.T.	each
ACOS							
GP79	20-63	X3M S/S			105 S/S		
GP91-18c-1	21-05	X3M S/S	21-50	106 S/S	90p		
GP91-28c	21-05	X5M S/S		DC400 S/S	70p		
GP91-38c	21-05	SX5M S/S	22-00	DC400S S/S	70p		
Suitable to replace		SX5H S/S		105 D/S	21-11		
TC8		SX5M D/S	22-10	106 D/S	21-11		
GP92	21-32	SX5H D/S		DC400 D/S	84p		
GP93-1	21-24	X4N D/S	22-50	DC400S D/S	84p		
GP94-1	21-55						
GP94-5	21-80						
GP95	21-24	850	22-95	STA D/S	21-35		
GP96	21-57	8800	29-35	BTA D/S	22-05		
ACOS		8800E	215-00	BTAH D/S	22-05		
104 1-10	22-09	8800 Super E	219-50				

## SEMICONDUCTORS BRAND NEW MANUFACTURERS MARKINGS NO REMARKED DEVICES

2N388A	69p	SN3704	23p	AF116	25p	BC118	33p	BF115	25p	T1843	40p
2N697	20p	SN3705	20p	BF117	25p	BC134	50p	BF117	48p		
2N698	25p	SN4061	23p	AF118	60p	BC135	P/A	BF167	35p	DIODES & RECTIFIERS	
2N706	13p	SN4062	23p	AF124	13p	BC139	P/A	BF167	25p	RECTIFIERS	
2N706A	13p	SN4286	18p	AF125	20p	BC137	P/A	BF173	35p	IN914	8p
2N930	25p	SN4291	18p	AF126	20p	BC138	P/A	BF178	35p	AA119	10p
2N1132	33p	SN49A	18p	AF127	20p	BC142	30p	BF179	73p	RA102	23p
2N1303	18p	40253	P/A	AF139	38p	BC143	P/A	BF180	35p	BA115	8p
2N1305	23p	40398	P/A	AF178	45p	BC147	18p	BF181	35p	BA114	13p
2N1306	25p</										

# YOUR OWN PROFESSIONAL SOLID STATE CLOSED CIRCUIT TELEVISION CAMERA

**ONLY £70**  
INCLUDING LENS  
AND VIDICON  
TUBE



This superb camera is for use with a standard 405 or 625-line TV set. Giving you the opportunity of operating your own complete professional CCTV system. Linstead supply it as a kit, so that you only need a screwdriver, pliers, cutters, soldering iron, a 20,000 ohms/volt multirange meter and a pair of headphones, to assemble and test it. Designed by the Mullard Educational Service, and shown on the BBC's 'Tomorrow's World' programme, the Linstead camera provides a composite output comprising sync, pulse and picture information. An RF modulator is available as an optional extra where users wish to use a TV receiver as a monitor.

## Free 78-page manual

We give you a superb, fully illustrated, 78-page construction and service manual with this kit. Apart from full assembly instructions, a complete description of basic camera principles, vidicon tube operation and circuit diagram, this manual shows all waveforms within the circuitry. We also supply a copy of the BBC Test Card F. For full details, send S.A.E. today.

THE BASIC KIT, EXCLUDING LENS AND TUBE, COSTS ONLY £45. A COMPLETE, FULLY CONSTRUCTED AND TESTED CAMERA COSTS ONLY £99.85

# Linstead

Linstead Electronics, Roslyn Works, Roslyn Road, London, N.15. Tel: 01-802 5144.

## TV's 19" NOW £11.95

TWO YEARS GUARANTEE ALL MODELS

405/625: 19" £29.95; 23" £39.95

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Transistor Radio Cases: 25p each. Size 9½" x 6½" x 3¼". Post 15p.  
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VHF/FM Tuners: 95p. 88-108 mcs. takes EEC85 valve (extra). Post 15p.  
BSR R/P Motors: 95p. Brand new. 200/250V. Post 20p.  
Precision Tape Motors: £1.95. 200/250V. Famous German manufacturer. Post 20p.  
Transistor Gang Condensers: 20p. Miniature AM. Post free. Modern Gang Condensers: 30p. AM/FM or AM only 20p. Post 10p.  
Transistors 15p each. Post free: AC126, AC128, AF114, AF117, OC45, OC71, OC81, OC81D. Valve ELL80 50p. Only stock in the country.  
Pots: 25p each. Post 5p. D/SW 500/500 KΩ. D/SW 500/100 KΩ. D/SW 1 meg/100 KΩ. S/SW 500/500 KΩ. S/SW 500/1 meg. 625 UHF/Aerial: £1.95. 10 Element fitting. Post 20p.

Knobs: 100,000 to clear. Brand New. 100 assorted radio and tv knobs. 50p. Post 25p.  
Radios £3.95 8 Transistor LW/MW. Free Case, Battery. Post 15p.  
Personal 6 Transistor MW. £2.95. Post 15p.

### TV TUBES REBUILT GUARANTEED 2 YEARS



14" £3.95; 17" & 19" £5.95;  
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Exchange Bowls carr. 55p.

### TEAK HI-FI STEREO CABINETS £14.95

Brand new 44" wide x 16" deep x 18" high with legs. A superb piece of furniture. Carriage £1. WHILE STOCKS LAST.

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19".....£5.50	23".....£7.50

### 'PANORAMA' & 'RIMGUARD' TYPES:

19".....£7.00	23".....£9.00
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### TWIN PANEL or BONDED FACE TYPES:

19".....£7.50	23".....£10.00
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### COLOUR TUBES:

Any type rebuilt—please advise type No. for quotation.

Carriage & Insurance: 75p extra for standard tubes; £1.50 extra rimguard and twin panel types.

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- ★ Two years' guarantee.
- ★ Trade enquiries invited.
- ★ 14 years' experience in tube rebuilding.

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REBUILT	BRAND NEW	A FEW SAMPLE TYPES, REMEMBER WE STOCK EVERY TUBE
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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.
<b>COLOUR TUBES IN STOCK. ALL PRICES ARE NETT</b> PRICES ON APPLICATION      TWIN PANELS      19" CME1906 A47-13W } ON APPLICATION      23" CME2306 A59/13W } ON APPLICATION		*NEW ONLY. NO REBUILDS

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**RADIO AND TELEVISION VALVES SMALL SELECTION**  
British made valves normally supplied. EVERY TYPE IN STOCK

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| DY86/7 | EY86/7 | PCL86  |
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| EABC80 | EZ81   | PFL200 |
| EB91   | EZ90   | PL36   |
| EBC90  | CZ34   | PL81   |
| EBF80  | GY501  | PL81A  |
| EBF89  | PC86   | PL82   |
| ECC81  | PC88   | PL83   |
| ECC82  | PC97   | PL84   |
| ECC83  | PC900  | PL302  |
| ECC804 | PCC84  | PL304  |
| 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 | UCL81  |
| EF184  | PCL82  | UCL83  |
| EH90   | PCL83  | UL41   |
| EL34   | PCL84  | UL84   |
| EY51   | PCL85  | UY85   |

**VALVE DISCOUNTS**  
41% ORDERS UP TO £50  
48½% ORDERS OVER £50

ALL MAZDA/BRIMAR TYPES IN STOCK.

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.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
.01	1000v.	£0.06
.022	1000v.	£0.06
.047	1000v.	£0.09
.1	1000v.	£0.09
.22	1000v.	£0.14
.47	1000v.	£0.19
.001	1500v.	£0.08

### WIRE-WOUND RESISTORS

(5's)	Value	Price
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

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180pf	68pf	£0.06
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50mfd	50v.	£0.10
100mfd	50v.	£0.13
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16mfd	£0.16
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50mfd	£0.25
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16/16mfd	£0.26
16/32mfd	£0.27
32/32mfd	£0.27
50/50mfd	£0.42
50/50/50mfd	£0.52

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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

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A59-14W (T)	C17/7A (M)	CME1602 (P)	CRM173 (M)	
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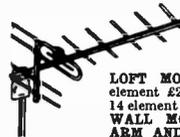
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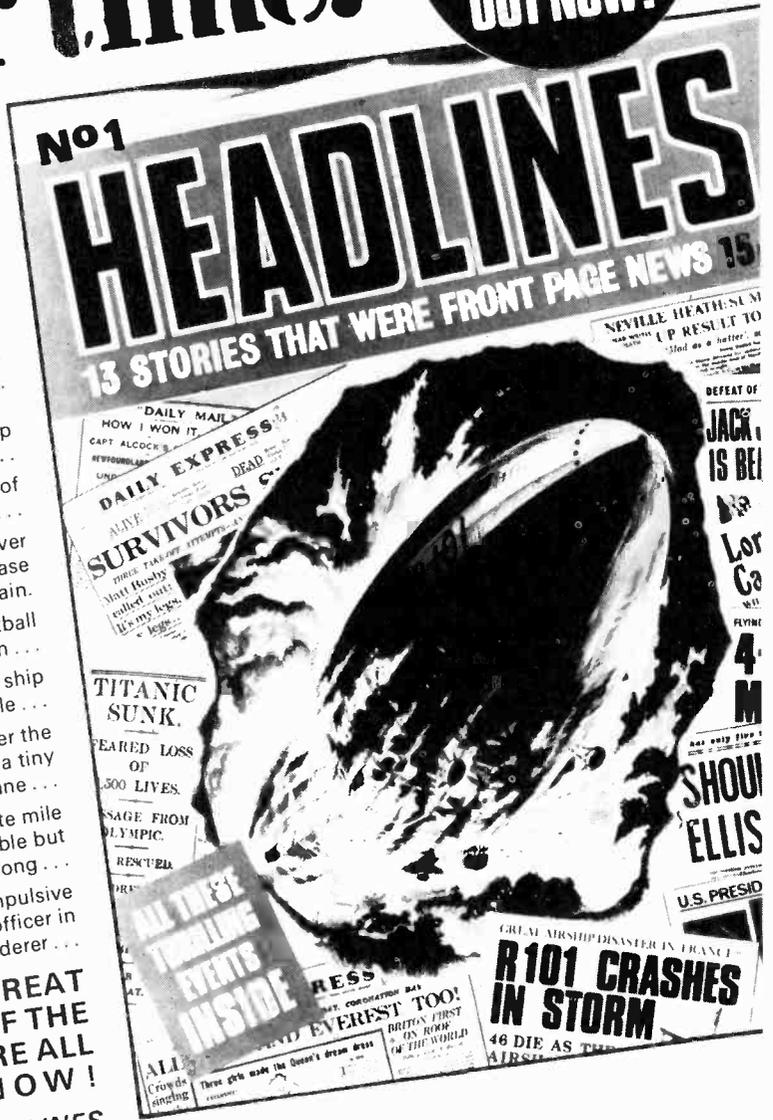
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# TELEVISION

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VOL 21 No 12  
ISSUE 252

OCTOBER 1971

## BROKEN BANDWAGON

Only a few years ago certain sections of the electronics industry were rubbing their corporate hands together as the sight of an apparently new Eldorado ascended over the skyline. Heralding the new prosperity was the growing demand for semiconductors in general and i.c.s in particular. Unfortunately this has now turned out to be the old, old story of enthusiasm clouding commercial judgement, with too many companies throughout the world setting up far too much production capacity for a market which for a fleeting moment seemed to be inexhaustible but which vanished into thin air like a Will o' the Wisp.

The hard fact is that the industry has vastly over-produced for customers who just aren't there. The result of this can be seen in the catastrophic fall in the prices of semiconductor devices—standard i.c.s particularly—to a level such that the UK division of GEC for example say that it costs them more for raw materials alone than the price at which they can sell a device! The gravity of the situation is underlined by the decision of GEC to withdraw from the market in standard mass-produced i.c.s and to close down two of its semiconductor plants, while last year Mullard report that they lost £1.4 million on integrated circuits.

A graphic illustration of the state of the market can be seen from the way in which the price level of dual-quad gates fell from £3 in 1967 to 75p in 1968-9 to around 30p at the end of 1969 and to 5p in 1970 (in the UK) and only 3p in the USA! This amounts to dumping. In the first quarter of this year the price of standard TTL-logic i.c.s fell by 50% while over the last 18 months prices in some cases have dropped to a *tenth* of their previous levels. We've seen all this happen before in other fields of course, with too many companies jumping on the bandwagon of a newly developing market. But the consequences are serious for the future development of the electronics industry.

Television is only a small part of the world of electronics and is at the moment shielded from the cold economic winds howling throughout the industry as a whole. But from our own experience of the ups and downs over the years we can perhaps be allowed to say that the present situation should never have got to its present out-of-hand condition: something must be done to restore sanity and rationalisation to the industry.

W. N. STEVENS, *Editor*

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# TELETOPICS



## CHANCELLOR'S GREEN LIGHT

The recent mini-budget certainly came at the right time so far as the TV trade is concerned—just as the rise in colour set deliveries was beginning to level out and the decline in monochrome set deliveries was leading to talk of redundancies and short-time working. There had in June, however, just before the budget, been a slight upturn again in colour set deliveries at 47,000 for the month. Now all seems plain sailing, with the 18% cut in purchase tax from 36½% to 30% and the abolition of HP, rental and credit agreement controls. Dealers should be wearing smiles on their faces, but possibly not just yet: there is reputed to be £250 million worth of tax-paid goods in the electrical shops, and there is no rebate on stocks held. We imagine, however, that the growing interest in colour and the easier terms will soon get us back to the set shortage condition again.

## TROUBLES IN THE IC FIELD

The cheer on the domestic front is not reflected elsewhere though. GEC's decision to stop making standard i.c.s emphasises the extraordinary mess that has developed in the semiconductor field, with the present prices of many standard i.c.s not even covering the cost of the raw materials used. Figures given in the House of Commons by Mr. B. Harrison M.P. of the fall in the price quoted for a standard quad-gate i.c. illustrate the situation: in 1967 these were quoted at £3 each; by 1968/9 the price had dropped to 15/- while in December 1969 the price was 5/6d; at the end of 1970 prices of 1/- in the UK and 7½d in the US were being quoted. The market collapsed following cutbacks in the US space and defence programmes, but even so there seem to have been too many firms trying to get on to a bandwagon that just wasn't big enough. It is sad on this side of the Atlantic to reflect that while the UK was in the forefront of the early development of radio, the thermionic valve, radar, television and the electronic computer we have never really been in the picture at all with the technology that produced the most far-reaching revolution in electronics of all, semiconductor technology. One wonders whether we are destined now to take a perpetual back seat.

## SENDING DIAGRAMS OVER THE PHONE

RCA Global Communications Inc. have introduced a new system, called the Videovoice, to enable diagrams, charts, etc. to be transmitted over ordinary voice-frequency telephone lines. In addition to the telephone itself each end of the link has a TV camera, monitor and control unit. The document to be transmitted is viewed by the camera and can be displayed

for several minutes or a new view can be transmitted at 30 second intervals. A single frame from a moving scene can be sent by operation of a freeze button. Conversation is discontinued while the picture is being transmitted but if duplex working is used discussion and picture exchange can take place simultaneously. The picture is stored by an RCA silicon-target storage tube which enables it to be scanned at a relatively slow speed: in this way it is possible to transmit picture information within a bandwidth 0.001 of that required for normal TV.

## 'SCOPE BANDWIDTH EXTENDED

We can now it seems think of 'scope bandwidths extending into the GHz range! This is the achievement of two Philips' engineers, C. Loty and G. Clement, who by mounting a channel-plate electron multiplier just behind the phosphor screen of the tube have obtained bandwidths of 2 and 3.3GHz at deflection sensitivities of 20mm/V and 5mm/V respectively. The channel plate (see *Teletopics*, April 1971) amplifies the beam current so that the potential across the tube can be substantially reduced—to about 400V—thereby much increasing the deflection sensitivity while still giving sufficient trace brightness. A travelling-wave deflection system is used consisting of an open helix which is wrapped around the axis of the gun current.

## SET AND TRADE NEWS

On the import side **Telefunken** have reduced the price of their colour sets and **Hitachi** the price of their monochrome portable, in both cases by about 10%. We've noticed considerable price cutting of imported set prices in the shops. **Teleton** have introduced a "go-anywhere" 12in. dual-standard portable, the TA12DU, which can be operated from a 12V battery or the mains. The weight is 20lb and the recommended price £89.75.

Mags of Bristol are importing a 26in. colour model from Finland. This is available to the trade with discounts. The set features two loudspeakers, tone and tint controls and a varicap tuner. It is on sale to the public at their branches in Bristol and South Wales at £375 which includes the first year's service free—they say is worth £20.

SGS have introduced three new i.c.s for the sound sections of TV receivers. Most noteworthy is the TBA631 which in addition to carrying out the usual intercarrier sound channel functions also incorporates a driver and audio power output stage. The output is 2.6-3W into 16Ω, depending on the distortion level. The TBA581 and TBA591 are intercarrier sound i.c.s,

the former suitable for driving a class AB complementary power output stage and the latter for driving high-voltage class A transistors or valves.

The latest BREMA set delivery figures give the first six months' totals for the year: 278,000 colour sets and 666,000 monochrome. In comparison with the first six months of 1970, colour deliveries are up 46% and monochrome deliveries down 16%.

### IMPROVING THE SHADOWMASK TUBE

A good example of the steady technical development that goes on, often unnoticed, is the work that has been put into improving the shadowmask tube since the start of colour broadcasting in the UK in the summer of 1967. This work was reported to the Royal Television Society recently by W. W. Wright, Chief Engineer of Thorn Colour Tubes Ltd., and the paper appears in the July/August issue of the Society's Journal. Over the period the brightness level of the white field obtained at 800 $\mu$ A has been increased by over 118%. This increase has been brought about in several ways: new phosphors are being used, and improvements have been made to the screen printing procedure, increasing the screen efficiency and giving closer control of beam landing so that a slight increase in mask transmittance is obtained. Other improvements to the tube have made setting up easier and increased the operating stability. Temperature-compensated masks—the use of a bimetal support system to provide axial movement of the mask-frame assembly to compensate for radial changes in register—have minimised warm-up registration drift, improvements to the gun focusing have resulted in better resolution and less variation with beam current and deflection angle, while convergence stability has been increased by taking various measures which reduce the beam diameter as it passes through the convergence assembly. Further developments are being worked on.

### TRANSMITTERS IN OPERATION

The BBC-2 service from **Carmel** (Carmarthenshire) has started on channel 63 with horizontal polarisation (receiving aerial group C). BBC-1 u.h.f. transmissions have started from **Bromsgrove** relay (Worcestershire) on channel 31 (vertical polarisation, receiving aerial group A—note that channel 21 was originally allocated for BBC-1 from this station), **Lark Stoke** relay (Gloucestershire) on channel 33 (vertical polarisation, receiving aerial group A) and **Craigkelly** (Fife) on channel 31 (horizontal polarisation, receiving aerial group A). Both BBC-1 and BBC-2 transmissions have started from **Haslington** (Lancs) relay, BBC-1 on channel 33 and BBC-2 on channel 26 (vertical polarisation, receiving aerial group A). BBC-1 test transmissions from **Fenton** (Stoke-on-Trent) have started on channel 31 (vertical polarisation receiving aerial group A).

### FOR THE SERVICE ENGINEER

First, soldering and desoldering. Henri Picard and Frere (34-5 Furnival Street, London EC4) have introduced a new desoldering gun called the Soldavac. This is a modified version of the tool recently commented upon in our *TV Test Report* series (see July issue, page 392). Steadying rests are provided for the fore and middle finger, with a large trigger for thumb operation to bring the tool into action. Light Solder-

ing Devices Ltd. (28 Sydenham Road, Croydon CR9 2LI) have introduced a dry desoldering wick, known as the Bradewick, for removing solder from all kinds of solder joints. The wick has a high solder absorption capacity as a result of the way in which it is impregnated with dry resin flux. From Orientation Ltd., Mayfield, Coverack, Cornwall, come two soldering bits designed for the removal of components whose leads are in T formation: they are said to be particularly suitable for soldering and unsoldering transistors in printed-circuit boards and will fit any standard soldering instrument.

Among a new range of Hameg 'scopes released by Echo Metrix Ltd. (113-5 The Broadway, Leigh-on-Sea, Essex SS9 1PG) are the HM312 which is suitable for colour TV work and the HM207 compact model designed for field servicing or production line applications. The HM312 has a d.c. to 10MHz bandwidth, maximum sensitivity of 50mV/cm. and 8 × 10cm. screen size. The HM207 has a d.c.-coupled 7MHz amplifier and 12-step input attenuator allowing measurements of signals up to 150V: the maximum bandwidth of d.c. to 12MHz is obtained with a 2cm. deflection.

Pye have introduced at £155 (to dealers) a colour TV service jig. This consists of a complete colour receiver in a rigid open frame with all panels plugged in. It can be stood on any side for easy access to components when servicing. Faulty panels from any Pye single-standard colour set can be plugged in.

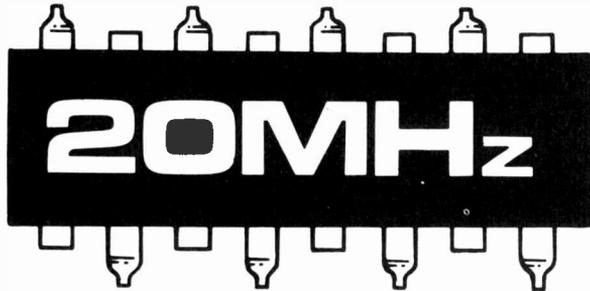
Lastly a useful tip from "Squarewave" writing in *Electrical and Electronic Trader* recently. He points out that the i.c.s now widely used in TV intercarrier sound channels normally produce very little background noise but produce a loud high-gain hiss with no signal input. This hiss can easily be mistaken for front-end noise! So it doesn't mean that the earlier stages are operating at high gain if you turn up the volume control and get a loud hiss from the loud-speaker.

### MULTIPLE HOLOGRAMS STORED IN CRYSTAL CUBE

Scientists at the RCA Princeton Laboratories New Jersey have developed a system of storing a number of separate three-dimensional holographic images in a crystal the size of a cube of sugar. This information storage system has a theoretical capacity of a trillion bits per cubic centimetre of crystal. The different holograms are formed in the crystal by using a different recording beam angle for each one. Subsequently only a minute change in the angle at which the read-out laser beam strikes the crystal makes it possible to select one hologram from another. The holograms are stored as a charge pattern in the doped crystal which is heated to 100°C to stabilise the pattern. The material used is said to be 500 times more sensitive to light than any previously used so that it is no longer necessary to use a very powerful laser to write in and read out the hologram, while the holograms are not destroyed in the read-out process.

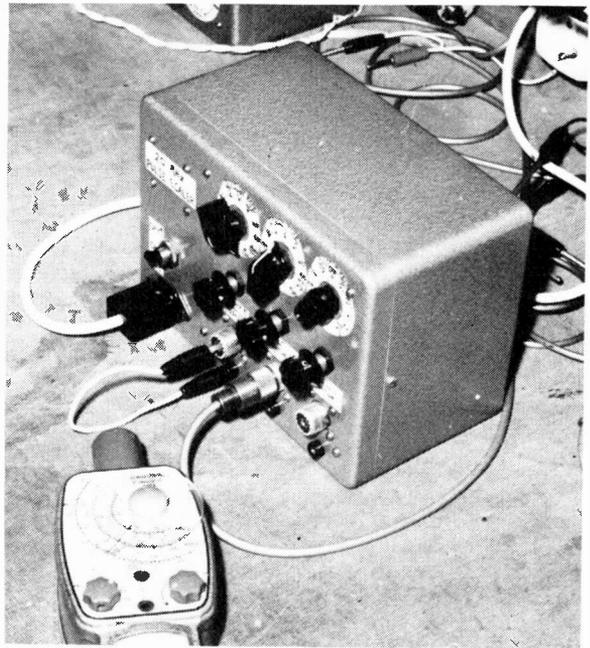
It seems that smallness equals advance just now in the world of electronics. RCA have also come up with a device capable of storing a complete TV frame in an area of 1 sq. cm. A vidicon is used to record on to a coplanar grid of silicon storage elements. The storage capacity is 600,000 bits of TV or the equivalent digital information. The system can perform a variety of operations including zooming in on any portion of the stored frame, erasure and alteration, etc.

THIS versatile instrument can be used on its own as a self-excited or externally-triggered wide-range pulse generator but has been specially designed to serve as a front-end adaptor for our recently published digital frequency meter. Used with this it extends the frequency range up to 20MHz on direct counting. The pulse scaler employs an aperiodic input amplifier which will handle signal frequencies up to 20MHz with a nominal counting trigger sensitivity of 10mV r.m.s. A single-turn loop of flexible wire (length about 4 to 6in.) connected between the input and a chassis socket will pick up sufficient signal voltage to trigger the counter system from the probe coil of a grid-dip meter, from oscillating tuned circuits in running



# PULSE SCALER/SIGNAL GENERATOR

MARTIN L. MICHAELIS M.A.



equipment or from any other source of localised r.f.

The accompanying photo shows how loose the coupling may be: the coupling loop, a piece of flexible insulated wire looped between two banana plugs connected to the input, is at a considerable distance from the probe coil of a grid-dip meter (Grundig Resonance Meter 1). This distance is roughly the maximum usable to still give reliable triggering of the frequency counting system for any frequency from 100kHz to 20MHz. Similar or smaller coupling loops consisting of one or a few turns may be connected to one end of a length of coaxial cable plugged into the scaler input to form a suitable probe for sampling active circuits in running equipment. The probe will not disturb the circuits in any way because the inductive coupling need only be extremely loose. Alternatively signals can be injected directly or capacitively from signal generators or other equipment with r.f. output sockets.

The waveform fed to the scaler is immaterial for all frequencies above 10kHz—sinewaves, distorted sinewaves or any other regular pulsed or rounded waveforms give equally secure triggering. Inputs below 10kHz should be pulsed, i.e. at least one peak-to-peak transition should occur at least every 50msec. If this condition is not satisfied loss of trigger sensitivity is the only consequence—the scaler will trigger even on sinewaves of 20Hz provided the amplitude is sufficient. Since however frequencies up to 100kHz can be fed directly to the digital frequency meter this limitation is not important. Using the digital frequency meter intermittent-counting mode to count for exactly 10sec the resolution of the digital frequency reading is  $\pm 1\text{kHz}$  at 20MHz. A resolution of  $\pm$

10kHz at 20MHz is obtained in a single counting second in the intermittent mode.

## Pulse Generator Functions

The instrument can be operated in two modes, self-excited or scaling/triggered. In the self-excited mode it produces accurate square output pulses continuously adjustable in amplitude from zero to 10V peak. Positive and negative output polarities are available simultaneously with separately adjustable amplitudes. The outputs are d.c. restored to approximately chassis potential so that between pulses there is nominally no voltage present at the output. The pulse and space times are independently adjustable with the respective selector switches, providing a wide range of combinations corresponding to pulse repetition frequencies from a fraction of the television field frequency to well above the television line frequency.

In the scaling/triggèred mode the instrument requires an input signal and adjustment of the trigger level control according to the amplitude of this input signal. The minimum input required is 10mV r.m.s. (or 30mV peak-to-peak for an arbitrary waveform) and the maximum is about 1.5V r.m.s. (5V peak-to-peak). Larger inputs may lead to erratic triggering and should be avoided by turning down the output level control of the signal source, loosening the coupling or using some other form of attenuation.

A third selector switch provides ten logarithmically graded digital scaling factors (frequency division ratios) from 1 to 1,000. The scaled down outputs are the same pulses as in the self-excited mode. The pulse time selector and output amplitude controls are



## ★ components list

### Resistors:

R1 47k $\Omega$	R6 47 $\Omega$	R11 10k $\Omega$	R16 3.3k $\Omega$	$\frac{1}{2}$ W, 10% carbon unless otherwise specified.
R2 68 $\Omega$	R7 47 $\Omega$	R12 47k $\Omega$	R17 100 $\Omega$ 1W	
R3 1k $\Omega$	R8 82 $\Omega$	R13 3.3k $\Omega$	R18 68 $\Omega$ 2W	
R4 10k $\Omega$	R9 15 $\Omega$	R14 10k $\Omega$	R19 220 $\Omega$ 1W	
R5 1k $\Omega$	R10 100 $\Omega$	R15 47k $\Omega$	R20 470 $\Omega$	

### Potentiometers:

VR1 10k $\Omega$ lin.	VR2 10k $\Omega$ log.	VR3 10k $\Omega$ log.
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### Capacitors:

C1 0.1 $\mu$ F	C15 1 $\mu$ F	C29 4700pF	C43 0.01 $\mu$ F	EI, 25V electrolytic, all others plastic film or ceramic 100-500 V. Select smallest possible types. C18-C50 change values in linear pro- portion if other times desired. C16, C17 may be tantalum electro- lytics.
C2 1 $\mu$ F	C16 10 $\mu$ F	C30 0.01 $\mu$ F	C44 0.022 $\mu$ F	
C3 1 $\mu$ F	C17 10 $\mu$ F	C31 0.022 $\mu$ F	C45 0.05 $\mu$ F	
C4 100 $\mu$ F EI	C18 4700pF	C32 0.05 $\mu$ F	C46 0.068 $\mu$ F	
C5 0.1 $\mu$ F	C19 0.01 $\mu$ F	C33 0.1 $\mu$ F	C47 0.1 $\mu$ F	
C6 0.1 $\mu$ F	C20 0.022 $\mu$ F	C34 0.22 $\mu$ F	C48 0.22 $\mu$ F	
C7 0.1 $\mu$ F	C21 0.05 $\mu$ F	C35 0.5 $\mu$ F	C49 0.47 $\mu$ F	
C8 2200pF	C22 0.1 $\mu$ F	C36 1 $\mu$ F EI	C50 0.68 $\mu$ F	
C9 0.1 $\mu$ F	C23 0.22 $\mu$ F	C37 2.2 $\mu$ F EI	C51 2200 $\mu$ F EI	
C10 2200pF	C24 0.5 $\mu$ F	C38 5 $\mu$ F EI	C52 1000 $\mu$ F EI	
C11 0.1 $\mu$ F	C25 1 $\mu$ F EI	C39 10 $\mu$ F EI	C53 100 $\mu$ F EI	
C12 680pF	C26 2.2 $\mu$ F EI	C40 2200pF	C54 100 $\mu$ F EI	
C13 0.1 $\mu$ F	C27 5 $\mu$ F EI	C41 4700pF	C55 100 $\mu$ F EI	
C14 1 $\mu$ F	C28 10 $\mu$ F EI	C42 6800pF		

### Semiconductors:

Tr1 BC107	D6-9 Any silicon signal diode	IC1-3 MC838P Motorola decade counters
Tr2 2N1613	D10-11 Silicon 0.5A i.t. rectifiers	IC4-5 MC851P Motorola pulse univibrators
Tr3 2N1613	D12-14 5V, 100mA zener diodes (tolerance +0.5V.)	
Tr4 BC107		
Tr5 BC107		
D1-4 Any silicon diode		
D5 Any r.f. diode		

### Miscellaneous:

P1, 3, 5 Coaxial sockets	S3 2 pole 11-way rotary	Cabinet, printed circuit board, etc.
P2, 4, 6 Chassis sockets	S4 2 pole on/off toggle	
P7 Mains input	T1 220V, 10.0-10V	
F1 1A fuse	approximately 0.5A	
S1, 2 1 pole 11-way rotary		

stage for every second input pulse they receive. The scaler chain consists of three i.c.s in cascade each of which scales by ten with four binary dividers. Now four binary dividers on their own will divide by 16, not 10. Thus each i.c. also contains feedback logic elements which sense when the ninth of the sixteen states occurs, thereupon introducing a feedback loop which makes the tenth input pulse reset the chain of four stages in the i.c. to zero and then switches the feedback path off again.

The i.c.s have separate pins giving access to the outputs of the four binary dividers in each. An output scaled down by 2 is obtained from the first and is regular and unaffected by the logic feedback that establishes the count of 10 instead of 16. The output scaled down by 5 is obtained from the second divider. In the absence of the decimal feedback logic this output should be scaled down by 4 rather than 5. It would thus produce output pulses on the fourth, eighth, twelfth and sixteenth input pulse without the feedback. With the decimal feedback the fourth and

eighth pulses appear undisturbed but the twelfth and sixteenth are missing because the feedback resets the i.c. to zero on the tenth input pulse. Thus the fourth and eighth input pulse of every set of ten produce an output pulse at the divide by 5 output which functions correctly so far as digital counting is concerned because we get exactly two output pulses for every ten input pulses. But the output pulses are not in regular sequence. The interval between the fourth and eighth pulse in every 10 is four input periods but the next output pulse interval, from the eighth in one set of 10 to the fourth in the next set of 10, is six input periods. This train of output pulses thus contains pulse intervals which are alternately 20% longer and 20% shorter than the average interval.

### Measuring Dead Times

This makes no difference so far as digital counting is concerned and the scaling factor of 5 can be treated as if it is a regular 5 instead of alternating

between 4 and 6. The scaling factors of 2 and 10 are regular, the former for the reason already explained and the latter because the decimal feedback in the i.c. ensures this regularity. Similarly the scaling factors that are decimal multiples of 2 and 10 are regular but the decimal multiples of 5 all show this flutter between 4 and 6.

There are two kinds of i.c. on the market for scaling down by 10. The first is the kind operating as just outlined. The second contains three stages with a binary capacity of 8, reduced to 5 by feedback, and a fourth independent stage in cascade to produce the division by 10. This type produces the 5 as well as the 2 without flutter. We have decided to use the type with fluttering 5 however because the waveform produced when scaling down from a conventional pulse generator is very useful in measuring *dead times* while the fluttering 5 is in no way inferior to a regular 5 so far as frequency metering is concerned.

All pulse circuits without exception possess a dead time, that is the minimum time which must elapse after one pulse before the circuit can respond correctly to the next pulse. This is sometimes loosely called the recovery time. It is often necessary in designing TV equipment to have a simple method of measuring the dead time and in particular to test whether drive frequencies close to the dead-time limit provoke any subtle forms of instability which could have a disastrous effect on the picture performance. Economical designs often drive circuits close to their dead-time limits, but not too close.

To investigate the dead-time characteristics of a circuit select one of the flutter scaling factors (5, 50 or 500) and trigger the scaler with the output of a conventional variable frequency pulse generator. Feed the fluttering output pulse train from the scaler on the equipment on test and observe the response on an oscilloscope. The train of pulses with 4-6 spacing is easily synchronised and observed. Next increase the pulse generator frequency gradually until the oscilloscope display becomes erratic. If the circuit's dead time is well defined and free from secondary instabilities—as it should be—only the set of pulses at the end of the 4-period intervals will vanish completely or erratically on the display while the set of pulses at the end of the 6-period intervals will remain unaffected. If both sets of pulses start to become erratic together the circuit on test has instability too near its dead-time limit. If there is no instability and the dead time is sharp the 4-interval pulse set vanishes within a very small frequency increase of the driving pulse generator and the 6-interval pulse set then persists until the pulse frequency has been increased by about 50% when the 6-period interval has also become equal to the sharp dead time so that the scope display then vanishes completely. If there is no instability but the dead time is diffuse the 4-interval set of pulses will vanish progressively in an erratic manner over a corresponding range of frequency increase of the driving pulse generator. The time scatter of the dead time obviously exceeds about 50% if the 6-interval pulse set commences to vanish too before the last remnants of the 4-interval pulse set have completely disappeared.

When making dead-time observations synchronise the scope externally with one of the scaler outputs, feeding the circuit on test from the other scaler output. It is then possible to note the positions on the screen corresponding to members of each pulse set

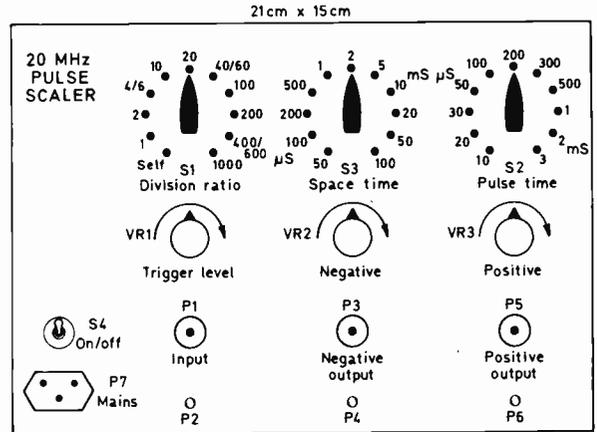


Fig. 2: Front panel layout.

and thus to see clearly which set commences to flicker and when. External sync also makes independent variation of the drive amplitude applied to the circuit on test possible. Drive amplitude has a profound effect on dead-time behaviour in many circuits.

### Circuit Description

The complete circuit (except for the power supply) of the 20MHz pulse scaler is shown in Fig. 1. It employs only five transistors and six integrated circuits. The three transistors Tr1 to Tr3 form a special trigger amplifier which is a modified Schmitt circuit with insufficient gain in this case to produce a true threshold trip. The inevitable finite hysteresis associated with such a response was found to be embarrassing for smooth toggling of the first decade counter IC1 at very high frequencies. Performance was poor above 2MHz with insufficient gain to give a trip but becomes very smooth up to at least 20MHz when the gain is reduced with R8 to the point where it is just insufficient for a trip yet still produces heavy positive feedback for good input sensitivity.

The functions of the three cascaded scaler decades IC1-IC3 and the associated division ratio selector switch S1 will by now be apparent. The selected scaled down output from the scaler chain drives the univibrator i.c. IC4. This rests with a logical 0 at output pin 6 and a logical 1 at output pin 1. Each transition from a 1 to a 0 applied to the input pin 3 causes the states at the output pins 6 and 1 to change over for the pulse duration determined by the pulse timing capacitor selected by S2. The opposite polarity output pulses from IC4 are amplified by the output stages Tr4 and Tr5 and fed to the respective output sockets. C16, D8 and C17, D9 provide d.c. restoration so that the negative pulses are entirely negative-going from the resting potential and the positive pulses are entirely positive-going from the resting potential regardless of the duty cycle (pulse/space time ratio).

The trigger amplifier Tr1-Tr3 and the scaler chain IC1-IC3 are out of circuit when S1 is in the self-excited position. IC4 then functions in the same manner as previously but is driven by IC6 which with IC5 and IC4 then form a closed pulse ring. The output pulse from IC4 triggers IC5 which triggers IC6 which then triggers IC4 so that the ring oscillates continuously.

CONTINUED NEXT MONTH



## PART 2

K. T. WILSON

## THE TAA700 JUNGLE CIRCUIT

THERE are limitations with integrated circuits which prevent the appearance of the "all-integrated" TV receiver. One important limitation is of voltage, which prevents the use of integrated circuits in high-voltage stages such as the video output stage. Another limitation is of power dissipation because of the small size of the silicon chip. This limitation prevents i.c.s being found in the line output stage though i.c. audio and field output stages are possible. A third difficulty is that inductors, or capacitors having values of more than a few tens of picofarads, cannot be economically produced in present silicon integrated circuits. R.F. or i.f. amplifiers using integrated circuits therefore take

the form of an integrated amplifier block used in conjunction with discrete inductors and capacitors to achieve the desired gain and selectivity.

The stages that lend themselves most readily to integration are those which use pulse or other untuned signals at low amplitudes. This description fits perfectly the circuits used for video preamplification, a.g.c., sync separation and flywheel sync—a set of circuits often nowadays referred to as the "jungle stages."

## Block Diagram

The Mullard TAA700 is a 16-lead integrated circuit in a rectangular  $22 \times 7 \times 4$ mm. case which carries out the functions of the jungle stages in monochrome or colour receivers. It is used in the Pye 169 single-standard monochrome chassis and the Philips G8 single-standard colour chassis. The block diagram is shown in Fig. 1 and indicates the circuit tasks carried out by it and also the required inputs and the outputs obtained.

## Video Section

The video preamplifier section can be driven directly from the video detector diode which will also be the take-off point for the intercarrier sound and often in colour receivers for the chroma signal as well. Any filters needed must be included between the video detector diode and the TAA700. The video output of the i.c. is at low impedance (from an emitter-follower stage, with the load resistor connected externally to minimise power dissipation in the i.c.) and can be used in a monochrome receiver to drive a video output stage of the BF178 type or in a colour receiver taken to the luminance delay line and thence to a buffer stage driving the RGB video amplifiers.

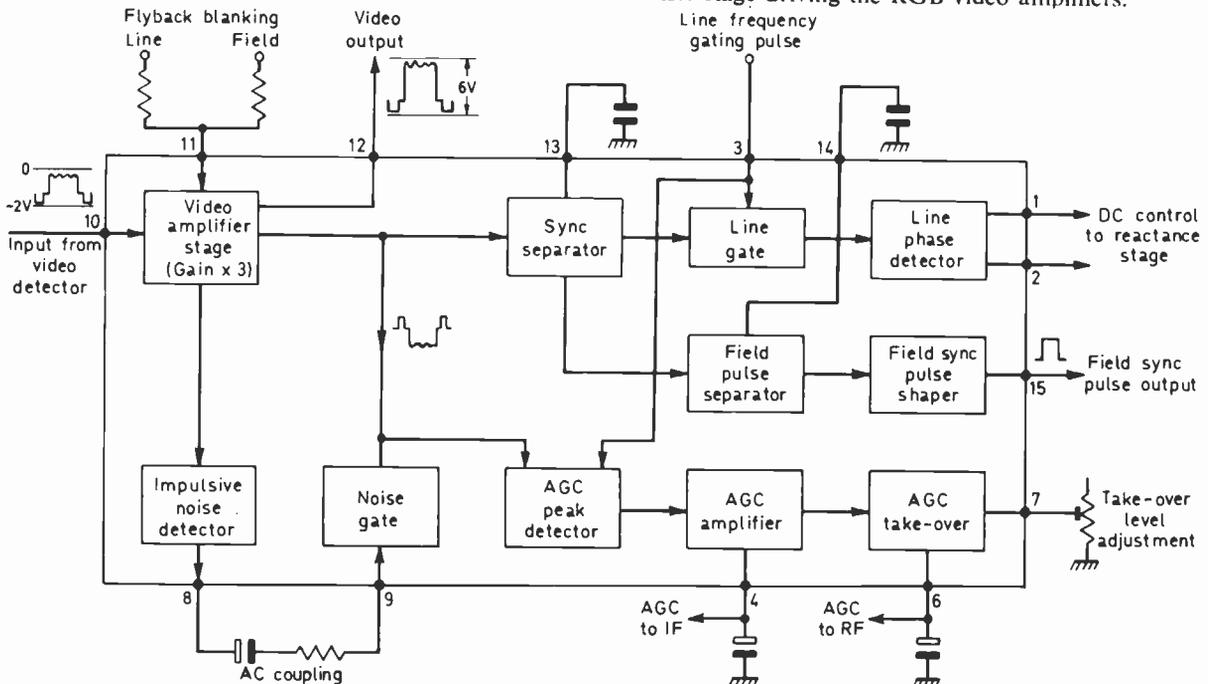


Fig. 1: Block diagram of the TAA700. The video output at pin 12 is positive-going with black at approximately 5V and peak white at approximately 9V. The output stage bias must take into account the positive sit-up of the video output from the TAA700. A 1-5V blanking pulse at pin 11 removes the video signal from the output.

# The largest selection

## BRAND NEW FULLY GUARANTEED DEVICES

AC107 15p	AF115 17p	BC140 35p	BCY31 22p	BF272 80p	EC403 15p	ORP60 40p	2N918 30p	2N2714 25p	2N3704 15p
AC113 20p	AF116 17p	BC141 35p	BCY32 25p	BF273 30p	GET880 27p	ORP61 40p	2N929 22p	2N2904 25p	2N3705 12p
AC115 23p	AF117 17p	BC142 45p	BCY33 17p	BF274 30p	MAT100 15p	ST140 12p	2N930 25p	2N2904A 30p	2N3706 12p
AC125 17p	AF118 30p	BC143 40p	BCY34 20p	BF308 35p	MAT101 17p	ST141 17p	2N1131 20p	2N2905 25p	2N3707 13p
AC126 17p	AF124 21p	BC145 45p	BCY70 17p	BF309 37p	MAT120 15p	T1543 40p	2N1132 22p	2N2905A 25p	2N3708 8p
AC127 17p	AF125 20p	BC147 17p	BCY71 30p	BF316 75p	MAT121 17p	U146 27p	2N1302 17p	2N2906 25p	2N3709 8p
AC128 17p	AF126 20p	BC148 17p	BCY72 15p	BFW10 55p	MPF102 43p	V405A 25p	2N1303 17p	2N2906A 27p	2N3710 18p
AC141K 17p	AF127 20p	BC149 17p	BCZ11 20p	BFX29 27p	MPF105 43p	V410A 45p	2N1304 20p	2N2907 25p	2N3711 10p
AC142K 17p	AF139 33p	BC150 17p	BD121 85p	BFX84 20p	OC19 30p	2G301 19p	2N1305 20p	2N2907A 30p	2N3819 40p
AC151 15p	AF178 50p	BC151 20p	BD123 85p	BFX85 27p	OC20 30p	2G302 19p	2N1306 22p	2N2923 13p	2N3820 11p
AC154 15p	AF179 50p	BC152 17p	BD124 75p	BFX86 27p	OC22 30p	2G303 19p	2N1307 22p	2N2924 15p	2N3903 25p
AC157 20p	AF180 50p	BC153 27p	BD131 80p	BFX87 25p	OC29 40p	2G304 20p	2N1308 27p	2N2925 13p	2N3904 27p
AC156 17p	AF191 50p	BC154 30p	BD132 80p	BFX88 23p	OC24 45p	2G306 35p	2N1309 27p	2N2926 15p	2N3905 25p
AC157 17p	AF186 45p	BC157 20p	BDY20 11p	BFY50 22p	OC25 25p	2G308 35p	2N1613 17p	(G) 12p	2N3906 27p
AC165 17p	AF239 37p	BC158 17p	BF115 22p	BFY51 20p	OC26 25p	2G309 35p	2N1711 20p	2N2926 15p	2N4058 15p
AC166 17p	AF231 37p	BC159 20p	BF117 45p	BFY52 20p	OC28 40p	2G339 17p	2N1889 35p	(V) 11p	2N4059 10p
AC167 20p	AF212 45p	BC167 13p	BF118 60p	BFY53 17p	OC29 40p	2G339A 15p	2N1890 45p	2N2926 15p	2N4060 12p
AC168 20p	AL102 85p	BC168 13p	BF119 70p	BSX19 15p	OC35 33p	2G344 15p	2N1893 37p	(O) 10p	2N4061 12p
AC169 14p	AL103 85p	BC169 13p	BF152 35p	BSX20 15p	OC36 40p	2G345 15p	2N2160 60p	2N3010 80p	2N4062 12p
AC176 23p	ASV26 25p	BC170 12p	BF153 35p	BSY25 15p	OC41 20p	2G371 13p	2N2147 75p	2N3011 20p	2N5172 12p
AC177 20p	ASV27 30p	BC171 12p	BF154 35p	BSY26 15p	OC42 22p	2G371B 10p	2N2148 60p	2N3053 20p	2N5459 43p
AC187 30p	ASV28 25p	BC172 13p	BF157 35p	BSY27 15p	OC43 15p	2G372 15p	2N2149 30p	2N3054 50p	25034 75p
AC188 30p	ASV29 25p	BC173 11p	BF158 25p	BSY28 15p	OC45 12p	2G377 27p	2N2193 30p	2N3055 63p	25301 50p
ACY17 23p	ASV50 25p	BC174 13p	BF159 30p	BSY29 15p	OC70 15p	2G378 15p	2N2194 27p	2N3391 17p	25302A 45p
ACY18 20p	ASV51 25p	BC175 22p	BF160 30p	BSY38 15p	OC71 9p	2G382 15p	2N2217 20p	2N3391A 20p	25302 45p
ACY19 22p	ASV52 25p	BC177 17p	BF162 30p	BSY39 15p	OC72 12p	2G401 30p	2N2218 25p	2N3392 17p	25303 60p
ACY20 20p	ASV54 25p	BC178 17p	BF163 35p	BSY40 30p	OC140 17p	2G402 12p	2N2219 27p	2N3393 25p	25304 75p
ACY21 20p	ASV55 25p	BC179 17p	BF164 35p	BSY41 35p	OC75 15p	2G417 25p	2N2220 22p	2N3394 15p	25305 11p
ACY22 19p	ASV56 25p	BC180 20p	BF165 35p	BSY95 12p	OC76 15p	2N388 30p	2N2221 22p	2N3395 20p	25306 11p
ACY27 18p	ASV57 25p	BC181 22p	BF167 23p	BSY95A 12p	OC77 25p	2N388A 50p	2N2222 27p	2N3402 22p	25307 11p
ACY28 19p	ASV58 25p	BC182 10p	BF173 23p	BU105 13p	OC81 15p	2N404 22p	2N2368 17p	2N3403 22p	25321 60p
ACY29 30p	ASV58 25p	BC182L 10p	BF176 35p	C111E 60p	OC81D 15p	2N404A 30p	2N2369 15p	2N3404 32p	25322 50p
ACY30 20p	ASV59 25p	BC183 10p	BF177 35p	C400 30p	OC82 15p	2N405 30p	2N2370 15p	2N3405 45p	25323A 75p
ACY31 25p	BC107 10p	BC183L 10p	BF178 45p	C407 25p	OC82D 15p	2N527 60p	2N2411 50p	2N3414 20p	25323 60p
ACY34 18p	BC100 10p	BC184 13p	BF179 50p	C424 17p	OC83 20p	2N696 12p	2N2412 50p	2N3415 20p	25324 11p
ACY35 18p	BC109 11p	BC184L 13p	BF180 30p	C425 40p	OC84 20p	2N697 15p	2N2616 55p	2N3417 37p	25325 11p
ACY36 30p	BC113 25p	BC186 27p	BF181 30p	C426 30p	OC139 15p	2N698 24p	2N2711 22p	2N3525 74p	25326 11p
ACY40 15p	BC117 25p	BC187 27p	BF182 30p	C428 20p	OC140 17p	2N699 55p	2N2712 22p	2N3702 12p	25327 11p
ACY41 15p	BC115 30p	BC207 27p	BF183 30p	C441 27p	OC170 15p	2N706 7p	2N2714 25p	2N3703 12p	
ACY44 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	2N709 45p	AA119 8p	BY130 15p	OA10 22p
AD149 43p	BC119 45p	BC213L 11p	BF194 23p	C720 12p	OC202 27p	2N710 8p	AA120 8p	BY131 15p	OA11 7p
AD161 25p	BC125 25p	BC214 11p	BF195 24p	C722 25p	OC203 27p	2N717 40p	BA116 12p	BY132 15p	OA12 7p
AD162 35p	BC126 35p	BC214L 12p	BF196 30p	C740 25p	OC204 25p	2N718 24p	BA126 12p	BY133 15p	OA13 8p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	C742 17p	OC205 35p	2N718A 50p	BY101 12p	BY134 15p	OA14 8p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	C744 17p	OC309 35p	2N726 27p	BY105 12p	BY135 15p	OA15 7p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	C760 17p	P346A 17p	2N727 27p	BY105 12p	BY136 15p	OA16 6p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	C762 17p	P375 15p	2N743 45p	BY105 12p	BY137 15p	OA17 7p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	C764 17p	OC71 43p	2N744 17p	BY126 15p	BY19 15p	OA18 7p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	CF271 17p	ORP12 43p	2N914 17p	BY127 17p	OA19 15p	OA200 6p
AD161 35p	BC126 35p	BC214L 12p	BF196 30p	CF272 17p	ORP12 43p				

### DIODES & RECTIFIERS

AA119 8p	BY130 15p	OA10 22p
AA120 8p	BY131 15p	OA11 7p
BA116 12p	BY132 15p	OA12 7p
BA126 12p	BY133 15p	OA13 8p
BY101 12p	BY134 15p	OA14 8p
BY105 12p	BY135 15p	OA15 7p
BY105 12p	BY136 15p	OA16 6p
BY105 12p	BY137 15p	OA17 7p
BY126 15p	BY19 15p	OA18 7p
BY127 17p	OA19 15p	OA200 6p

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BP00 = 7400	Quad. 2-input NAND gate	0-15	0-14	0-12
BP01 = 7401	Quad. 2-input positive NAND gate (with open collector output)	0-15	0-14	0-12
BP02 = 7402	Quad. 2-input positive NOR gates	0-15	0-14	0-12
BP03 = 7403	Quad. 2-input positive NAND gates (with open collector output)	0-15	0-14	0-12
BP04 = 7404	Hex Inverters	0-15	0-14	0-12
BP05 = 7405	Hex Inverter (with open-collector output)	0-15	0-14	0-12
BP10 = 7410	Triple 3-input positive NAND gates	0-15	0-14	0-12
BP13 = 7413	Dual 4-input Schmitt trigger	0-28	0-28	0-24
BP20 = 7420	Dual 4-input positive NAND gates	0-15	0-14	0-12
BP30 = 7430	8-input positive NAND gates	0-15	0-14	0-12
BP34 = 7430	Dual 4-input positive NAND buffers	0-15	0-14	0-12
BP41 = 7441	BCD to decimal nixie driver	0-67	0-64	0-58
BP42 = 7442	BCD to decimal decoder (4-10 lines, 1 of 10)	0-67	0-64	0-58
BP46 = 7446	BCD-to-seven-segment decoder driver	2-00	1-75	1-50
BP47 = 7447	BCD-to-seven segment decoder drivers (15V outputs)	0-97	0-94	0-88
BP48 = 7448	BCD-to-seven-segment decoder driver	0-97	0-94	0-88
BP50 = 7450	Expandable dual 2-input and-or-invert	0-15	0-14	0-12
BP61 = 7451	Dual 2-wide 2-input NAND-or-invert gates	0-15	0-14	0-12
BP53 = 7453	Quad. 2-input expandable NAND-or-invert	0-15	0-14	0-12



BP54 = 7454	4-wide 2-input NAND-or-invert gates	0-15	0-14	0-12
BP60 = 7460	Dual 4-input expander	0-15	0-14	0-12
BP70 = 7470	Single-phase J-K flip-flop	0-28	0-28	0-24
BP72 = 7472	Master-slave J-K flip-flop	0-28	0-28	0-24
BP73 = 7473	Dual master-slave J-K flip-flop	0-37	0-35	0-32
BP74 = 7474	Dual D type flip-flop	0-37	0-35	0-32
BP75 = 7475	Quad. latch	0-47	0-45	0-42
BP76 = 7476	Dual J-K with pre-set and clear	0-43	0-40	0-38
BP80 = 7480	Gated full adders	0-67	0-64	0-58
BP81 = 7481	16-bit read-write memory	0-67	0-64	0-58
BP82 = 7482	2-bit binary full adders	0-67	0-64	0-58
BP83 = 7483	Quad. full adder	1-10	1-05	0-95
BP86 = 7486	Quad. 2-input exclusive Nor gates	0-32	0-30	0-28
BP90 = 7490	BCD decade counter	0-67	0-64	0-58
BP91 = 7491	8-bit shift registers	0-67	0-64	0-58
BP92 = 7492	Divide-by-twelve counters	0-67	0-64	0-58
BP93 = 7493	4-bit binary counters	0-67	0-64	0-58
BP94 = 7494	Dual entry 4-bit shift register	0-77	0-74	0-68
BP95 = 7495	4-bit up-down shift register	0-77	0-74	0-68
BP96 = 7496	3-bit parallel in parallel out shift-register	0-77	0-74	0-68
BP100 = 74100	8-bit bistable latches	1-75	1-65	1-55
BP104 = 74104	Single J-K flip-flop equiv. 9000 series	0-67	0-64	0-58
BP105 = 74150	Single J-K flip-flop equiv. 9001	0-67	0-64	0-58
BP107 = 74107	Dual master-slave flip-flop	0-40	0-38	0-38
BP110 = 74110	Gates master-slave flip-flop	0-55	0-53	0-50
BP111 = 74111	Dual data lock-out flip-flop	1-25	1-15	1-00
BP118 = 74118	Hex set-reset latches	1-00	0-95	0-90
BP119 = 74119	Hex set-reset latches. 24-pin	1-35	1-25	1-10
BP121 = 74121	Monostable multivibrators	0-67	0-64	0-58
BP141 = 74141	BCD-to-decimal decoder/driver	0-67	0-64	0-58
BP145 = 74145	BCD-to-decimal decoder/driver. O/C	1-50	1-40	1-30
BP150 = 74150	16-bit data selector	1-80	1-70	1-60
BP151 = 74151	8-bit data selectors (with strobe)	1-00	0-95	0-90

The input includes an integrated resistor of  $2.7k\Omega$  and no d.c. bias is required here. The video input should be 2V peak which in a monochrome receiver can be readily obtained from the detector diode. For colour sets improved linearity can be obtained by operating the detector diode at a higher level: a potential divider must then be used as the detector load with the input to the i.c. taken from the junction of the resistors. This approach may also be used where a higher sound signal level is required.

The video output signal has a peak-to-peak amplitude of about 6V with the black level at +5V and a black-to-white signal amplitude of 3.8V. This is suitable for driving a video output transistor such as the BF178. Line and field flyback blanking pulses can be fed in at pin 11 when the i.c. is used in a monochrome receiver. In a colour television receiver where a.c. coupling and d.c. level clamping of the luminance signal is used flyback blanking cannot be carried out in the TAA700: it must be done elsewhere. In this case pin 11 must be connected to chassis.

### AGC System

The a.g.c. system built into the i.c. detects the amplitude of the sync pulse tips and is gated by line pulses to minimise the disturbance to the a.g.c. potential that would otherwise occur during the field sync pulse group. This enables a short time-constant to be used for the a.g.c. circuit, minimising picture flutter. The line gating pulse fed to pin 3 should have an amplitude of +1 to +5V peak. The a.g.c. output is positive and is intended for forward a.g.c.—where an increase in the emitter current of the controlled stage results in decreased gain. Two outputs are available, one for the i.f. amplifier and the other for the r.f. stage. A reservoir capacitor is necessary at each output and should be mounted close to the i.c. Decoupling at the controlled stages is important.

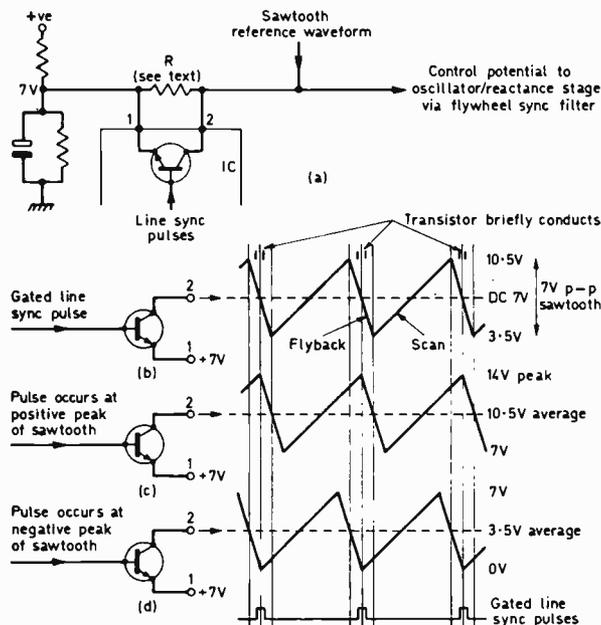


Fig. 2: Operation of the flywheel line sync discriminator.  $R$  is  $10k\Omega$  with a transistor line oscillator,  $220k\Omega$  with a PCF802 line oscillator.

In a.g.c. systems generally it is best for the control to operate on only the i.f. amplifier at lower signal voltages, transferring to the r.f. amplifier stage at higher signal levels. This ensures that the best signal-to-noise ratio is obtained with small amplitude signals where noise is most noticeable. The voltage at which control shifts from i.f. to r.f. control is determined by an external preset potentiometer connected to pin 7.

### Sync Separation

Separate line and field sync separator stages are used in the i.c. The line sync separator stage is of the conducting-on-peaks variety and uses an external charge-storage capacitor since the  $220nF$  required is too large to be built into the i.c. A low-pass filter is incorporated so that high-frequency noise and the colour bursts are removed before sync separation. The line sync pulses are then used internally in the line flywheel phase discriminator circuit to be described later. The field sync separator circuit requires a  $47nF$  integrating capacitor connected to pin 14. The 10V rectangular field pulse output at pin 15 is best connected to the field oscillator through a d.c. blocking capacitor of about  $1nF$ . The internal circuit of the TAA700 includes protection diodes to avoid damage to the field sync separator caused by pulses fed back from the oscillator.

### Noise Gating

It is important that the a.g.c. and sync systems are protected from impulsive noise. This is done by detecting noise pulses of amplitude greater than the video signal and using them to gate the a.g.c. and sync channels internally. To prevent lock-out causing loss of signal, a.c. coupling is introduced into the noise protection system via pins 8 and 9.

### Flywheel Line Sync

Pins 1 and 2 on the TAA700 are connected internally to the emitter and collector of a transistor which acts—instead of the conventional pair of diodes—as the flywheel sync phase detector. This transistor will conduct in either direction. A d.c. bias voltage is applied to pin 1 and the reference sawtooth waveform (derived by integrating flyback pulses from the line output stage) is applied to the collector of the phase detector transistor and the sync pulses to its base. Fig. 2(b) shows the effect when the reference waveform and the sync pulses are in sync: the transistor conducts briefly at the centre of the sawtooth flyback and the control potential remains at 7V. If now the line sync pulse applied to the base of the transistor causes it to conduct on the positive peak of the reference waveform (oscillator slow) the rectified signal at pin 2 is at a d.c. level of  $7V + 3.5V = 10.5V$ .

The principle of operation of the phase detector is outlined in Fig. 2 where (a) indicates the basic circuit arrangement. The 7V standing bias at pin 1 is applied to the oscillator via the transistor in the i.c. and the usual externally-connected flywheel filter circuit. The sawtooth waveform is applied to the collector of the phase detector transistor and the sync pulses to its base. Fig. 2(b) shows the effect when the reference waveform and the sync pulses are in sync: the transistor conducts briefly at the centre of the sawtooth flyback and the control potential remains at 7V. If now the line sync pulse applied to the base of the transistor causes it to conduct on the positive peak of the reference waveform (oscillator slow) the rectified signal at pin 2 is at a d.c. level of  $7V + 3.5V = 10.5V$ .



# THE TELEVISION

TELEGENIC

## trouble-shooting chart

THIS list of symptoms and the possible causes of television receiver faults is not a complete servicing guide but is intended to provide useful guide-lines for those new to television or servicing. In compiling this guide nearly all types of receiver—single- or dual-standard, valved, transistorised or hybrid—have been taken into account. Some checks must be ignored if they are not applicable to the type of receiver at fault.

### Blank Screen, No Sound

(1) *Heaters dead.* Check mains fuse; heater dropper resistor; mains tapping panel or connections; open-circuit valve or c.r.t. heater; open-circuit power plug to tuner or other subchassis; heater chain thermistor; heater chain rectifier.

(2) *No h.t.* Check h.t. fuse; h.t. mains dropper resistor; h.t. rectifier.

Check for an h.t. short-circuit if the h.t. fuse is blown.

### Blank Screen, Sound Normal

(1) *No e.h.t.* Check e.h.t. rectifier or e.h.t. multiplier; efficiency (boost) diode; line output valve or transistor; line oscillator valve or transistor or driver transistor; line blocking or sinewave oscillator transformer; flywheel sync diodes; drive to line timebase (negative voltage at grid of output valve); boost reservoir capacitor; other timebase components; line output transformer.

(2) *C.R.T. biasing.* Check first anode voltage; c.r.t. grid and cathode potentials; grid and cathode biasing and decoupling components including v.d.r. in brilliance circuit if fitted; video amplifier if direct coupled.

(3) *C.R.T.* Check for open-circuit heater; low emission; ion trap missing or mispositioned; poisoned cathode (ionised).

### Raster OK, No or Poor Picture, 405 Sound OK, 625 Poor or No Sound

(1) *Video amplifier.* Check valve or transistor(s); video detector; video amplifier components.

(2) *Vision i.f. strip.* Check valves or transistors; power supply to strip including dropper resistor to transistorised strip; components in strip.

### Raster OK, No or Poor Picture, No or Poor Sound on both Systems

(1) *Common i.f. stage.* Check valve or transistor; interconnecting coaxial lead from tuner to i.f. strip; other components in common stage.

(2) *Tuner.* Check r.f. amplifier and oscillator/mixer valves or transistors; switch contacts; other components.

(3) *Aerial.* Check coaxial plug to receiver; aerial connections; aerial location; receiver input components.

(4) *Low h.t. to tuner.* Check h.t. rectifier; dropper resistor in feed to tuner(s).

### Picture OK, No or Poor Sound

(1) *Audio amplifier and output stage.* Check for open-circuit loudspeaker leads; valves or transistors; other components.

(2) *Sound i.f. and demodulator.* Check demodulator diode(s); valves or transistors in strip; other components in strip.

If noise is heard on turning up the volume control the circuits following the control are in order.

### Intermittent Sound or Vision

(1) *I.F. circuits, video or audio output circuits.* Check joints on chassis or printed board; printed circuit board for hairline cracks; cracked or overheating resistors; chassis contacts of screening cans; coaxial cable connections between tuner(s) and i.f. strip; dirty valvebases or pins.

(2) *Tuner.* Check for badly aligned turret contacts or poor tension; locating cam loose or broken; mechanical rigidity; poor aerial socket contact.

(3) *Aerial.* Check connections; mechanical stability; shorting along feeder length caused by cable grip or feeder rubbing on sharp edge.

### Uncontrollable Brightness

(1) *C.R.T. biasing.* Check grid and cathode bias components; video amplifier valve or transistor(s); d.c. restoration diode.

(2) *C.R.T.* Check for open-circuit electrode or inter-electrode short.

### Varying Width and Height

(1) *E.H.T. generation.* Check e.h.t. rectifier; efficiency diode; boost reservoir capacitor; line output transformer.

(2) *C.R.T.* Check for varying tube capacitances by replacement.

### Lack of Height

(1) *Field output stage.* Check valve or transistor(s); cathode (emitter) bypass electrolytic and bias resistor; adequate h.t.; linearity circuit; leaky coupler; output transformer and damping components across primary.

(2) *Field oscillator.* Check valve or transistor; check boost supply to valve (high-value feed resistor, faulty height control, boost reservoir capacitor, also possibility of interelectrode leak in tube); charging capa-

citor from anode of oscillator to chassis or cathode of output valve.

(3) *Field deflection coils*. Check for possible shorted turns; coil damping resistors; insulation to chassis; thermistor in coil circuit.

### Top or Bottom Compression

(1) *Field output stage*. Check output valve or transistor(s); cathode bypass electrolytic and value of bias resistor; field charging capacitor; leaky coupler; components in linearity circuit; damping across output transformer and output transformer for shorted turns (these last two affect the top of the picture).

(2) *Field deflection coils*. Check for possible shorted turns.

### Lack of Width

(1) *Line output stage*. Check line output valve or transistor(s); boost diode; preset width control(s); e.h.t. stabilisation circuit; h.t. voltage; line output valve screen resistor; adequate line drive; S-correction capacitor(s); line output transformer.

(2) *Line deflection coils, width or linearity coil*. Check for possible shorted turns; insulation to chassis; core of width or linearity coil secure; width or linearity coil damping resistors.

### Different 405, 625 Widths

*Line output stage*. Check S-correction capacitors; width/stability control setting; stabilisation circuit.

### Poor Line and/or Field Hold

(1) *Sync separator*. Check valve or transistor; anode or screen resistors; grid leak or base bias resistors; heater rectifier in some Bush-Murphy models.

(2) *Video amplifier*. Check valve; screen decoupling; cathode bypass capacitor.

(3) *Sync coupling*. Check coupling components between sync separator and timebases including interlace diode in case of poor field hold.

(4) *Flywheel sync circuit*. Check discriminator diodes; flyback pulse coupling components; d.c. amplifier if incorporated.

(5) *Line oscillator*. Check valve or transistor(s); operation of hold control and its series resistors; oscillator stage components.

(6) *Field oscillator*. Check valve or transistor; hold control and associated components; leaky coupling capacitors in stage; interlace diode; heater chain rectifier in some models where the field output stage bias is derived from the heater chain; boost reservoir capacitor; interlace control if fitted.

### Horizontal Line Moving Vertically

(1) *Hum*. Check h.t. smoothing components; stage decoupling capacitors.

(2) *Valves*. Check for heater-cathode breakdown.

### Picture not Central

(1) *Shift magnets or deflection coils*. Check setting and position.

(2) *Field deflection coils*. Check for d.c. through coils due to output transformer insulation breakdown.

(3) *Line deflection coils*. Check for d.c. through coils due to output transformer insulation or capacitor breakdown.

(4) *Line oscillator*. Check line hold control setting on receivers with large pull-in range.

### Line Ringing

(1) *Third or spurious harmonic ringing*. Check width and linearity coils and damping resistors; line deflection coil inductance; line output stage tuning capacitors; line output transformer.

(2) *Spurious oscillations*. Check chokes at top caps of line output valve and efficiency diode; line output valve screen decoupling.

### Picture Ringing

(1) *Excessive video h.f. response*. Check h.f. peaking components in video amplifier and detector circuits and detector compensating network.

(2) *Tuner*. Check oscillator setting and level.

(3) *Aerial*. Check for feeder mismatching at array and receiver; receiver aerial input circuit; ghosting.

(4) *A.G.C. circuit*. Check a.g.c. circuit decoupling components.

(5) *Vision i.f. strip*. Check alignment.

### Poor Definition

(1) *Poor video h.f. response*. Check h.f. peaking components in video amplifier and detector circuits and detector compensating network.

(2) *Vision i.f. strip*. Check alignment.

(3) *Lack of signal*. Check aerial and siting.

(4) *Video signal level low*. Check tuner and i.f. valves or transistors.

(5) *Aerial*. Check for feeder mismatches on short cable run.

### Poor Focusing

(1) *C.R.T.* Check first anode and focus potential; ion trap (if fitted) position; focus control circuit.

(2) *H.T.* Check h.t. rectifier; boost reservoir capacitor.

### Arcing and Corona Discharge

Check e.h.t. lead; e.h.t. voltage tripler; e.h.t. rectifier heater; internal arcing in efficiency diode; line output transformer.

### Picture Distortions

(1) *Line pulling*. Check for weak signal; poor aerial; low gain.

(2) *R.F. patterning*. Check for foreign or co-channel interference; cross-modulation caused by excessive signal (check sensitivity preset); heater chain decoupling; radiating video amplifier; poor i.f. screening can chassis connections; oscillator setting; 4.43MHz rejector setting (625).

(3) *Pincushion distortion*. Check c.r.t. correction magnets; line linearity control setting.

(4) *Line non-linearity*. Check line linearity sleeve setting on c.r.t. neck; width control setting; efficiency diode (left-hand edge non-linearity); line output valve or transistor (right-hand edge non-linearity); line output valve screen voltage; S-correction capacitors

(centre non-linearity); cathode or emitter circuit of line output stage (centre non-linearity).  
 (5) *Ghosting*. Check aerial matching; aerial position; multipath reception.

### Negative Picture

- (1) *Vision interference limiter or black spotter*. Check setting of preset control; diode; bias components.
- (2) *Low e.h.t.* Check e.h.t. rectifier; line output valve; efficiency diode; boost reservoir capacitor; h.t.; line output transformer.
- (3) *C.R.T.* Check for low emission; low heater current.
- (4) *Signal overloading*. Check preset sensitivity control setting; a.g.c. circuit; try inserting an aerial attenuator.
- (5) *Ion trap*. Check position.

### Sound-on-Vision

- (1) *I.F. and video amplifiers*. Check 3.5MHz trap setting (405); 6MHz trap setting (625); sensitivity preset control setting; overloading—a.g.c. circuit; sound trap.
- (2) *Tuner*. Check oscillator tuning.
- (3) *Microphony (increases with volume)*. Check for microphonous valves (particularly in tuner); microphonous c.r.t.
- (4) *H.T. feedback*. Check smoothing components; decoupling capacitors.

### Vision-on-Sound

- (1) *Sound i.f.* Check first i.f. transformer (405); 6MHz take-off coil tuning (625).
- (2) *H.T. feedback*. Check smoothing components; decoupling capacitors.
- (3) *Radiating video amplifier*. Check for "soft" valve; heater decoupling.

- (4) *Microphony*. Check for microphonous valves.
- (5) *Field buzz*. Check field oscillator stage decoupling.
- (6) *Hum*. Check h.t. smoothing components; valve heater-cathode leakage.

### Sound Distortion

- (1) *Hum*. Check h.t. smoothing components; decoupling capacitors; valves for heater-cathode leakage.
- (2) *Field buzz*. See vision-on-sound above.
- (3) *6MHz buzz (625)*. Check a.m. rejector control in ratio detector circuit; detector diodes; 6MHz take-off coil tuning; alignment of 6MHz tuned circuits.

### General Safety Precautions

- (1) Nearly all receivers use a.c./d.c. techniques: thus the receiver chassis may be *live*. For safety always check the chassis potential and reverse the mains connections if necessary.
- (2) Never assume that the receiver mains switch is functioning correctly.
- (3) Ensure discharge of the c.r.t. final anode cavity before removing tube.
- (4) Do not dispose of old c.r.t.s in public places or in dustbins. Do not attempt to destroy them unless the space they are within is well sealed.
- (5) Never overtighten c.r.t. clamps.
- (6) Never carry a c.r.t. by its neck.
- (7) Always replace implosion screens where they were originally fitted.
- (8) Never attempt to use a multimeter at the anode of the line output valve or transistor or efficiency diode cathode—nor on the line output transformer windings.
- (9) Never check for e.h.t. sparks in the line output stage if transistors are employed. ■

## LETTERS . . . .

### SYNCHRONOUS DETECTORS

In your interesting article on Synchronous Detectors in the January issue there is an error: like the other three circuits shown in Fig. 4 the first one also switches on just once each reference signal cycle. On the half cycle when the anodes of diodes 1 and 2 are positive with respect to the cathodes of diodes 3 and 4 all the diodes conduct: on the following half cycle all the diodes are cut off.—**T. John** (London).

Mr. John is quite correct: our apologies for this slip.—*Technical Editor*.

### MULTI-CHANNEL UHF RECEPTION

I reported in June 1970 on the channels which could be regularly received in Bands I and III here at Leeds. As a follow-up readers might be interested in the stations now receivable here using an eleven-element rotatable Group B u.h.f. aerial at 30ft.

Ch. 22	BBC-1	Belmont (Lincs)	Excellent
Ch. 24	ITV	Sandy Heath (Bedford)	Extremely weak
Ch. 25	ITV	Belmont Anglia TV	Excellent
Ch. 26	BBC-2	Bilsdale (N. Yorks)	Excellent
Ch. 28	BBC-2	Belmont	Excellent
Ch. 29	ITV	Bilsdale Tyne Tees TV	Excellent
Ch. 33	BBC-1	Bilsdale	Excellent

Ch. 44	BBC-1	Emley Moor Local	Excellent
Ch. 47	ITV	Emley Moor Local	
		Yorks TV	Excellent
Ch. 51	BBC-2	Emley Moor Local	Excellent
Ch. 55	BBC-1	Winter Hill (Lancs)	Good, slightly grainy
Ch. 58	BBC-1	Waltham (Leics)	Fair, grainy
Ch. 59	ITV	Winter Hill	Good
		Granada TV	
Ch. 61	ITV	Waltham ATV	Fair
Ch. 62	BBC-2	Winter Hill	Good
Ch. 64	BBC-2	Waltham	Fair

The pictures from Belmont and Bilsdale are equally as good as the local transmitter Emley Moor which can be seen on a clear day. The pictures from Waltham are fairly good but the grain is more prominent. The picture is however watchable. The Sandy Heath signals are extremely weak with heavy fading.

The u.h.f. tuner is transistorised, using two BF180 transistors, and is almost noise free.

The pictures from Winter Hill and Waltham are better when received on a 6 over 6 Yagi for 2 metres (Ham Band) which is at 40ft. and clears rooftops that the u.h.f. aerial does not.

The only trouble with having all these channels available is that it doesn't leave many free channels for the reception of Continental stations during Trops! I have received Holland, France and E. and W. Germany on u.h.f. but as yet no Belgium. I wonder why?—**C. Morton (G8EMS)** (Leeds).

# LONG-DISTANCE TELEVISION

## ROGER BUNNEY

CONDITIONS have remained reasonably active throughout July though there has been a slight drop in the number and intensity of Sporadic E openings. At the time of writing, however, there is every reason to suppose that we can look forward to continued Sp.E openings into August. Thanks to the prolonged hot spell during the first half of July, tropospheric were active for many enthusiasts in favourable positions. Indeed, we have received a number of letters telling of enhanced tropospheric reception, mainly on u.h.f. from West Germany and the Low Countries. One particularly interesting letter came from C. Dalziel giving news of his West German u.h.f. reception on an extremely long North Sea path at his home in Aberdeen. My own log for the period under review is as follows:

- 2/7/71 TVE (Spain) E2, E3, E4; RAI (Italy) 1A; ORF (Austria) E2a; plus unidentified signals.
- 3/7/71 USSR R1; TVP (Poland) R1, R2; MT (Hungary) R1; Switzerland E2; CT (Czechoslovakia) R1.
- 4/7/71 USSR R1, R2; TVR (Rumania) R2; MT R1; TVP R1; RAI 1A; TVE E2; SR (Sweden) E2.
- 5/7/71 USSR R1; JRT (Yugoslavia) E3, E4; Switzerland E2, E3.
- 6/7/71 RAI 1A.
- 7/7/71 TVE E2, E3, E4.
- 9/7/71 TVE E2, E3, E4; RTP (Portugal) E2, E3.
- 10/7/71 USSR R1; ORF E2a; TVE E2.
- 11/7/71 TVE E3; RTP E3.
- 13/7/71 TVE E2, E3, E4; RTP E3; RAI 1A, 1B.
- 14/7/71 TVE E2, E3; RTP E2, E3; RAI 1A, 1B.
- 16/7/71 NRK (Norway) E2, E3, E4; SR E3, E4; RAI 1A; USSR R1, R2; TVP R1.
- 17/7/71 USSR R1, R2; NRK E2, E3 twice. E4: Iceland E4 (first time this year!).
- 19/7/71 USSR R1; NRK E3; SR E2.
- 20/7/71 USSR R1; TVE E3, E4.
- 22/7/71 NRK E2; Iceland E4; plus unidentified signals.
- 24/7/71 TVP R1, R2; MT R1; CT R1; RAI 1A, 1B; JRT E3, E4; SR E2; plus unidentified signals.
- 25/7/71 RAI 1A.
- 27/7/71 CT R1; MT R1; RAI 1A; JRT E3, E4.
- 28/7/71 TVE E2, E4.

As before, I have included only Sp.E loggings in order

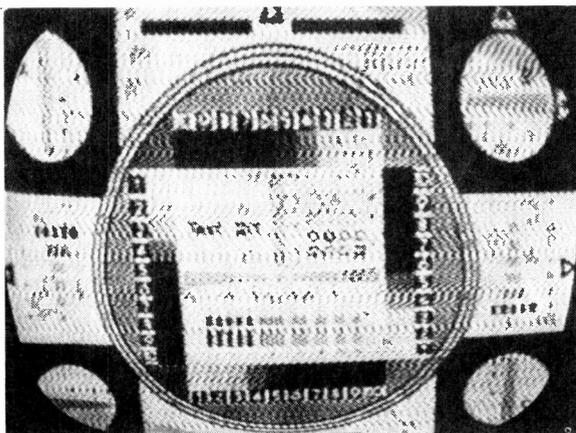
to keep the log down to a reasonable size for the column. Sufficient to relate that during the first two weeks of July the various Northern French v.h.f. and u.h.f. transmitters were received at reasonable strengths during the enhanced tropospheric conditions at that time. It is interesting to note that at this particular location the south and south-east still seem to be favoured, with repeated reception of both TVE, RAI and JRT. One mystery signal was noted on 27/7/71. At 16.45 BST I noted on ch.E3 a cartoon film which faded into the noise to be replaced with a weak Telefunken-type test card. Both above and below the central circle on the edge of the frame were three widely spaced white letters. The card appeared at 16.52 and faded at 17.05. Direction seemed to be ESE, suggesting JRT. I wonder if anybody noted this test card? Frank Smales (Pontefract) has noted TVE to carry an identification on the main test card, from the ch.E4 transmitter at Guadalcanal, the name appearing just under "TVE", stating the transmission site "Guadalcanal".

### News

**Yugoslavia:** We gather that the official inauguration of the first colour transmissions will be on New Year's Eve from a 1,000kW e.r.p. u.h.f. transmitter serving RTV Belgrade. Other high-power transmitters are also planned, taking their programmes from each Studio Centre of the six Republics of Yugoslavia. The various centres are being enlarged for the second service programming and production and a fairly rapid coverage of the six regions is expected although initially colour transmissions (PAL) will be of material received on Eurovision/Intervision exchanges.

**France:** We understand that ORTF-1 (French 1st Chain on 819 lines v.h.f.) are now testing on 625 lines with positive video each Tuesday from 09.00-12.00 BST. At 12.00 transmissions change to the normal 819-line service. Various patterns are radiated on 625 lines including the 2nd Chain test card. Sound transmissions remain unaffected throughout this time. There is no official word at present on the reason for these tests.

**Albania:** We have been making further enquiries as to the television situation here and now have some definite news. Via our friend Michele Dolci in Bergamo, we



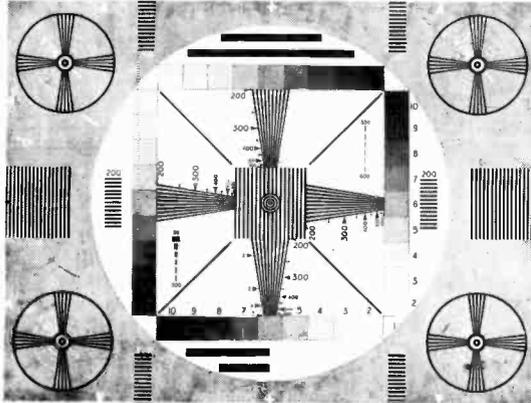
Albanian test card



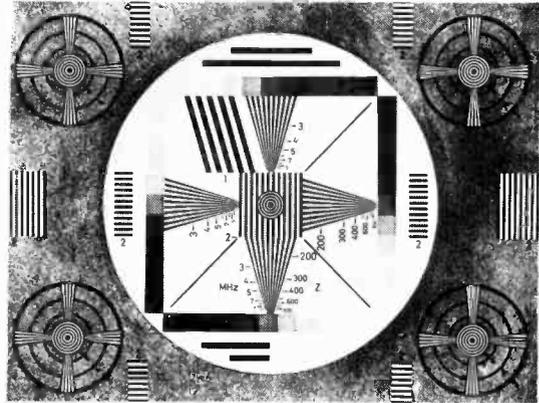
Albanian station identification slide

**DATA PANEL 3—2nd series**

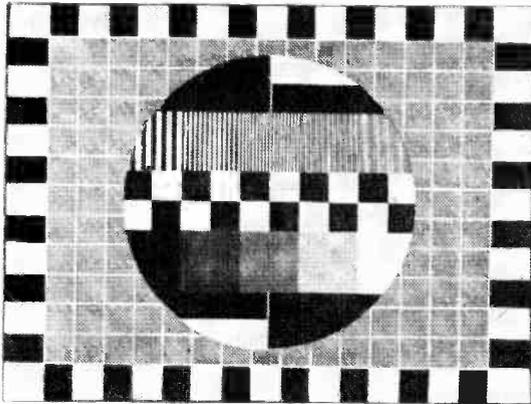
**STANDARD PATTERNS**



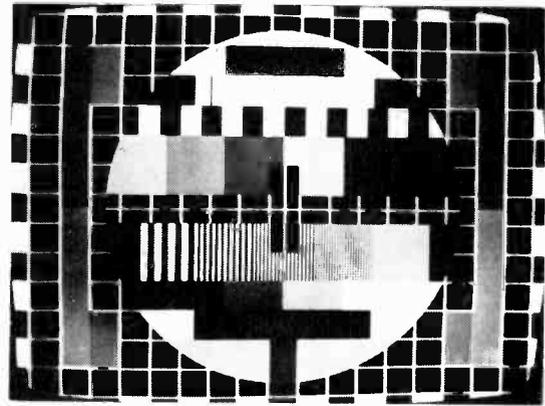
**RMA Test Card**



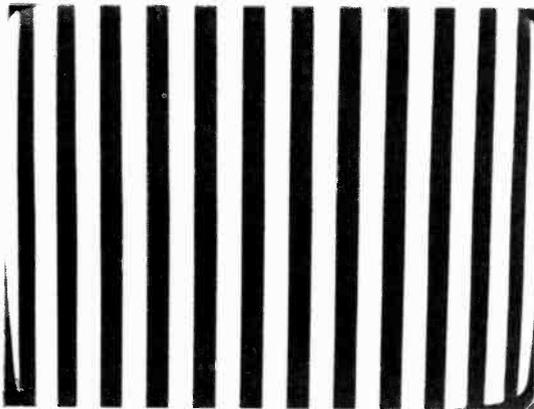
**Telefunken Test Card**



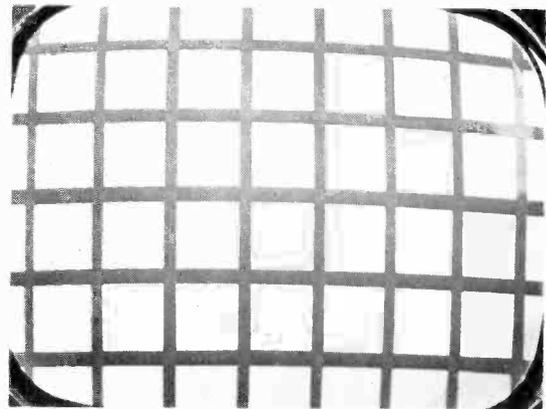
**Philips PM5540 Electronic Test Card**



**ORF PM5544 Electronic Test Card**



**Vertical Bars Pattern**



**Test Grid**

understand that a fellow enthusiast in Brindisi has been receiving signals which are now reported as ch.R7. These transmissions, however, do not come from the Tirana area but from an area in the south of the country. Both test transmissions and programmes are being radiated and we are most fortunate to be able to show the test card and the station identification slide this month. These were actual off-air photographs and consequently are not up to our usual standard, but in view of their importance we feel that they must be shown. The vertical test bars pattern is also radiated, as shown in our Standard Patterns

this month. The 50W transmitter is still the only one listed for Albania—at Tirana. We have received no reports of its reception and, indeed, do not know if it is still operative—on ch.R2. We have found difficulty in obtaining information regarding Albanian TV so if anyone can assist with further information it will be most gratefully received.

*Sunspots:* Predictions of smoothed monthly counts: July 58, August 56, September 54, October 52, November 50, December 48. The increasing fall in sunspots is reflected in the above numbers; indeed, the actual mean

value for June 1971 was 47.1, somewhat below the actual prediction. Courtesy Swiss Solar Observatory.

#### From our Correspondents

A long letter has arrived from Hugh Cocks (Mayfield, Sussex). Hugh uses a Sony transistor television receiver containing coils for the American channels A2-6. Consequently Hugh is at present unable to receive ch.E2 but he certainly makes up for this with excellent coverage of the various Band II (TV) channels. Among the stations he has received in Band II has been the transmitter at Zielona Gora ch.R3 200kW in Poland. Hugh has also been very active with tropospheric during the periods noted above and has presented a fine record of various West German, Dutch and Belgian u.h.f. stations. In his letter Hugh mentions reception of various radio stations on frequencies around 70MHz, apparently of East European origin. Well, there is in Czechoslovakia an extensive f.m. radio network transmitting in a band between 66.32MHz-72.50MHz. This is apparently a countrywide network with transmitters ranging in power up to 10kW and radiating programmes for the whole day, from approximately 04.30 to 24.00 BST. Consequently if you hear East European signals whilst tuning for Band II TV signals it is almost certain that the Czechoslovakian f.m. radio service is being received. I hope that answers Hugh's query and also to have covered a possibly rather little-known transmission band.

A letter from Hal Moorshead (Wanstead, North-East London) reports excellent colour DX signals (CDX) on his KB 22in. colour receiver. Living in a most favourable position by all accounts, with no high ground between Hal and the sea, signals from West German, Dutch, Belgian and French transmitters were received (the latter with reversed video). Hal in particular notes excellent colour from the Goes, Holland, transmitter on ch.E29. A 10-element group A aerial is the only one in use so we can see that long-distance reception is possible on relatively simple equipment.

R. Finch (Birmingham) has sent in a most impressive log detailing the various days of Sp.E reception in his area. Signals seem to have been received from most countries, including the new Czechoslovakian test pattern on several occasions. A rather alarming comment at the end of his letter tells that during the last season (1970) his DX aerial mast was struck by lightning. Although, apparently, lightning never strikes in the same place twice, he is taking no chances and has rebuilt his Band I aerial on a rotator in the loft!

#### In Remembrance

It is with considerable regret that I heard the news that our old friend Doug Bowers (Saltash) had passed away on July 11th, 1971. Doug was a long-established DX enthusiast and despite being disabled for the past 11 years had been very active. He will be particularly remembered for his tropospheric reception of Spain on various occasions, on both v.h.f. and u.h.f. We would like to pass our sincere condolences to Mrs Bowers and her son in their sad and unexpected loss.

## BACK NUMBERS

We regret that owing to the closure by the Company of the department concerned it is no longer possible to supply back numbers of TELEVISION. To ensure that readers get TELEVISION regularly we strongly recommend that a regular order is placed with a local newsagent or that an annual postal subscription (£2.65 including postage for one year to any part of the world) is taken out. Reference to past issues is possible at some public libraries which hold bound volumes and we understand that some offer a photostat service.

**NEXT MONTH IN**

# TELEVISION

## SIMPLE UHF AERIAL PREAMP

A recent transistor, the BF272, is used in a simple circuit housed in a 35mm. film can. The emphasis has been placed on simple construction and minimum expense. The earlier AF139 can be used as an alternative, reducing the cost still further.

## SERVICING TV RECEIVERS

Continuing our coverage of chassis widely used in the rental trade, next month we deal with the Plessey/Defiant 9A50-9A52 series.

## PANORAMIC MONITOR

... Or things you can do with varicap tuners! These are now readily available and are very versatile. One application highlighted is as a Band monitor—the tuner is swept across the Band and the output monitored on an oscilloscope.

## TRANSISTOR VIDEO CIRCUITS

Recent articles have gone into the l.f. and h.f. aspects of valve video circuits in some depth: this concluding article rounds off the subject by dealing with the characteristics peculiar to transistorised video circuits.

## CONSTRUCTORS' CIRCUITS

Next month the audio side: two transistor audio circuits for TV sets will be presented, a simple general-purpose one and a high-performance one with a specification that will satisfy the hi-fi enthusiast.

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# SECRETS OF THE SONY COLOUR RECEIVER



K. ROYAL

THIS is the colour receiver which has been the subject of a number of press reports in recent months: it is the one designed to operate on the PAL system but without infringing the Telefunken patents. There is no doubt that it is a remarkable set which has been very carefully and cleverly evolved by the Sony engineers. It is also a very sensitive set which I personally can vouch works extremely well in fringe areas.

### Display Tube

The display device is not the usual shadowmask tube but a tube called the Trinitron which, instead of using diminutive clusters of red, green and blue glowing dots, is based on vertical red, green and blue glow-

ing stripes. Moreover it uses a single electron-gun assembly (but with three beams) as distinct from the three guns of the shadowmask tube. These features significantly reduce the complexity of convergence both in circuitry and adjustment. However, the screen size is currently smaller than that of shadowmask tubes, being 13in. in the KV1320UB. Our main purpose in this article though is to examine the chroma and decoder departments to see how Sony have exploited the PAL signal without getting into trouble with Telefunken.

The Trinitron tube requires primary-colour drive and the block diagram (Fig. 1) shows that the colouring section concludes with a matrix taking the three colour-difference signals and the Y signal and delivering the red, green and blue signals to the Trinitron

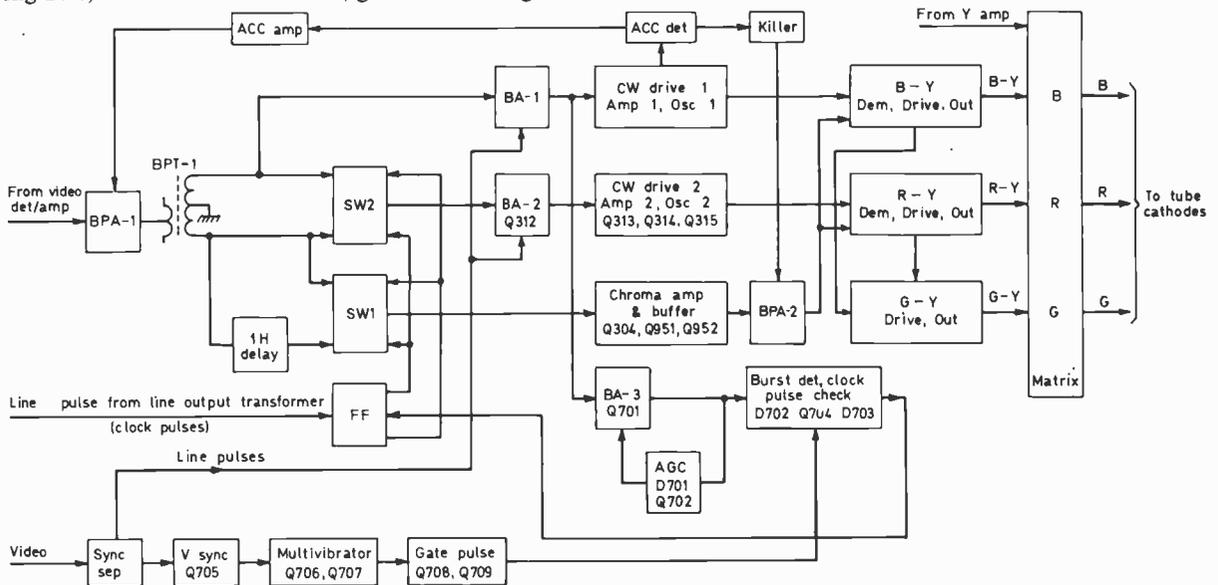


Fig. 1: Block diagram of the Sony decoder and tube-drive system.

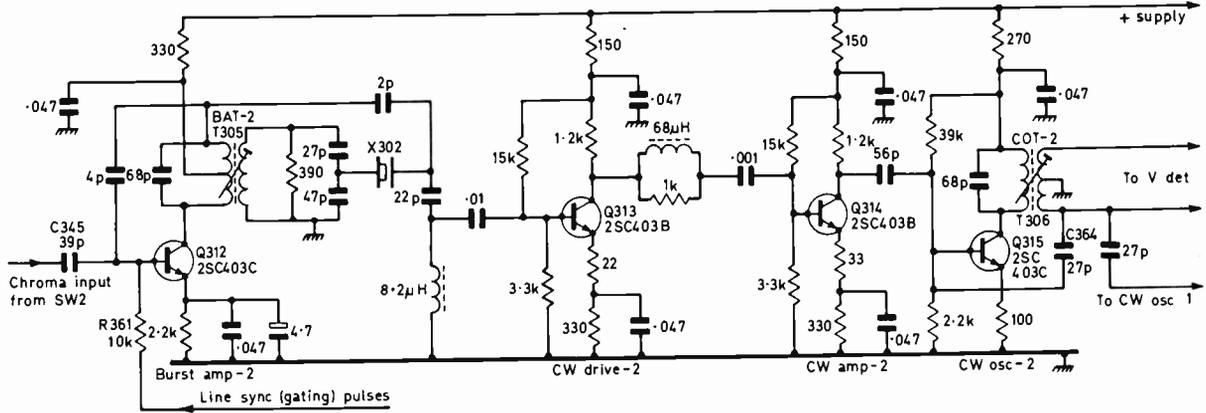


Fig. 2: Circuit of the V reference signal channel.

cathodes: this section of the set is reasonably conventional.

**Reference Signal Generators**

The R-Y (V) and B-Y (U) synchronous detectors produce the two transmitted colour-difference signals in the usual way, but instead of there being just one reference signal generator there are two of them, denoted CW drive 1 and CW drive 2 in Fig. 1. For proper quadrature demodulation we need of course two reference signals with a 90-degree phase displacement between them. Ordinary PAL sets accomplish this by including a 90-degree phase shifter in the reference signal feed to one of the synchronous detectors: Sony do it differently as we shall see.

Each reference signal channel starts with a 4.43MHz crystal which is stimulated, and thus caused to oscillate, by colour bursts applied to it from the burst amplifier. Again there are two of these, one in each channel, denoted BA-1 and BA-2 in Fig. 1. The circuit of one channel (the other is just the same), including the burst section, is shown in Fig. 2.

The amplifiers receive chroma signal from the

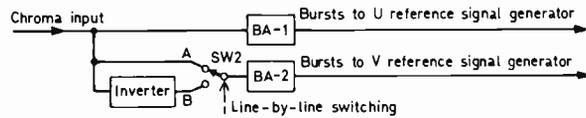


Fig. 3: Simplified block diagram showing how SW2 inverts the signal fed to BA-2 on alternate lines.

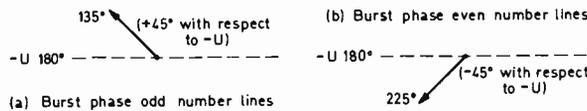


Fig. 4: The phase of the PAL bursts, (a) on odd lines, (b) on even lines.

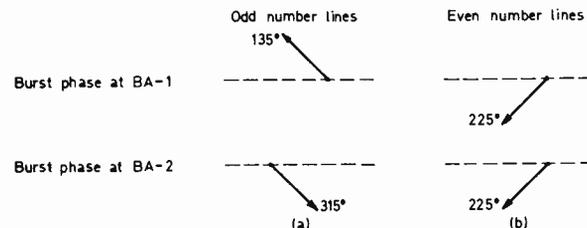


Fig. 5: Phase of the burst signals fed to BA-1 and BA-2 on odd lines (a) and even lines (b).

chroma channel BPA-1 (Fig. 1) via transformer BPT-1. Amplifier BA-1 in the B-Y channel is fed direct from BPT-1 but the feed to BA-2 in the R-Y channel is via SW2 which introduces a 180-degree inversion on alternate lines. This can be appreciated better from Fig. 3. SW2 itself is operated by line-by-line pulses (from block FF in Fig. 1) and thus switches between positions A and B line-by-line (FF is a "flip-flop", see later). Thus with SW2 in position A the chroma signal is fed direct to both BA-1 and BA-2 while in position B the chroma signal applied to BA-2 is changed 180 degrees in phase by the inverter. (In practice inversion is carried out by the centre-tapped secondary winding of BPT-1.)

**PAL Swinging Bursts**

What is the significance of this? First let's recap on the PAL chroma signal and recall to start with that the phase of the bursts swings 45 degrees about the -U chroma axis (see Fig. 4) so that on one line they are +45 degrees and on the next line -45 degrees. It is convenient to consider lines of chroma signal in consecutive number (1, 2, 3, 4, etc.) and that the bursts swing from 135 degrees on one line to 225 degrees on the next consecutive line (this is because the -U chroma axis is regarded as 180 degrees). On this basis then the PAL signal is transmitted so that the bursts on odd number lines (1, 3, 5, 7, etc.) are at a phase of 135 degrees while those on even number lines (2, 4, 6, 8, etc.) are at a phase of 225 degrees as shown in Fig. 4.

**Action of SW2**

Now let us see what happens when these line-by-line bursts are switched by SW2 and processed by the inverter in Fig. 3. If the chroma line is say an odd number and SW2 is at position B then the bursts fed to BA-2 will have a phase of 315 degrees (since they are shifted 180 degrees by the inverter) while those fed to BA-1 will have the transmitted 135-degree phase. These conditions are shown at (a) in Fig. 5. On the next consecutive line, which will be an even number one, the bursts will have a phase at BA-2 of 225 degrees, since now SW2 is at position A—in other words the phase will coincide with that transmitted as shown at (b) in Fig. 4—while the phase of the bursts at BA-1 will also be at 225 degrees because the chroma input to BA-1 is direct. These conditions are shown at (b) in Fig. 5.

The net result of all this is that BA-2 driving the V reference signal channel is fed with bursts swing-

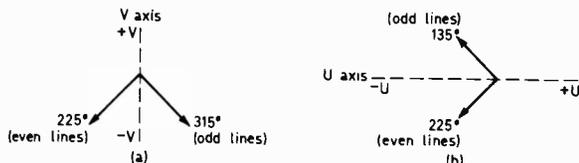


Fig. 6: The average phase of the reference signal fed to the V detector is coincident with the V chroma axis (a) while that of the reference signal fed to the U detector is coincident with the U chroma axis (b).

ing  $\pm 45$  degrees relative to the V chroma axis while *BA-1* driving the U reference signal channel is fed with bursts swinging  $\pm 45$  degrees relative to the U chroma axis, as shown respectively at (a) and (b) in Fig. 6.

The burst amplifiers *BA-1* and *BA-2* drive the 4.43 MHz crystal tuned circuits and because of the high *Q* of these and the time-constants involved the average phase of the signal generated in the *CW drive 1* channel lines up with the U axis while the average phase of the signal generated in the *CW drive 2* channel lines up with the V chroma axis. Moreover the intervals between the bursts are effectively deleted so that each synchronous detector receives a c.w. signal at 4.43MHz with a 90-degree displacement between the two signals as required for correct quadrature demodulation. That is, the phase of the signal applied to the V detector is along the V axis and that of the signal applied to the U detector along the U axis.

When we commenced investigating the action of switch *SW2* and the inverter in Fig. 3 we assumed that *SW2* was at position B during odd number lines. We could have started the discussion by assuming the switch to be in position A during odd number lines. Exactly the same net results would have been achieved, but instead of the average phase of the bursts fed to *BA-2* lining up with the  $-V$  chroma axis the phase would have lined up with the  $+V$  chroma axis. That is the phasors in Fig. 6(a) would have been pointing upwards instead of downwards as shown. The 90-degree phase difference between the reference signals going to the V and U detectors would thus still have been maintained.

From this aspect therefore it matters not in the least whether *SW2* switches from A to B on odd or even lines. In fact the set works (with certain provisos) whichever line *SW2* latches on to. Nevertheless there is an identification (ident) system which synchronises the switching to one particular line mode, the even number lines. We shall see in a minute that such lines correspond to PAL lines of reversed V chroma phase—i.e.  $-V$  lines.

### Reference Signal Channels

Transistor Q312 in Fig. 2—the *BA-2* burst amplifier—receives at its base the chroma signal via C345 and also line sync pulses through R361. The transistor is normally biased off but during the bursts it is biased

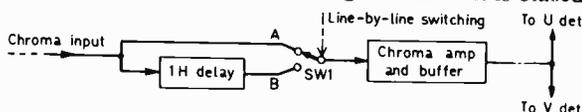


Fig. 7: Simplified block diagram showing how *SW1* feeds the signal from the delay line to the chroma channel on alternate lines.

on by the line sync pulses. These are positive-going and about 6V p-p. They are taken from the sync separator through an LC circuit which adjusts their timing to correspond to the periods of the bursts. Q312 is thus a gated burst amplifier so that the bursts only arrive at the crystal X302 via transformer *BAT-2* when Q312 briefly conducts during the burst period, i.e. the chroma information is deleted. The crystal produces the 4.43MHz c.w. signal which after amplification by Q313 and Q314 is fed to Q315. This transistor is under conditions of mild positive feedback (from transformer *COT-2* in the collector via C364 to its base), ensuring that a steady 4.43MHz signal is fed to the V detector. The other channel is just the same but drives the U detector.

### PAL V Chroma Phase Alternations

Going back to Fig. 1 we see that there is a second diode switch *SW1* which is associated with the delay *IH*. This switch feeds chroma signal from transformer *BPT-1* to the chroma amplifier and buffer (and thence through *BPA-2* to the V and U detectors) either direct or through the delay *IH*. Fig. 7 shows the relevant section in block diagram form. *SW1* is also switched line-by-line and as for *SW2* the switching source is *FF*. Thus *SW1* and *SW2* switch in synchronism line-by-line.

We must now look at the second parameter of the PAL signal, namely the line-by-line phase alternations of the V chroma signal. These 180-degree alternations accompany the swings of the bursts so that on odd number lines when the bursts are at 135 degrees the V chroma signal is positive (i.e.  $+V$ ) while on even number lines when the bursts are at 225 degrees the V chroma signal is negative (i.e.  $-V$ ). The action is clarified in Fig. 8. The U chroma signal of course has a constant phase axis on all lines.

Now let's see what *SW1* (Fig. 7) does to these alternations. If the line is say an odd number with  $+V$  chroma and *SW1* is at position A then the chroma signal is applied directly to the chroma amplifier and buffer and the conditions are as shown in Fig. 8(a). On the next line however when the transmitted signal is  $-V$  (an even number line) *SW1* will be at position B and chroma signal will pass to the chroma amplifier etc. through delay *IH*. The period of delay provided by *IH* is exactly equal to a line period (64 $\mu$ S). Thus with *SW1* in position B the chroma amplifier etc. will receive a signal corresponding to the previous line, an odd number one carrying  $+V$  chroma. In this switching mode therefore the chroma amplifier will receive only those lines of chroma signal corresponding to  $+V$ . In other words it will not receive lines with  $-V$  chroma signal and instead will process the previous lines with  $+V$  chroma signal. If the switching mode is reversed only the  $-V$  chroma lines will be processed and since *SW1* is synchronised to *SW2* the reference signal phase would change to suit these lines. This then is

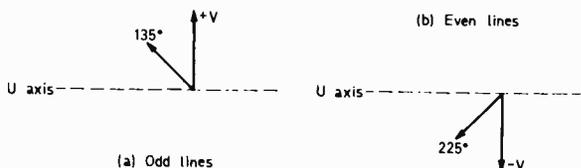


Fig. 8: PAL line-by-line V chroma 180-degree alternations; (a) during odd lines, (b) during even lines.

why it doesn't matter whether *SW1/SW2* switches from A to B on odd or even lines from the general theory of the system.

While all this is going on the lines of Y (luminance) information are being handled in the normal way. What the system does is to delete the phase alternations of the PAL signal at the expense of a rather insignificant reduction in the chroma information used owing to the +V (could be -V) lines being repeated during the times when -V chroma is being transmitted. Note carefully though that the Y information is not in any manner impaired since from this aspect the receiver works normally: and it's the Y signal of course that carries the picture detail.

Since the PAL parameters have been removed the receiver behaves like one designed for the American NTSC signal. The phase correction attribute of the PAL system is thus deleted. This is done because to retain it in any way would be an infringement against the Telefunken patents. In practical terms this means that the colours can change mildly with changes in chroma signal phase anywhere in the system (at the transmitter, in propagation or at the receiver).

**Hue Control**

Since there is no PAL "colour lock" the receiver is equipped with a hue control—as are American NTSC receivers—and the circuit of this is shown in Fig. 9. This can be tied up with the overall block diagram (Fig. 1). The chroma signal is fed to Q951 base from Q304, a buffer amplifier in the chroma channel, which is an emitter-follower. The signal is then passed to Q952 base through transformer T951 and thence from the emitter of this transistor via colour and subcolour controls to *BPA*-2 which feeds the V and U detectors with chroma signal.

The network concerned with the hue control is related to the secondary of T951 and the components between this and Q952 base. The hue control proper (VR905) comes into this of course and owing to the capacitive reactance of C956/C957 working in conjunction with the network resistors relative to the centre-tap on T951 secondary the phase of the colour vector can be swung about ±20 degrees by the hue control. The transformer is tuned to provide the correct nominal phase when the hue control is at mid-setting, indicated by a "click" position.

Relative to the centre setting therefore the hue can be swung towards magenta one way and towards

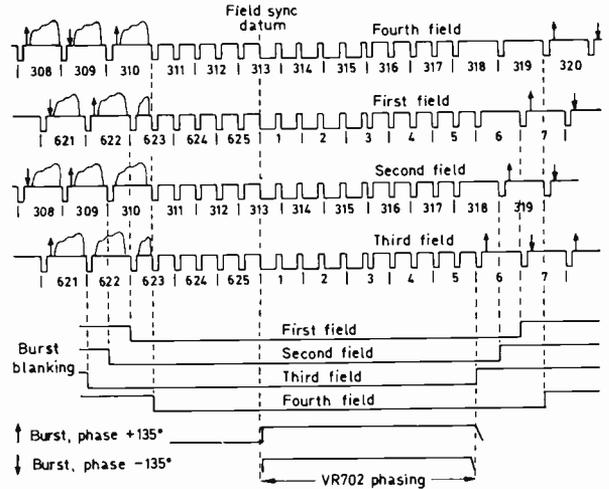


Fig. 10: The BBC's burst blanking sequence during the field sync periods, showing how this is related to the Sony "ident" switching system.

cyan the other and which direction of rotation gives the particular change depends on whether *SW1/SW2* are switching from A to B on odd or even lines. Assuming that T951 is accurately adjusted for exactly the correct hue when VR905 is at its centre "click" position, then random changes in the line-by-line switching mode have no effect at all on the colours. Since this condition would never exist in practice however (the hue control is there to adjust anyway!) random changes in line-by-line switching would tend to introduce colour error (the eye would average the colours produced by the two switching modes and discern the incorrect colours).

To avoid this *SW1/SW2* are switched from A to B on either odd number or even number lines and a unique ident circuit has been developed for this. It is understood that this is engineered so that the even number lines (those carrying -V chroma signal) are used for the chroma information. But the receiver would work equally as well—so far as I have been able to judge—by the use of odd number lines (those carrying +V chroma signal).

**Sony Ident System**

Although it has so far been assumed that line pulses directly switch *SW1/SW2* this is not strictly true: *FF* (Fig. 1) a bistable ("flip flop") circuit which is triggered line-by-line by pulses from the line output transformer actually controls *SW1/SW2*. The action is similar to the V detector bistable switching of ordinary PAL receivers.

Figure 1 shows that *FF* also receives an input from the burst detector clock pulse check. This is the ident section which produces pulses to set the *FF* switching to the selected lines of the chroma signal. Thus if *SW1/SW2* tend to switch in the incorrect mode the ident system yields a cancelling pulse—causing *FF* to miss a count—thereby restoring the correct (selected) switching mode. This action is again similar to that of V detector switching synchronisation in PAL receivers. While, however, PAL receivers obtain the V ident signal from the 7.8kHz "ripple" produced from the swinging bursts by the reference oscillator a.f.c. loop phase detector, the Sony receiver obtains the switching information from the special burst

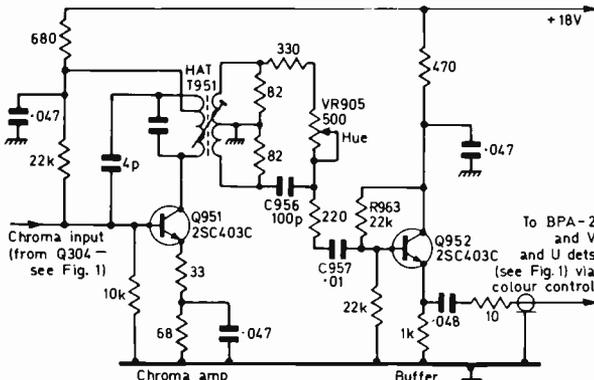


Fig. 9: The chroma amplifier and buffer circuits, showing the hue control arrangement.



# **RAPID** **LINE TIMEBASE** **Fault Diagnosis**

**K.B. Whapples MSERT**

In the author's opinion it is the speedy diagnosis of faults in the line timebase that causes the greatest difficulty to less experienced service technicians. The purpose of this article is to encourage the use of quick methods of diagnosis in the field—since it is in the field that rapid checks are essential if service calls are to be efficient. The basic idea put forward is that a flexible series of quick checks can often lead to the fault being corrected on the spot: only if these checks fail to reveal the cause of the trouble is it then necessary to bring the set in to the repairshop for conventional stage-by-stage testing and evaluation in logical sequence with the full complement of test gear.

Of paramount importance in the field is initial careful examination of the set: learn to look, listen, smell and if necessary touch parts as the set warms up. The procedure should become automatic as experience is gained. As an example of the importance of physical checks, it is hardly meritorious to find by methodical testing that low gain is due to low screen voltage in a stage if the offending feed resistor is all the while obviously and visibly burnt!

## **Sound Normal, No Raster**

Consider then the typical domestic dual-standard receiver with the familiar symptoms of sound normal, no raster. In 80-90% of such cases the cause is a line timebase fault. The important steps are to confirm whether this is so and then to decide whether the repair can be made there and then. Assume then that the set is switched on and that our senses have revealed nothing unusual—initial sensory checks should of course include tube and valve heaters and any signs of overheating.

First ascertain the presence of e.h.t. If the a.c. side (anode top cap) of the rectifier is the most accessible point and the voltage here seems satisfactory, replace the rectifier and check that the heater of the new one is alight. If the set uses an e.h.t. multiplier disconnect this and confirm the presence of sufficient a.c. at the output from the line output transformer e.h.t. overwinding by means of a spark test. A faulty multiplier will almost always load the timebase to virtual standstill and the strong odour is immediately detectable and recognisable. Disconnecting a faulty multiplier will allow the timebase to burst into life which becomes immediately apparent. If now satisfied that there is sufficient e.h.t., check the c.r.t. for correct bias, first anode voltage, heater voltage or ion trap (if fitted) troubles. These points are readily accessible and if all's right here we know we have to concentrate on the line timebase.

The method I advocate and use myself in the field is next to set about eliminating possibilities, not in

any logical order but in a sequence depending entirely on the accessibility of the components in the offending timebase. This approach relies on working through a list—given later—of possible failures. This should be done in such a way that information gathered from each preceding check is used in conjunction with the next most convenient move to make.

Check the operation on both systems, ensuring that the system switch moves to a positive mechanical position and that the contacts used in the timebase appear to be in good order—some receivers, particularly certain GEC and Thorn group models, are notorious for line faults due to poor switch contacts. Any valve which could possibly cause the symptoms should be checked by substitution as this is quickly done and puts our mind at rest before going on to more troublesome tests. Standard tests like lifting the top cap of the efficiency diode to check for a short-circuit boost capacitor are however easily done before getting around to valve changing.

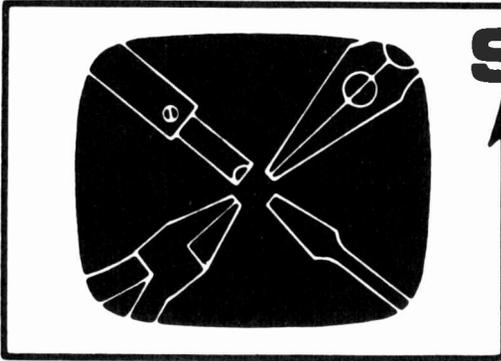
If there is no a.c. on the efficiency diode or e.h.t. rectifier top caps and a labouring output pentode one would suspect lack of drive from the line oscillator stage. A faulty e.h.t. multiplier, deflection coil assembly or perhaps an e.h.t. rectifier with short-circuit heater could, however, produce similar symptoms and all these can usually be eliminated by making disconnections and noting results in the time taken to locate the line output valve grid lead and make a measurement there. Width/set-boost controls are also worth checking by turning to show whether the track is faulty.

The approach suggested may appear random and undisciplined but I can assure readers that in my own experience it has proved its worth in so far as this method enables most line timebase faults to be detected and repaired in a shorter time than by using the classic stage-by-stage technique.

## **Possible Faults**

Here then is the list of possibilities which can be rapidly worked through: **valves**—check all in the timebase if in doubt; **boost capacitor**—lift top cap off efficiency diode to see whether this produces some sort of results; **deflection coils**—often easily unplugged to note whether a short is loading the timebase; **video**—check that the tube bias varies as the brightness control is adjusted; **system switch**—check if not throwing and for bad contacts; **plugs**—check mating of any form of connections; **pulse capacitors** (connected across sections of the transformer)—examine for signs of distress and if necessary cut one lead and note effect; **width potentiometer**—check for bad track; **ion trap**—check for broken strap and/or maladjustment; check **line drive**, presence of **boost voltage**, tube and valve heaters, **e.h.t. multiplier**, line output valve **screen voltage** and the condition of the **linearity sleeve**.

In most sets all these things can be checked in a few minutes and a decision can then be made as to whether the receiver can be repaired on the spot. In conclusion, criticisms and suggestions will be received with great interest, bearing in mind that the aim of the approach outlined is to provide a rapid system of fault-finding which does not overlook too many possible causes of line timebase failure and is yet realistic and economical in this very competitive industry. ■



# SERVICING television receivers

L. LAWRY-JOHN'S

SOBELL ST282 SERIES—cont.

## Field Timebase

There are several trouble spots which affect the height, shape and field hold. Now that these sets have had a good deal of use there are a few not so common faults which did not show up previously. For example an almost total collapse of the height need not be due to a fault in the timebase itself but to one in the h.t. line. If the main smoother loses capacitance (C92, 200 $\mu$ F) the only obvious symptom may be that the raster is only an inch or so high in the centre. Clipping a test electrolytic from Ch1 to chassis (convenient on the lower left) will prove whether this is so and may save a lot of time checking around the PCL85 stage.

This is not to say that faults do not often occur in the timebase itself. On the contrary there are many common fault conditions, mainly due to defective capacitors. It is our practice to replace all suspect paper types from C112 to C119. This is not expensive and can be done quite quickly. C115, C116 and C122 should be rated at 1kV for reliability. At the same

time the electrolytic C117 should be replaced and the value of R118 checked. This resistor is often damaged by a faulty PCL85 and should not be left in circuit if it is discoloured.

It is not unusual for C117 to explode scattering bits of its inside over a wide area. This happens when the PCL85 shorts internally. The thing to do in this case is to replace the valve, R118 and C117.

## IF Stages

At the top of the panel there is a three-pin plug and socket. This is the connection to the volume control. It is a common complaint that the sound may suddenly blare out at full blast irrespective of the position of the control. The control itself is rarely at fault: it is the three-pin socket which is normally found to be responsible. The trouble is that the socket legs are not making proper contact with the print. Good contact must be made on both sides of the panel and all connections should be cleaned and resoldered. This may not prove to be as easy as it sounds.

The nearby PCL84 valve is the audio output valve and is often responsible for low and distorted sound. Also check C76, C77 and C79. The first two are often leaky and the latter often open-circuit. A defective PCL84 may have damaged R76 which must also receive attention.

Sound distortion should also direct attention to R66 (4.7M $\Omega$ ). This is the load resistor of the noise limiter MR3: its value sometimes goes high, clipping even normal signals. Also check C73 and C75.

In the sound i.f. stage V9, R60 may be found burnt out due to C65 shorting. The same thing occurs in the vision i.f. stage V4 where the resistor is R30 and

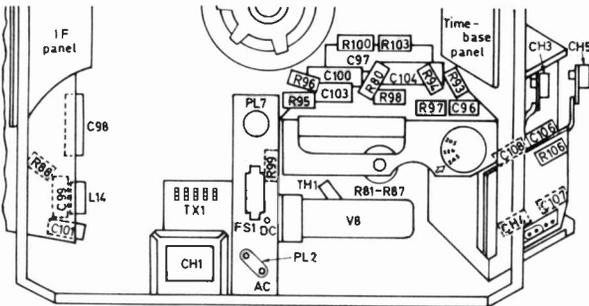


Fig. 2: Rear chassis view.

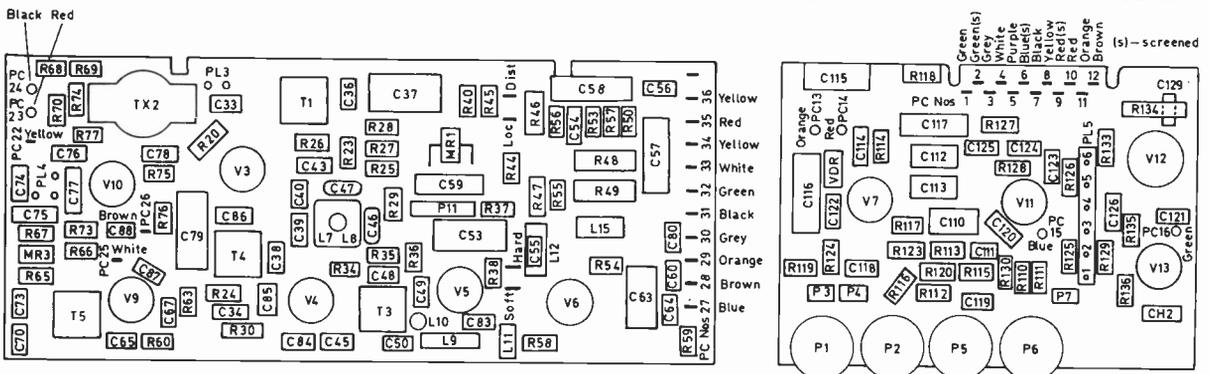


Fig. 3: Layout of the timebase and i.f. printed panels.

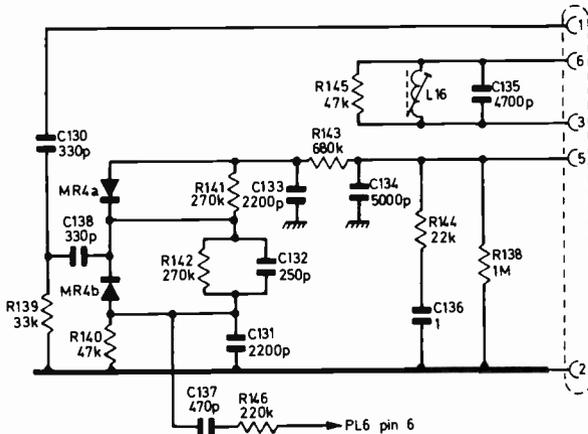


Fig. 4: Circuit of the optional plug-in flywheel sync unit fitted in some fringe area sets. In later flywheel units R138 is 680k $\Omega$ , R140 27k $\Omega$ , R143 1.5M $\Omega$  and R145 is omitted.

the capacitor C45. The panel itself is often damaged by this type of short and the consequent burning. Some careful cutting away of the affected parts with replacement wiring is often necessary to avoid replacing the complete panel.

Note also the h.t.-to-chassis path formed by the resistors R23, R25 and R27. If R23 is burnt but not R25 check the EF183 and C40. If both R23 and R25 are damaged change both as the trouble is more likely to have been caused by a change in value rather than a short elsewhere.

## Video Stage

Changing the PCL84 video amplifier V6 can do wonders for the picture contrast and definition and a further improvement can be had by replacing C58. This capacitor also has a profound effect upon the field and line synchronization, being in the PCL84 cathode circuit: if it becomes open-circuit current feedback is introduced thereby reducing the gain of the stage particularly at the lower (sync) frequencies.

## Tuner Units

The tuner found fitted may be of the push-button type or the standard Sobell rotary. Quite a bit of trouble has been experienced with the push-button type, mainly mechanical (broken or worn plastic members etc.). It is essential to set up any particular button in the first instance (channel selection) with the button *not* pushed in (remove outer cover to adjust). When the channel has been selected, the button may be depressed and the red fine tuner end adjusted for optimum results. If the plastic is worn this may not be possible.

The rotary tuner shares with the push-button type one common defect. This is the tendency of the oscillator load resistor to rise in value to a point where the local oscillator fails and the only signals received are those which break through at the i.f. The rotary tuner uses a 10k $\Omega$  1W type in a fairly open position under the PCF806 valvebase. If the one fitted is discoloured cut it out and fit another. Even if this is not essential at the moment it can save trouble later.

The same cannot be said for the resistor used in

the push-button tuner. A 12k $\Omega$  1W type is used and a certain amount of dismantling must be done to gain access to it. Therefore, if the tuner is functioning leave it alone and merely check the valves and clean the contacts.

## Conclusion

If one further word of advice may be offered it is to purchase several of these secondhand sets cheap and not in going order rather than to buy one at a higher price reputedly in good going order. This ensures the availability of spares and enables one to have the comfort of knowing that the finished set is not bodged in any way.

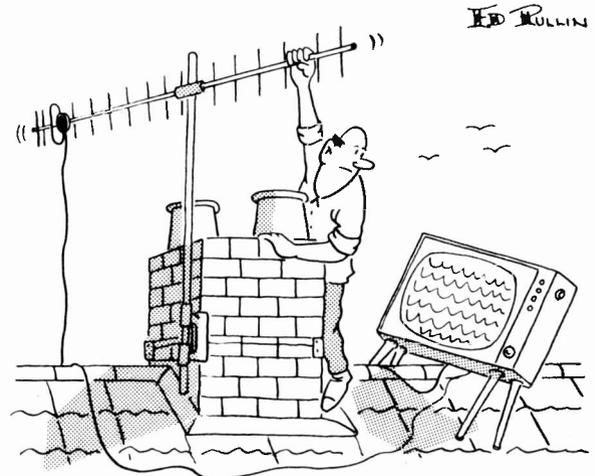
*Editorial Note:* We understand that these sets are available in "as-is" condition from RBTv, 82 North Lane, East Preston, Sussex at £16 plus £1.50 carriage.

## NEXT MONTH: DEFIANT 9A50-9A52 SERIES

## AERIAL NEWS

The aerial makers have been busy with new introductions and improvements to existing ranges. Maxview aerials have introduced a direct-to-chimney wall bracket which in conjunction with a new universal clamp is claimed to fix any aerial to any mast, making aerial orientation easier and reducing installation time. Details from Maxview Aerials Ltd., Maxview Works, Setch, King's Lynn, Norfolk. J Beam have made a number of improvements to the radiator (skeleton slot dipole) and reflector elements used in their Parabeam and Multibeam u.h.f. aerials. The junction box cable connections have also been modified. Rigid-lock is incorporated in the radiator and reflector elements to prevent displacement by birds or high winds.

From Aerialite come the Constant, a set-top bi-square with two circular stainless steel elements at £1.80, the Selector, a smaller 9-element version of their Supreme fringe-area u.h.f. aerial with S-shaped directors and a pair of coplanar-mounted folded dipoles, and a new range of loft aerials, the 45/6/L 6-element aerial at £2.10 and the 45/10/L 10-element aerial at £2.50. These loft aerials are based on the Golden-Gain models but have an improved mounting arrangement for fitting to joists, roof beams or walls, providing a wide range of movement in all directions.



# BASIC CIRCUITS FOR THE CONSTRUCTOR

## THIS MONTH: 405-LINE SOUND IF STRIP AND GATED AGC CIRCUIT

THE sound i.f. section is one of the least complicated parts of the receiver and should present few problems. The requirements for a 405 sound i.f. amplifier are that it should provide stable amplification at 38.15MHz with around 500kHz bandwidth, and also that the a.m. detector should produce a voltage which when used for the purpose of gain control will keep the audio output level reasonably constant with variations in signal strength. Without gain control the final i.f. transistor would go into limiting on all but the weakest signals, thus stripping the amplitude modulation from the i.f. carrier.

The circuit (Fig. 1) is very similar to that of the 405 vision i.f. channel described in the June issue, the only real difference being that the coils are designed to give a much narrower bandwidth. A 38.15MHz tuned circuit (L12, C14) in the vision i.f. (see Fig. 2, page 345, June issue) feeds a low-level signal to the base of Tr401. This transistor is reverse gain controlled by a negative voltage fed back from the sound detector D401. It is permissible to use reverse gain control in this application because we are not too worried about changes in i.f. response shape—a tilt of a few dB does not matter here while it would be undesirable in a vision i.f. strip.

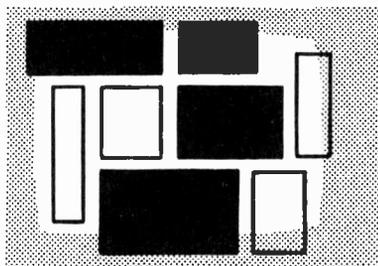
After amplification by Tr401 the i.f. signal is developed across an undamped single tuned circuit L401, C406. Impedance matching into the next stage is achieved partly by the primary-secondary turns ratio of L401 and partly by the potential divider formed by C409 and the input capacitance of Tr402. The second stage of i.f. amplification employs an identical tuned circuit L402, C426 and additionally the stage is unilateralised by R409 and C414. The final stage is also unilateralised and uses a double-tuned circuit, L403a/b with C421 and C422, to couple the high-level signal to the sound detector D401. L404 and C424 filter residual i.f. from the detected audio signal and a negative a.g.c. voltage is developed across C423 and passed back to the base of Tr401 via suitable low-pass filtering (R412, C408).

### Construction and Testing

The recommended layout for the sound i.f. strip is shown in Fig. 2 and is very similar to the layout of the 405 vision i.f. strip (circuit No. 1 in this series). The screened input cable connected to the base of Tr401 should be as short as possible: this can only be achieved if the 405 vision i.f. strip is laid out alongside the sound i.f. strip as indicated. Medium-loss v.h.f. coaxial cable, not microphone cable, should be used. If the length of cable differs greatly from 5cm, a change in the value of C14 may be necessary to permit the correct tuning of L12.

As a preliminary test measure the resistance across C427: a short-circuit indicates a fault in one of the feedthrough capacitors. Assuming that all is well connect a 15V supply to the strip. The transistor emitter voltages should be between 1.5 and 4.0V.

Disconnect one end of R412, thus disabling the a.g.c. Inject a 100mV 38.15MHz signal at the junction



J.W. THOMPSON

of C11 and C12 (Fig. 2, June issue) and detect with a voltmeter across C424 (positive side of the meter to chassis). Peak L12, L401, L402 so that the meter reading does not exceed 2V. When all the coils are fully peaked at 38.15MHz, manually sweep the signal generator between 37 and 39MHz and note the response shape of the i.f. amplifier. The response should be similar to that shown in Fig. 3. If it is narrower it is possible to detune L401 and L402 so that the response is "spread" to the correct limits. R412 may then be reconnected and the i.f. amplifier tested on an off-air signal. The level of audio from the detector may be changed if necessary by altering resistors in the a.g.c. loop, in particular R402 and R412.

### Line-gated AGC Circuit

It is quite difficult to derive a suitable source of a.g.c. for a 405-line vision i.f. strip. Many readers will be aware of the unpleasant effects caused by the "mean-level" a.g.c. system generally used: the i.f. gain is dependent on picture content and on night scenes the gain is turned right up with a resultant increase in picture noise. The use of a line-gated a.g.c. circuit easily repays the extra effort involved in its construction.

The circuit (Fig. 5) is conventional and employs three transistors. The 405-line video signal is fed to the base of Tr405 in the collector circuit of which the gating transistor Tr404 is connected. Tr404 allows current to flow through the two transistors during part of the line flyback period only. Thus regardless of the picture content the video signal returns to black level at the beginning and end of each line (these periods are known as the front and back porches). If the line flyback gating pulses fed to the base of Tr404 arrive at the right time the black level of the picture will be effectively sampled by the series combination of Tr404 and Tr405 and an a.g.c. voltage will build up across C431. The level of this voltage will be proportional to signal strength and completely independent of picture content. Tr406 amplifies the a.g.c. voltage which is then used to control the gain of Tr11 in the vision i.f. strip.

The layout of the a.g.c. circuit is not at all critical and it may be built most easily on paxolin pinboard. If the connection between D403 and C110 is particularly long screened cable should be used, but do not screen the video feed to Tr405.

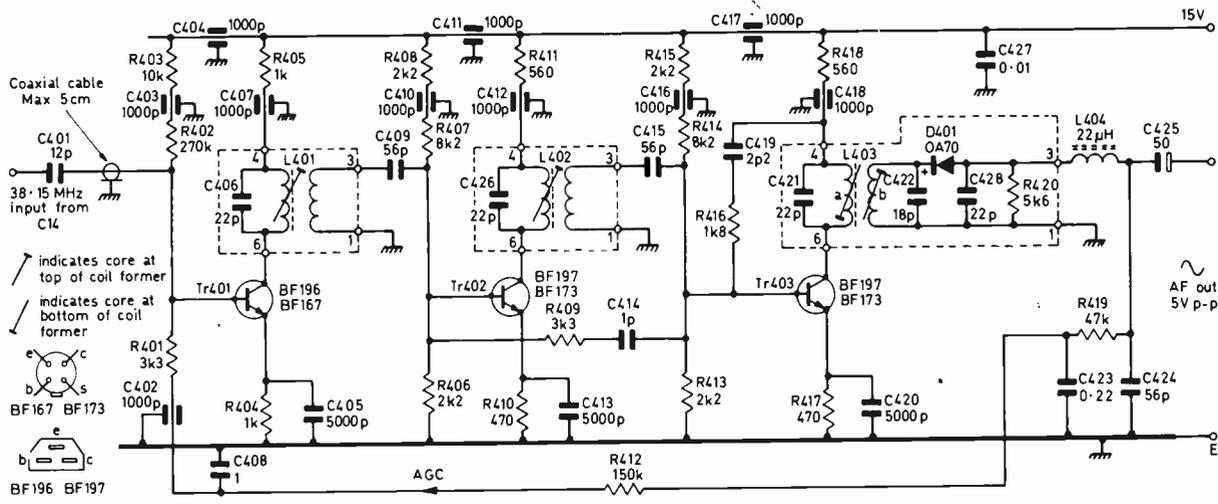


Fig. 1: Circuit diagram of the 405-line sound i.f. strip.

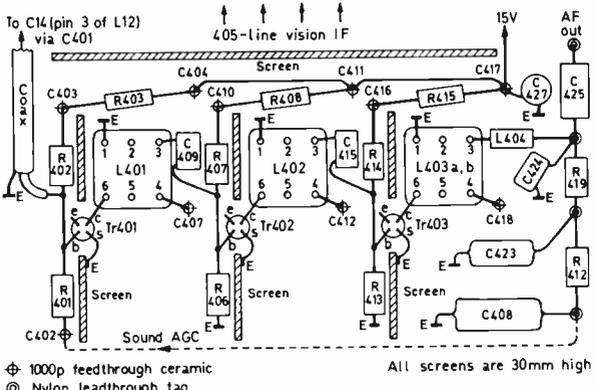


Fig. 2: Recommended layout (underside). For clarity the emitter resistors and capacitors, R405, R411 and R418 and the neutralising components have been omitted. The neutralising components should be connected in the same manner as those in the 405-line vision i.f. strip (see Fig. 4, page 347, June issue).

Fig. 3 (right): 405-line sound i.f. strip response curve.

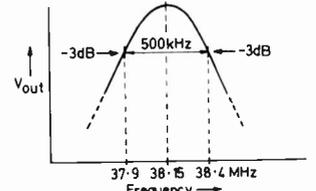


Fig. 4 (below): Coil data for the sound i.f. strip.

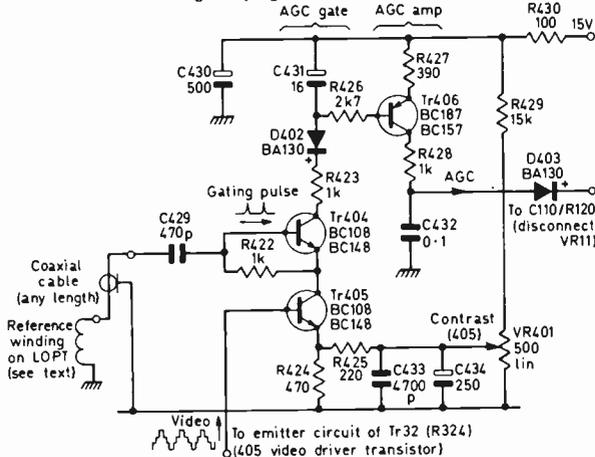
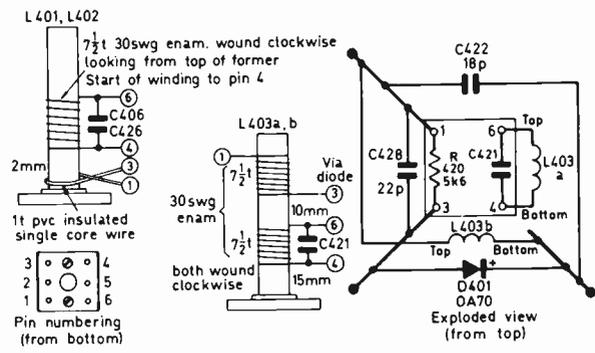


Fig. 5: Line-gated a.g.c. circuit for use with the 405-line vision i.f. strip. The BC157 has the same base as the BC148 and the BC187 the same base as the BC108, see Fig. 12, page 447, August issue. The gating pulse is obtained by winding four turns of e.h.t. cable on to the primary winding of the line output transformer.

Installation of the a.g.c. unit in the receiver is straightforward. Disconnect VR11 completely and connect the lead which went to the slider of this control to D403. The contrast is then controlled by VR401. To obtain a suitable source of line gating pulses wind four turns of e.h.t. cable on to the primary winding of the line output transformer. One end of this reference winding is connected to chassis and the hot end to C429 through screened cable (see Fig. 5). The phasing of the winding may have to be reversed to obtain gating pulses of the correct polarity (positive-going). Note that the contrast will vary with the setting of the line hold control; the correct setting for this control will normally be near the centre of its lock-in range. More specific details of this will follow when the line timebase circuit is discussed.

## ADDITIONAL NOTES ON CIRCUIT 2

### Adding AFC

All tuners including varicap types suffer from oscillator drift with change in temperature. This drift may be as much as 500kHz for every 20°C rise in temperature. Drift can be minimised by mounting the tuner

## ★ components list

### Resistors:

R401	3.3k $\Omega$	R407	8.2k $\Omega$	R413	2.2k $\Omega$	R419	47k $\Omega$	R426	2.7k $\Omega$	All $\frac{1}{4}$ / $\frac{1}{2}$ W 5% carbon film VR401 500 $\Omega$ Variable lin.
R402	270k $\Omega$	R408	2.2k $\Omega$	R414	8.2k $\Omega$	R420	5.6k $\Omega$	R427	390 $\Omega$	
R403	10k $\Omega$	R409	3.3k $\Omega$	R415	2.2k $\Omega$	R422	1k $\Omega$	R428	1k $\Omega$	
R404	1k $\Omega$	R410	470 $\Omega$	R416	1.8k $\Omega$	R423	1k $\Omega$	R429	15k $\Omega$	
R405	1k $\Omega$	R411	560 $\Omega$	R417	470 $\Omega$	R424	470 $\Omega$	R430	100 $\Omega$	
R406	2.2k $\Omega$	R412	150k $\Omega$	R418	560 $\Omega$	R425	220 $\Omega$			

### Capacitors:

C401	12pF	SM	C411	1000pF	F	C421	22pF	SM	C431	16 $\mu$ F	E
C402	1000pF	F	C412	1000pF	F	C422	18pF	SM	C432	0.1 $\mu$ F	PE
C403	1000pF	F	C413	5000pF	DC	C423	0.22 $\mu$ F	PE	C433	4700pF	PE
C404	1000pF	F	C414	1pF	SM	C424	56pF	SM	C434	250 $\mu$ F	E
C405	5000pF	DC	C415	56pF	SM	C425	50 $\mu$ F	E	E	electrolytic 15V	
C406	22pF	SM	C416	1000pF	F	C426	22pF	SM	F	feedthrough	
C407	1000pF	F	C417	1000pF	F	C427	0.01 $\mu$ F	DC	SM	silver mica	
C408	1 $\mu$ F	PE	C418	1000pF	F	C428	22pF	SM	PE	polyester 160V	
C409	56pF	SM	C419	2.2pF	SM	C429	470pF	C	DC	disc ceramic	
C410	1000pF	F	C420	5000pF	DC	C430	500 $\mu$ F	E	C	ceramic	

### Semiconductors:

Tr401	BF167	(BF196)	Tr404	BC108	(BC148)	Lockfit equivalents in brackets
Tr402	BF173	(BF197)	Tr405	BC108	(BC148)	D401 OA70
Tr403	BF173	(BF197)	Tr406	BC187	(BC157)	D402, D403 Any silicon diode, e.g. BA130, 1N914, etc.

### Miscellaneous:

L404	22 $\mu$ H choke (Painton)	4	Hexagonal dust cores 6 × 12.7mm. (Z81A)	Numbers in brackets from Home Radio catalogue.
3	Aladdin coil formers $1\frac{3}{8}$ × $\frac{1}{2}$ in. (CR14)	4	Nylon feedthrough tags (Z149)	30s.w.g. enamelled copper wire, etc.
3	Screening cans (CR15)			

in a cool part of the receiver but even this measure may not be necessary as even 500kHz drift is barely noticeable on a monochrome receiver. On a colour receiver however the tuning limits are much finer and the tolerable drift may be only 200kHz. In the writer's colour receiver (in which circuit No. 2 in this series is currently being used) the effects of drift were almost eliminated by sensible positioning of the tuner and the use of a very effective a.c.c. circuit in the decoder.

Drift can also be eliminated by the use of a.f.c.

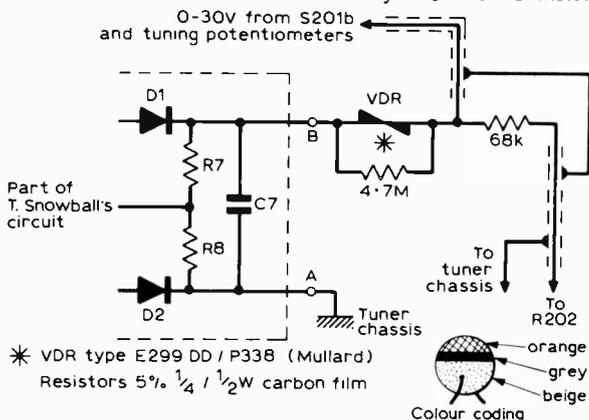


Fig. 6: Method of using the a.f.c. circuit given by T. Snowball in the June issue to provide a.f.c. for the varicap tuner used with the 625-line i.f. strip (Fig. 3, page 400, July issue).

(automatic frequency control). T. Snowball's circuit given in the June issue can be modified for use with a varicap tuner and the details are given in Fig. 6.

Tr2 (see Fig. 4, page 361, June) and the associated components are omitted and the voltage from the a.f.c. discriminator (across points A and B in Fig. 6) is fed to the tuning voltage line of the varicap tuner via a resistance network incorporating a v.d.r. This device ensures that the a.f.c. loop gain is constant over Bands IV and V—it is a standard Mullard component (type E299DD/P338). Points A and B may need to be interchanged so that correct a.f.c. phasing is obtained.

The alignment procedure given in T. Snowball's article should of course be followed. Take the input for the base of Tr1 in the a.f.c. circuit from the junction of C244, C242 in the 625-line i.f. amplifier (Fig. 3, pages 400-1, July issue) via a 1pF capacitor. Realignment of L208/L209 will be necessary.

### Extending the AGC Range

In certain locations the range of the a.g.c. circuit used in the 625-line i.f. strip may be found to be inadequate. The situation is likely to arise when signals are available from two or more u.h.f. transmitters, one of which might be about 10mV and another about 50 $\mu$ V. Changing the preset gain applied to Tr202 by selecting a suitable alternative value for R217 would in this case be inconvenient but it is possible to apply a.g.c. to Tr202 as follows. Change

—continued on page 565

# COLOUR RECEIVER CIRCUITS

## BASIC PAL CODING AND DECODING

GORDON J. KING

IN the last four articles we have considered in some detail the various circuits used with colour-difference and primary-colour picture tube drive, while the two articles prior to these investigated the circuits handling the video and luminance signals. We must next investigate the circuits which lead to the delivery of the two transmitted colour-difference signals, R-Y and B-Y, to the colour-difference preamplifiers. In this month's instalment however we shall, to set the scene, outline the basic features of the transmitted colour signals.

### Encoding Summary

The signal path from the camera to the main modulator at the transmitter is shown in Fig. 1. The three pick-up tubes in the camera deliver R, G and B primary-colour signals in proportion to the colour in the scene present. These signals are applied to a matrixing system which produces three different signals. In one section of the matrix the R, G and B signals are added in the proportions of 30%, 59% and 11% respectively to obtain the Y (luminance) signal. In other sections of the matrix this new signal is subtracted from the R and B primary-colour signals to give R-Y and B-Y colour-difference signals. Thus at this stage there are three main signals: Y, R-Y and B-Y.

The Y signal constitutes the basic monochrome modulation and is applied to the u.h.f. carrier wave in more or less the normal way along with the sync and blanking pulses. This makes it possible for an ordinary black-and-white receiver to produce a monochrome picture from a colour transmission without undue complications: such a receiver does not of course respond to the colouring information in the composite signal.

### PAL Signal Weighting

R-Y and B-Y signals in a PAL system transmitter are weighted and then applied to separate modulators. After weighting they are referred to as the V and U signals respectively. This weighting is

introduced to avoid overmodulation of the composite vision carrier during peaks of the chroma signal. The values of the PAL weighting are such that  $V=0.877 (R-Y)$  and  $U=0.493 (B-Y)$ .

At the U and V modulators the U and V signals are modulated on to a subcarrier with a frequency of exactly 4.43361875MHz—for convenience however this is generally given as 4.43MHz. The exact frequency is chosen to minimise the effect of the subcarrier on monochrome receiver picture displays and also allows the colouring information to be accommodated at the top end of the video spectrum within the normal 625-line monochrome channel bandwidth.

### Quadrature Modulation

The U and V modulators work with the same subcarrier frequency but the phase angle of the V subcarrier leads the U subcarrier by 90 degrees. The two modulators use double-sideband amplitude modulation with suppressed subcarrier and the two outputs are then added, the resultant signal multiplex being known as the *chrominance* (chroma for short) signal.

This technique of carrying two lots of different information on one carrier (or subcarrier) is known as *quadrature modulation*, because the phase of the carrier upon which one lot of information is carried differs by 90 degrees from that upon which the other lot of information is carried. In this way it is possible to carry two independent signals with minimal interaction on a common signal multiplex and subsequently to reclaim each signal separately and in isolation at the receiver.

### Colour Bursts

A circuit in the receiver replaces the subcarriers suppressed at the transmitter, but since the demodulation in the receiver is possible only when the frequency and phase of the reintroduced subcarrier (generally called *reference signal*) match those at the transmitter the transmitted signal must carry information to enable this synchronism to be achieved accurately. For this purpose the colour burst signal,

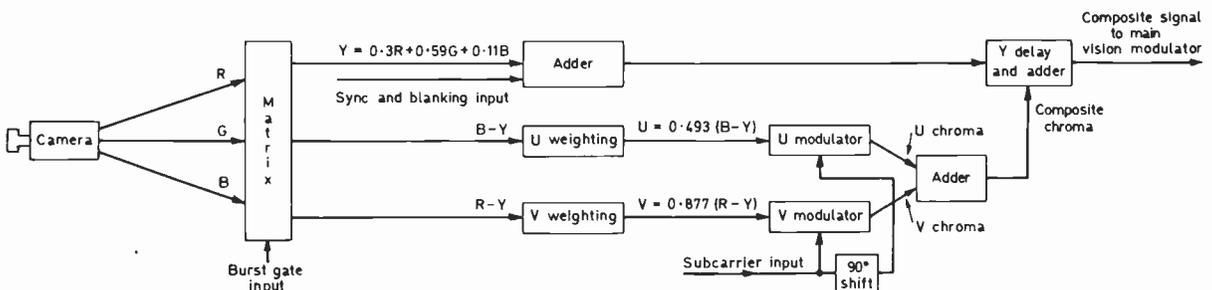


Fig. 1: Basic features of a colour transmitter (see also the PAL V switching shown in Fig. 8).

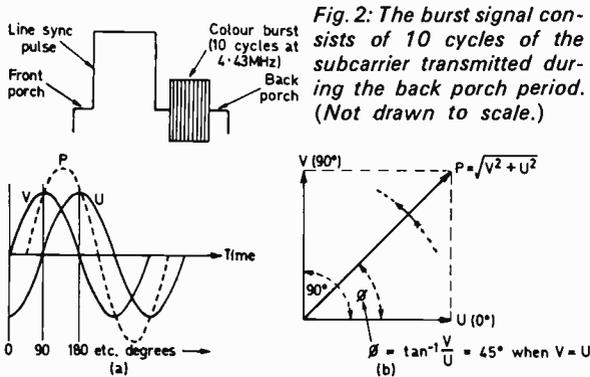


Fig. 2: The burst signal consists of 10 cycles of the subcarrier transmitted during the back porch period. (Not drawn to scale.)

Fig. 3: V and U chroma signals with the resultant P obtained from their addition, (a) shown in sinewave form and (b) in vector form.

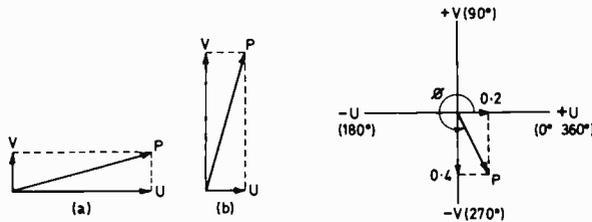


Fig. 4 (left): How the phase of the resultant P changes with differences in the relative amplitudes of V and U.

Fig. 5 (right): Chroma axes, showing the phasor P produced by -0.4V and 0.2U.

which consists of 10 cycles of subcarrier signal, is transmitted during the back porches of the line sync pulses as shown (not to scale) in Fig. 2. This signal is obtained from the subcarrier generator at the transmitter and so is of exactly the right frequency and phase to synchronise the reference oscillator used in a receiver. The receiver in effect processes these line-by-line bursts and changes them into a continuous signal for application to the chroma demodulators.

**Modulators**

The composite chroma signal is then added to the delayed Y signal and fed to the main vision modulator. Delay in the Y channel is necessary—as in the

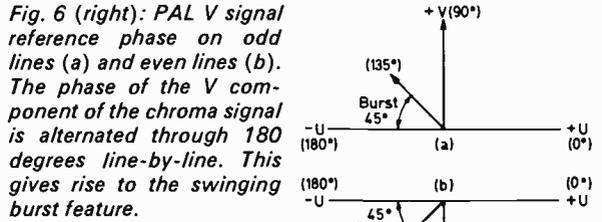


Fig. 6 (right): PAL V signal reference phase on odd lines (a) and even lines (b). The phase of the V component of the chroma signal is alternated through 180 degrees line-by-line. This gives rise to the swinging burst feature.

receivers themselves—to compensate for the narrower bandwidth of the chroma channel relative to the Y channel. Signals pass faster through the latter and so need to be delayed to secure time coincidence at the main modulator.

The V and U modulators delete the subcarrier signal, their outputs consisting of sideband energy only. This means that when the camera is scanning a colourless scene (i.e. one composed of white, through greys to black) there is no output from the modulators. Thus the modulators provide an output only when there is colour in the scene. The smaller the colour saturation the smaller the output from the modulators and the less risk there is of the chroma information causing dot interference on monochrome receivers.

**The PAL System**

Our basic block diagram (Fig. 1) has been simplified in order to give a clear overall picture of what goes on at the transmitter and does not show the PAL alternate line V switching. The V component of the chroma signal is transmitted with a 180° phase shift on alternate lines in the PAL system and among other things this means that the colour bursts swing in phase +45 degrees on one line and -45 degrees on the next line relative to the -U chroma axis as shown later (see Fig. 6).

Try to visualise the two components of the composite chroma signal first as ordinary sinewaves and then as vector equivalents. Fig. 3 shows at (a) V and U sinewaves of the same frequency but with a 90-degree phase displacement. The V wave is shown leading the U wave by 90 degrees. By adding the instantaneous values of the two waves we get the new

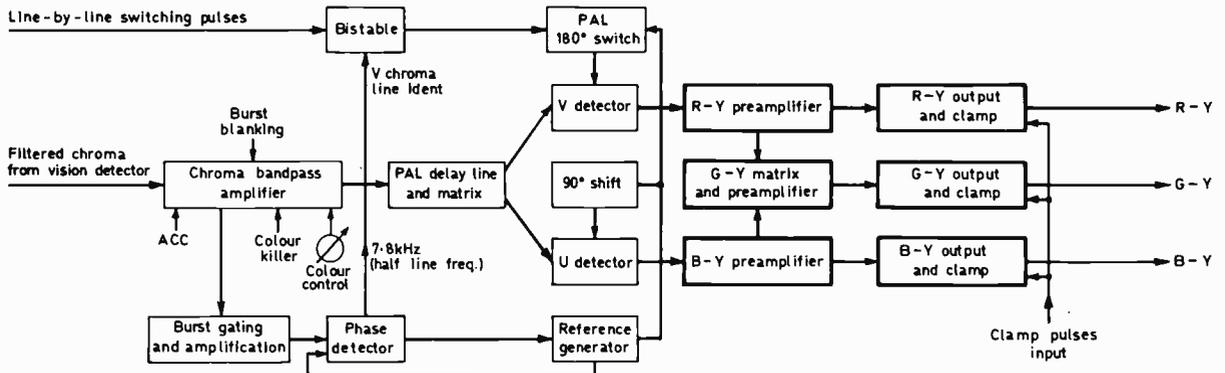


Fig. 7: Block diagram of the sections of a PAL-D receiver that deal with the colour signals. The sections shown in thick line (for colour-difference drive) have already been dealt with, those in thin line remain to be investigated in subsequent articles.

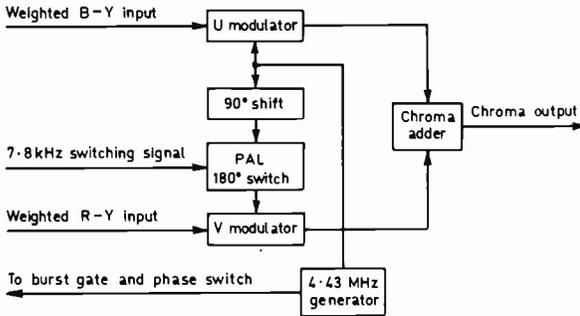


Fig. 8: Basic transmitter PAL switching system.

wave shown in broken line as P. Since waves V and U have the same amplitude and 90-degree displacement, the peak amplitude of the new wave P is equal to 1.4 times the peak of wave V or U. The vector equivalent at (b) reveals the function more clearly. The angle of the new wave P obtained from waves V and/or U depends on the relative amplitudes of the V and U waves. In colour TV parlance the U axis is regarded as the 0-degree datum so that V is at +90 degrees and with the V and U waves the same amplitude P is at +45 degrees. Fig. 4 shows what happens to P when the relative amplitudes of the U and V waves alter. Clearly the angle of P changes with relative changes in amplitudes of V and U; also the amplitude of P changes with changes in amplitude of V and U. In other words wave P contains information relating to both waves V and U!

Now the V and U signals can have either positive or negative values—depending on the chroma information—and because of this the sum or composite signal—P in Figs. 3 and 4—can fall anywhere within the four quadrants from 0 to 360 degrees shown in Fig. 5. Our P signal in fact indicates by its phase the hue and by its amplitude the saturation of the colour present. In Fig. 5 a  $-V$  signal of amplitude 0.4 and a  $+U$  signal of 0.2 amplitude are shown superimposed on the negative and positive V and U axes. The amplitude of the resultant P is  $0.447 \sqrt{(U^2 + V^2)}$  while its angle is  $+296^\circ 36'$  ( $\phi = -\tan^{-1}V/U$ ). The resultant P is known as the phasor, and for the conditions in Fig. 5 it represents a medium saturation blue-green hue.

Having got clear the fact that the phasor can take up any angle over 360 degrees and have any amplitude up to that corresponding to full saturation

(limited by the PAL weighting) as determined by the phase and amplitudes of the V and U signals, we can next turn to the PAL parameters of the signal.

Figure 6 shows the PAL reference U and V axes and bursts on odd lines at (a) and on even lines at (b). The V phase is alternated through 180 degrees line-by-line and with this phase alternation the colour bursts swing in phase by  $\pm 45$  degrees about the  $-U$  axis (hence the term "swinging bursts"). This is conveniently remembered in terms of odd and even lines, taking the line numbering consecutively, so that on odd lines (1, 3, 5, 7, etc.) the V chroma is along the 90-degree axis, with the bursts simultaneously phased at 135 degrees, while on even lines (2, 4, 6, 8, etc.) the V chroma is along the 270-degree axis, with the bursts simultaneously phased at 225 degrees.

So far as the V chroma signal is concerned therefore a natural  $+V$  signal occurring during an odd line will be presented unaltered to the decoder in the receiver but the same signal occurring during an even line will appear at the decoder input as  $-V$ . We shall be seeing next month how this action helps to prevent the display of an incorrect hue even when there is a phase error somewhere in the overall system.

### Decoder Block Diagram

To conclude this month's stage setting Fig. 7 shows the basic essentials of a PAL-D decoder. The composite chroma signal at the input is filtered from the complete signal present at the vision detector—this particular arrangement is often used in modern receivers. The chroma signal as a whole passes through a bandpass amplifier and thence to the PAL delay-line matrix circuit, where the PAL alternations just described are processed. This action effectively separates the V and U components of the signal, these then being fed separately to the V and U synchronous detectors which are so called because they must also receive a synchronised reference signal to replace the subcarrier signal which was suppressed at the transmitter. The outputs from the synchronous detectors are de-weighted and the resulting R-Y and B-Y signals used in the ways outlined in the last four instalments. The sections shown in thin line in Fig. 7 are those yet to be explored. As a concluding thought Fig. 8 shows the PAL switching at the transmitter. Next month we shall be making a start on the circuits proper.

TO BE CONTINUED

## BASIC CIRCUITS FOR THE CONSTRUCTOR

— continued from page 562

the values of R217 to 10k $\Omega$ , R250 to 560 $\Omega$  and C265 to 500 $\mu$ F. Connect a type OA90 diode between the collector of Tr206 and the junction of R215 and R217 with the cathode (marked positive) of the diode to Tr206 collector. Remember to disconnect this diode and also to change R217 back to 2.7k $\Omega$  during alignment.

### Sync Performance and Crossmodulation

Under certain signal conditions sync pulses may leak on to the a.g.c. line thereby degrading the picture synchronising performance. To prevent this connect a 4.7 $\mu$ F 15V tantalum capacitor between Tr205 collector and chassis, observing correct capacitor polarity.

With aerial signals of greater than 10mV cross-modulation may occur in the r.f. stage in the tuner. The appearance of this effect on the picture is very similar to that of sound-on-vision as seen on 405-line receivers except that the pulsating bars on the picture are not synchronised with the sound. In extreme cases several pictures may be seen superimposed upon each other. The remedy is simple: fit a 12dB Belling-Lee coaxial attenuator in the aerial lead.

### Corrections

A minor error occurred in the list of component values: the rating of R244 should be 1/10W and R246 1/4W. This does not in any way affect performance but it does make the layout more convenient. In Fig. 4(b) last month the transistor should have been numbered Tr34, not Tr35.



# SERVICE NOTEBOOK

G. R. WILDING

## No Focus Control Action

Poor focus was the complaint with a single-standard Philips colour receiver fitted with the G6 chassis and inspection showed that operating the focus control R5045 (see Fig. 1) produced no discernible effect. Tests on the tube base at focus pin 9 indicated almost 6kV irrespective of the setting of R5045 whereas optimum focus is usually obtained in the region of 4.2kV.

Seven megohm-value resistors plus R5045 (5M $\Omega$ ) form a high-impedance potential-divider from the heater of the EY51 focus rectifier to chassis and it appeared that one of the resistors between R5045 and chassis was open-circuit. These seven resistors are mounted on a panel adjacent to the PY500 boost rectifier in the line output assembly and on testing along we found that almost all EY51's output was developed across R5049 which was clearly open-circuit.

Replacing this 3.3M $\Omega$  component restored the slight

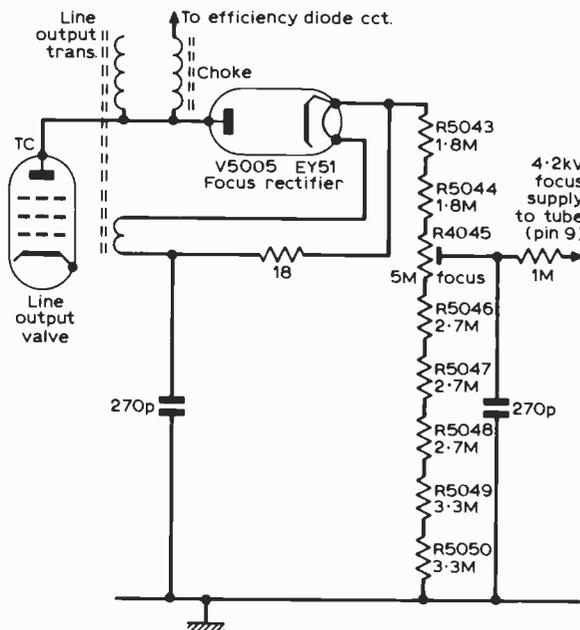


Fig. 1: Focus supply circuit used in the Philips G6 single-standard colour chassis.

current drain through the chain and the proportional voltage drop across each resistor so that the focus control was able to vary the d.c. output in the usual manner.

## No Raster

A 19 in. Defiant model had normal sound but no raster. The owner found however that when the brilliance control was turned to one end of its travel bright streaks would appear across the screen on rotating the channel selector. This clearly indicated adequate e.h.t. and an operational tube and it seemed that either the tube's cathode voltage was too high or its grid voltage too low.

Although in current designs the brilliance control may vary either the grid or cathode d.c. potential in many older models such as the Defiant model in question the video pentode is d.c. coupled to the c.r.t. cathode while the brilliance control varies the grid voltage. The most common cause of no raster in such receivers is failure of the video pentode to pass anode current. This will result in zero voltage drop across the video pentode load resistor so that its anode voltage and therefore the c.r.t. cathode voltage will be at nearly the full h.t. rail potential, cutting off the c.r.t. Zero video pentode current is usually caused by a burnt out screen feed or cathode resistor, often the result of an intermittent or complete interelectrode short in the valve. Component inspection around the video valveholder failed however to bring to light any signs of over-heating or even discoloration. All voltages were about normal and the small cathode potential showed that the anode/screen current was normal.

Turning our attention to the c.r.t. base we found that operating the brilliance control varied the grid voltage normally but that the screen flashes produced by channel selector rotation were obtained with the control at its *minimum position*. On then checking at the first anode pin we found zero voltage and a complete short from this point to chassis. Following through the chassis wiring we found the cause to be an 0.47 $\mu$ F decoupler and after replacing this we obtained a first class picture.

When investigating cases of no raster with the e.h.t. present remember that zero first anode voltage will always prevent beam current but the focus anode potential is immaterial. When the e.h.t. and first anode voltages are present temporarily shorting the tube's grid and cathode will by removing all bias always produce a full brilliance raster in an operational tube. If a raster fails to appear and the heater can be seen glowing then tapping the tube neck will often produce momentary screen flashes to prove that there is a tube defect.

## Weak, Distorted Sound

An interesting sound fault was present on a GEC 2038 receiver and as the circuitry involved is contained in many other models the cause is well worth knowing. The symptoms were weak and distorted output on 405 (625 was locally unobtainable). The distortion clearly indicated an a.f. fault but replacing both the PCL84 output pentode and the EH90 preceding it failed to produce any improvement.

As the rear half of the receiver containing the PCL84 extended over the cabinet base we were able to make voltage checks on this valve without remov-

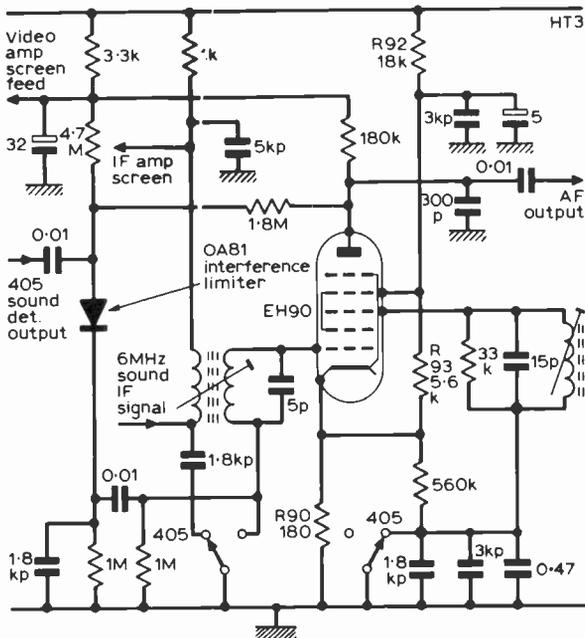


Fig. 2: EH90 625-line sound detector/405-line sound amplifier circuit used in GEC-Sobell dual-standard models. R92, R93 and R90 had all changed value.

ing the chassis. All proved normal. The EH90 stage (see Fig. 2) used in these and other models acts as f.m. discriminator on 625 and as a.f. amplifier only on 405. It seemed highly possible that grossly incorrect anode, screen or cathode voltages here might be the cause of the trouble. There was also the possibility that one of the high-value resistors associated with the a.m. noise limiter diode was open-circuit and as they were all conveniently mounted on top of the chassis we used the old dodge of connecting our meter on the 1,000V range across each suspect and noting the effect. There was no improvement and the diode itself was all right. The detector diode could be ruled out as although when high-resistance they cause great loss of volume they cannot introduce the high level of distortion present.

We next checked that the EH90 cathode resistor was 180Ω as specified and though it was markedly lower at 130Ω this could not be the cause of the present symptoms. On dusting off the surface dirt we then noticed that R93 a 5.6kΩ carbon resistor between the EH90's screen and cathode was discoloured and on checking its value found it to be just over 3kΩ. On replacing this component results improved enormously but were still not quite up to standard. Further tests showed that R92 an 18kΩ resistor from the h.t. rail to screen was also markedly reduced in value and after replacing this and the cathode resistor R90 the results were again first class.

Multiple resistor failures of this nature can be instigated by value reduction in any one of them but it shows once again how important it is to always look for visual evidence before making voltage checks. A discoloured resistor is certain to have altered value. This may be due to the long-term effects of running close to its maximum rating, to a leak in an associated capacitor or to excessive current consumption by a valve or transistor.

TO BE CONTINUED



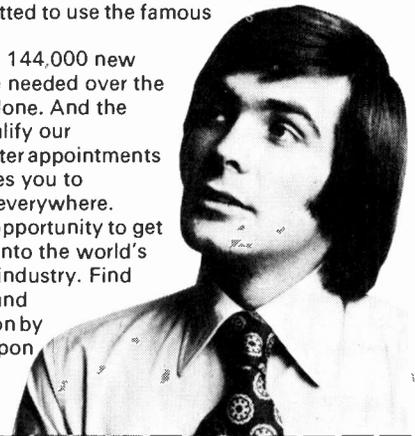
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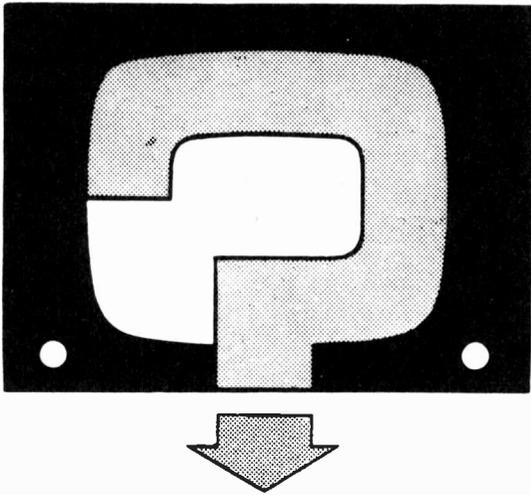
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## **EKCO T407**

A u.h.f. tuner has been added to this set to convert it for 625-line operation. The set has given very little trouble in the past but after conversion it is suffering from field slip—on 625 only, not on 405. I have checked the field timebase and the video and sync circuits without finding the source of the fault. The signal strength in this area is good.—G. Osborn (London).

This model usually has touchy field lock after conversion and a check with an oscilloscope around the PCL84 video amplifier stage should reveal the source of the trouble—pay particular attention to the  $2\mu\text{F}$  screen decoupler. First of all however we suggest you try extra main smoothing. Check the front-to-back ratio of the field sync pulse shaper MR3.

## **PHILIPS 23TG170**

On 625 lines the picture pulls to the left then goes back again and if the contrast control is turned back the fault seems to clear but the definition is lost. I have changed the PFL200 and its associated electrolytics and also the two ECC82 valves without improvement.—J. Lightfoot (Malvern).

The solution to this problem is to change the small clamping diode (X206, type BA115) in the a.g.c.-contrast circuit.

## **BUSH TV125U**

When switched to u.h.f. the sound and picture fade off after about three minutes. The screen remains illuminated but the sound is a continuous hiss.—L. Kingsmoor (Ipswich).

We suggest you change both valves in the u.h.f. tuner unit, PC86 at the front and PC88 at the rear.

## **PHILIPS 1768U**

The picture quality is very good but the sound is distorted. The audio valve and the sound i.f. and tuner unit valves have been replaced without curing the trouble.—C. Barker (Chalfont).

If the  $150\Omega$  bias resistor of the PCL83 audio output valve is in order then check the  $2.7\text{M}\Omega$  anode load resistor of the triode section of this valve (pin 1): the supply to this is derived from the boost rail.

## **PYE 11U**

The vertical hold control is right at one end of the track and the height control (preset at the back of the set) has to be adjusted to get the picture to lock. The PCL85 field timebase valve has been replaced without improving matters.—T. Dowling (Three Bridges).

We suggest you replace the  $1.2\text{M}\Omega$  resistor R83 in series with the height control. This frequently changes value. Also check the PCL85 cathode decoupler C74,  $200\mu\text{F}$ .

## **COSSOR CT1972A**

The overall height of this set is reduced by about 20% at both top and bottom. The field timebase valves have been tested but found to be OK.—L. Cribbings (Cheadle).

The reduced height seems likely to be the result of insufficient boost voltage to the field generator stage. We suggest you check the two boost capacitors C415 and C416 (both  $50\text{kpF}$ ) and R438 in series with the height control. If these are OK check the h.t. voltage and the resistors (R108/R109) in series with the field scan coils.

## **HMV 2705**

The fault on this colour set is crossmodulation. I understand that this could be due to an a.f.c. fault or faulty aerial orientation. The aerial has been repositioned but this does not get rid of the crossmodulation. The crossmodulation can be got rid of by adjusting the tuner button but doing this loses the colour as well. Adjustment of the local/distant r.f. gain preset does not improve matters at all.—C. Claymore (Bristol).

The a.f.c. circuit is a frequent cause of patterning on colour when the set is correctly tuned in. The circuit concerned is on the i.f. panel and a variable control (R141) is provided. Under no signal conditions you should be able to read 4.5V at the slider of this control. To set this control correctly first operate the set-white switch on the video board and disconnect the aerial. Then adjust R141 for 4.5V. Also check that the a.c.c. is set correctly by, if necessary, slight adjustment of R308.

**PYE CT72**

There is an intermittent fault on this set: when changing from one channel to another sometimes instead of getting the normal colour picture there is a black-and-white picture with horizontal colour bars about  $\frac{1}{2}$  to  $\frac{3}{4}$  in. wide giving an effect rather like a coloured Venetian blind. By pushing the tuning button several times the fault will sometimes right itself.—T. Bride (Bath).

The reference oscillator on the decoder board needs readjustment. Simply turn RV10 the set a.p.c. bias control until good colour lock is obtained. RV10 is on the decoder board (the farthest in of the three boards on the bottom tray) and is on the left of the chroma delay line. It may be sealed with paint. Make sure that the oscillator link on the right of the delay line is not connecting intermittently.

**BAIRD 673**

There is at times partial line slip with parts of the picture waving from right to left about an inch or so. This cannot be cured by altering the line controls but can be stopped by reducing the contrast control setting. The line oscillator valve has been changed and this section of the receiver checked over generally.—T. Howorth (Leeds).

The fault could be in the PFL200 video amplifier section and this is the part of the set which should receive attention. Check the valve and its 4 $\mu$ F screen decoupler (pin 9). Also check the EF80 sync separator valve and its 8 $\mu$ F screen decoupler. A more thorough check of the a.g.c. circuit may be necessary.

**HMV 2601**

The fault with this set is no sound or vision though the raster is OK. The tuner valves and common vision and sound i.f. amplifier valve have been replaced.—A. Miller (Wirral).

It appears that the h.t. supply is not reaching the tuner. There are two feeds, one to the oscillator and the other to the r.f. amplifier, both via 5.6k $\Omega$  resistors (R51 and R52) on the right-hand side of the upper deck. Check for h.t. at both ends of these resistors.

**PYE V510**

The PCL82 sound output valve gets red hot with distorted sound which fades away. The valve has been replaced with the same results.—F. Douglas (Broadway).

There are two capacitors in the audio circuit which could cause this effect. They are the 0.022 $\mu$ F coupler C22 between the two halves of the valve and the feedback capacitor C21 100pF.

**EKCO TC268**

I have replaced the original CRM211 tube in this set with a CRM212 which is the same in all respects except for the tube deflection angle (90° instead of 70°) but I am unable to get it to display a picture.—A. Winfelt (Middlesbrough).

The bases of the two tubes are the same so you should be able to see a raster. Suspect a displaced ion trap magnet which would need moving along and around the tube neck for optimum results.

**GEC 2028**

Recently the line oscillator failed and a 560k $\Omega$  replacement resistor was necessary to restore working. Since this time there has been an intermittent fault—varying brilliance. Sometimes there is no change, at other times there are many alterations every few minutes. After the initial switch on the full picture scan builds up to normal brilliance only to fade quickly and then build up slowly again. At times there is blurring of the right-hand edges of images.—C. Major (Edinburgh).

Since this is an intermittent fault it might take a while to track it down. As it occurred following replacement of a resistor in the line oscillator stage it is possible that a socket or lead in the luminance circuit has been accidentally dislodged. Ensure that all connectors are tightly fitting and check that the system switch is on 625 correctly. The PL802 luminance amplifier valve may be faulty: if you have not got a replacement check the following base voltages (625), pin 7 175V, pins 6 and 8 240V, pin 1 1V. An unorthodox way of checking the PL802 is to lightly tap it to see whether the brilliance level changes. Also check the cathode circuitry of this valve, especially the components in coil T109 can. The luminance delay line connections can sometimes cause the brightness to alter. The beam current limiter should be set to 2.7V at the test point to the right-hand side of the set beam current control P507.

**PYE CT78**

This colour set gives an excellent picture but there is a hissing sound when words with an s, sh and sometimes c are spoken.—J. Arvin (Cheltenham).

The sibilance you are experiencing can be reduced by restoring R60, 10k $\Omega$ , if this is missing and by changing C59 to 10,000pF. These components with R59 form a combined detector load/de-emphasis network.

**EKCO T417**

The fault on this model is similar to line tearing but occurs only on 625 lines. It mostly takes the form of a band of about 2 $\frac{1}{2}$  in. slowly moving down the screen and then repeating itself. The severity of the interference seems to be determined by the picture content. Test card reception is good, i.e. the resolution, frequency response etc. seem to be all right.—K. T. Smith (Grantham).

The problem appears to be hum in the u.h.f. tuner and we suggest you check the two valves in the tuner and the smoothing of the tuner h.t. supply.

**KB CK402**

There is a fault in the sound on this colour model, a grating sound being present almost all the time. The volume control has to be turned half-way round to get any reasonable results. The picture is excellent.—J. Tadworth (Preston).

Check the PCL86 audio valve. If a spare is not to hand wait until the fault occurs and see if the valve electrodes are glowing a dull red. If they are check the grid coupling capacitor Cf3 0.01 $\mu$ F to pin 8. If the valve does not glow check the other valve voltages—220V at pin 3, 200V at pin 6, 5.5V at pin 7 and 104V at pin 9. The loudspeaker could be at fault though this is unlikely as the fault is progressive.

**MURPHY V310**

The U26 e.h.t. rectifier has had to be replaced several times. I replaced it again recently, obtaining normal sound and a good picture, but the next time I switched on there was sound but no picture—the U26 had gone again. The line output transformer seems to be OK but I got a shock from the glass envelope of the U26.—R. Royle (Durham).

It is unusual for the U26 to keep blowing without the 30P4 line output valve suffering too. We suggest you check that the line output transformer has not at some time been replaced with one with a 6V e.h.t. rectifier heater winding intended for use with an EY86 type rectifier. Touching the U26 heater across a 2V battery will show you the U26 heater brightness when the valve is operating correctly.

**EKCO T330F**

The flywheel line sync discriminator diodes in this set need replacement. These comprise a single unit type D3-2-1YZ. Would two BA115 diodes do instead? I also wish to replace the interlace diode MR1 which is marked Q3/4. Would an OA81 suit here? Replacements for the originals seem hard to obtain.—C. Wells (Cheam).

The current BA115 or BA155 diodes will act as suitable replacements for the line and field sync diodes in your set. You could try an OA81 in the interlace diode position if you have one handy but the field synchronisation could be touchy with this.

**EKCO CT103**

The skin tones have become yellowish-brown. The colour-difference amplifier stages have been set up in accordance with the manual and the PCL84 colour-difference output valves changed but the skin tones are still the same.—T. Morton (Barnstaple).

We suggest you try adjusting RV26, the green colour-difference drive control on the colour-difference amplifier panel. Do this whilst watching the flesh tints on test card F.

**PHILIPS 19TG175A**

The picture and sound on u.h.f. are OK but on switching to v.h.f. the e.h.t. rectifier heater goes out and the line output valve overheats.—J. O'Brien (Barrow).

It appears that there is an open-circuit in either the 405-line hold control, the resistor in series with it or the system switch contacts which select the correct hold control.

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**TELEVISION OCTOBER 1971**

**TEST CASE****106**

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

A colour receiver with primary-colour drive was being investigated for mild colour fringeing. The symptom was similar to horizontal misconvergence but with the difference that the fringeing occurred only on those parts of the picture corresponding to sharp changes in level of luminance or saturation. The effect was present on both colour and monochrome and close examination through a magnifying glass revealed that the horizontal colour displacement at the parts of the picture carrying highly defined vertical components was of the nature of yellow and blue.

The whole of the dynamic and static convergence procedures was run through but the trouble remained. The technician handling the repair was conversant with the symptom resulting from a fault in the luminance delay line, which also produces horizontal displacement, but generally in this case of the colour

from the luminance information. It is the purpose of the luminance delay line to reduce the transient response of the Y channel so that it matches that of the chroma channel, thereby making the colour and luminance components of the picture coincide on the screen of the picture tube. Tests proved that the luminance delay line and associated circuits and components were in order however.

What section(s) of the receiver could have been responsible for this symptom and what would be the most likely components at fault? See next month's TELEVISION for the solution to this problem and for a further Test Case item.

**SOLUTION TO TEST CASE 105**

Page 523 (last month)

The incorrect colour-bar display detailed last month is a fair indication that the PAL V chroma switch has failed. Such trouble results in alternate lines of one field and alternate pairs of lines in a complete interlaced picture frame changing colour, this being responsible for the Hanover blind symptom. Similar trouble is caused when the PAL decoder delay-line circuit is out of balance.

In the case under consideration it was found that one of the switching transistors in the PAL switch bistable circuit had failed. The bistable circuit could therefore not be triggered by the line pulses and the R-Y signal phase alternation on alternate lines remained instead of being cancelled out by the PAL switch.

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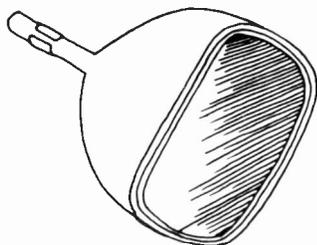
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1D5	0-38	6BQ5	0-22	6L18	0-48	12AU6	0-21	30PFL12	0-70	A1234	0-98	0-38	0-38	ECC807/1-70	1-70	EL85	0-34	KTW61/0-63	0-63	PEN45DD/0-75	0-75	R19	0-30	UY19	0-73
1D6	0-48	6BQ7A	0-38	6L19	1-38	12AU7	0-19	30PFL14	0-68	A3042	0-75	DY87/6-25	0-25	ECC808/0-27	0-27	EM34	0-80	KTW62/0-63	0-63	PEN46-0-20	0-20	R20	0-56	UY20	0-85
1FD1	0-30	6BR7	0-79	6LD20	0-48	12AV6	0-28	30L1	0-29	AC044	1-18	DY802/0-37	0-37	ECC82	0-27	EM80	0-38	KTW63/0-50	0-50	PEN45BDD	0-38	R22	0-35	UY25	0-65
1G6	0-30	6BR8	0-63	6N7GT	0-40	12AX7	0-22	30L15	0-68	AC2/PEN	0-98	E80F	1-20	ECC84	0-24	EM83	0-75	MHL4000-74	0-74	PEN4A/0-98	0-98	R23	0-66	UY26	0-56
1H5GT	0-33	6B87	1-25	6P28	0-59	12AY7	0-68	30L17	0-69	0-98	0-98	E83F	1-20	ECC81	0-27	EM84	0-31	MHL44-0-75	0-75	PEN4DD/0-98	0-98	R24	0-66	UY27	0-85
1L4	0-13	6BW8	0-43	6Q7	0-43	12BA6	0-30	30P4M	0-95	AC6PEN-38	0-38	E88CC	0-60	ECC82	0-27	EM85	0-55	P88	0-48	PEN4200-63	0-63	R25	0-66	UY28	0-85
1LD5	0-30	6BW7	0-55	6Q7G	0-57	12BE6	0-30	30P12	0-69	AC2/PEN	0-98	E92CC	0-40	ECC83	0-39	EY81	0-35	N308	0-95	PEN43BDD	0-38	R26	0-66	UY29	0-68
1LN5	0-40	6BZ8	0-31	6R7	0-55	12BH7	0-27	30P16	0-30	AC/	0-98	E180F	0-90	ECC84	0-40	EY83	0-55	N339	0-44	PEN43DD	0-38	R27	0-66	UY30	0-68
1N5GT	0-37	6C6	0-19	6R7G	0-35	12E1	0-85	30P19/	0-98	AC/PEN(7)	0-98	E182CC-113	0-113	ECC85	0-40	EY84	0-50	N359	0-44	PEN43DD	0-38	R28	0-66	UY31	0-68
1R5	0-27	6C9	0-73	6SA7GT	0-35	12J7GT	0-33	30P4	0-58	0-98	0-98	E1148	0-63	ECC86	0-40	EY87/6-30	0-30	P61	0-48	PEN43DD	0-38	R29	0-66	UY32	0-68
1R4	0-22	6C17	0-63	6SA7	0-35	12K5	0-50	30P11	0-59	AC/TH10-50	0-50	EAO	0-18	ECC87	0-40	EY88	0-43	PABC80-33	0-33	PEN43DD/0-38	0-38	R30	0-66	UY33	0-68
1R5	0-20	6CB6A	0-26	6SC7GT-33	0-33	12K7GT	0-34	30P13	0-76	AC/TP	0-98	EAO	0-18	ECC88	0-40	EY89	0-40	P88	0-48	PEN43DD	0-38	R31	0-66	UY34	0-68
1U4	0-28	6CB8G	1-08	6SG7GT	0-38	12Q7GT	0-28	30P14	0-65	AL60	0-78	EABC80-30	0-30	ECC89	0-40	EY90	0-40	P88	0-48	PEN43DD	0-38	R32	0-66	UY35	0-68
1U5	0-48	6CB8A	0-50	6SH	0-53	12SA7GT	0-38	30P15	0-67	AR3	0-35	EAC91	0-38	ECC90	0-40	EY91	0-35	N308	0-95	PEN43DD	0-38	R33	0-66	UY36	0-68
2D21	0-35	6CH5	0-38	6M7	0-35	12S47	0-40	35A3	0-50	ATP4	0-12	EAF42	0-48	ECC91	0-40	EY92	0-35	N339	0-44	PEN43DD	0-38	R34	0-66	UY37	0-68
3A4	0-20	6CL6	0-43	6SK7GT	0-33	12S47	0-40	35A3	0-50	ATP4	0-12	EAF42	0-48	ECC92	0-40	EY93	0-35	N339	0-44	PEN43DD	0-38	R35	0-66	UY38	0-68
3B7	0-25	6CL8A	0-50	6SG7GT	0-38	12S47	0-40	35A3	0-50	ATP4	0-12	EAF42	0-48	ECC93	0-40	EY94	0-35	N339	0-44	PEN43DD	0-38	R36	0-66	UY39	0-68
3D6	0-19	6CU5	0-50	6U4GT	0-60	12SH7	0-15	35L6GT-42	0-42	AZ41	0-53	EBC41	0-11	ECC94	0-40	EY95	0-35	N339	0-44	PEN43DD	0-38	R37	0-66	UY40	0-68
3Q4	0-38	6CW4	0-63	6U7G	0-63	12S47	0-23	35W4	0-23	B36	0-33	EBC81	0-33	ECC95	0-40	EY96	0-35	N339	0-44	PEN43DD	0-38	R38	0-66	UY41	0-68
3Q5GT	0-35	6D5	0-15	6V6G	0-17	12S47	0-24	35Z3	0-50	CL33	0-30	EBC90	0-18	ECC96	0-40	EY97	0-35	N339	0-44	PEN43DD	0-38	R39	0-66	UY42	0-68
3S4	0-27	6E17	0-50	6V6GT	0-20	12H7GT	0-20	35Z4GT	0-24	CV6	0-53	EBC91	0-30	ECC97	0-40	EY98	0-35	N339	0-44	PEN43DD	0-38	R40	0-66	UY43	0-68
3V4	0-32	6D7A	0-50	6X4	0-20	12H7GT	0-20	35Z5GT	0-30	CY1C	0-53	EBC92	0-30	ECC98	0-40	EY99	0-35	N339	0-44	PEN43DD	0-38	R41	0-66	UY44	0-68
3Y4G	0-33	6EW6	0-55	6X5GT	0-52	14H7	0-45	35Z6GT	0-30	CY31	0-31	EBC93	0-38	ECC99	0-40	EY100	0-35	N339	0-44	PEN43DD	0-38	R42	0-66	UY45	0-68
5V4G	0-35	6F1	0-59	6Y6G	0-55	1487	1-75	35C5	0-32	D63	0-25	EBC94	0-38	ECC100	0-40	EY101	0-35	N339	0-44	PEN43DD	0-38	R43	0-66	UY46	0-68
5Y2GT	0-28	6F6	0-63	6Y7G	0-63	19A05	0-24	35C6D6G2-17	0-17	DAC3C	0-33	EBC121	0-63	ECC101	0-40	EY102	0-35	N339	0-44	PEN43DD	0-38	R44	0-66	UY47	0-68
5Z3	0-45	6F9G	0-25	7B6	0-53	19G6	1-45	50EH3	0-55	DAF91	0-20	EBC122	0-63	ECC102	0-40	EY103	0-35	N339	0-44	PEN43DD	0-38	R45	0-66	UY48	0-68
5Z4G	0-35	6P14	0-33	7B7	0-35	19H1	0-30	50L5GT-0	0-0	DAF96	0-33	EBC123	0-63	ECC103	0-40	EY104	0-35	N339	0-44	PEN43DD	0-38	R46	0-66	UY49	0-68
630L2	0-55	6P14	0-43	7C6	0-30	20D1	0-65	72	0-33	DD4	0-53	EBC124	0-63	ECC104	0-40	EY105	0-35	N339	0-44	PEN43DD	0-38	R47	0-66	UY50	0-68
6AG7	0-33	6P15	0-65	7F8	0-88	20D4	1-05	85A2	0-43	DF33	0-37	EBC125	0-63	ECC105	0-40	EY106	0-35	N339	0-44	PEN43DD	0-38	R48	0-66	UY51	0-68
6AGC	0-15	6P18	0-45	7H7	0-88	20F2	0-65	85A3	0-40	DF91	0-14	EBC126	0-63	ECC106	0-40	EY107	0-35	N339	0-44	PEN43DD	0-38	R49	0-66	UY52	0-68
6AC5	0-25	6P23	0-68	7R7	0-85	20L1	0-98	90A9	3-38	DF96	0-33	EBC127	0-63	ECC107	0-40	EY108	0-35	N339	0-44	PEN43DD	0-38	R50	0-66	UY53	0-68
6AK5	0-25	6P24	0-68	7V7	0-85	20P1	0-88	90A9	3-38	DF97	0-33	EBC128	0-63	ECC108	0-40	EY109	0-35	N339	0-44	PEN43DD	0-38	R51	0-66	UY54	0-68
6AK6	0-30	6P25	0-58	7Z4	0-85	20P4	0-82	90C3	1-70	DH63	0-27	EBC129	0-63	ECC109	0-40	EY110	0-35	N339	0-44	PEN43DD	0-38	R52	0-66	UY55	0-68
6AM6	0-17	6P26	0-70	9BW6	0-50	20P4	0-89	90C1	1-68	DH76	0-25	EBC130	0-63	ECC110	0-40	EY111	0-35	N339	0-44	PEN43DD	0-38	R53	0-66	UY56	0-68
6AM8A	0-50	6P32	0-15	9D7	0-78	20P5	1-00	90CV1	0-59	DH77	0-18	EBC131	0-63	ECC111	0-40	EY112	0-35	N339	0-44	PEN43DD	0-38	R54	0-66	UY57	0-68
6AN5	0-40	6H8A	0-50	10C1	1-25	25A6G	0-29	150B2	0-58	DH81	0-58	EBC132	0-63	ECC112	0-40	EY113	0-35	N339	0-44	PEN43DD	0-38	R55	0-66	UY58	0-68
6A8X	0-22	6GU7	0-50	10C2	0-60	25L6G	0-22	301	1-00	DH107	0-50	EBC133	0-63	ECC113	0-40	EY114	0-35	N339	0-44	PEN43DD	0-38	R56	0-66	UY59	0-68
6AR6	1-00	6H6GT	0-15	10P27	0-50	25Y5	0-38	302	0-83	DK32	0-33	EBC134	0-63	ECC114	0-40	EY115	0-35	N339	0-44	PEN43DD	0-38	R57	0-66	UY60	0-68
6AT6	0-18	6J5G	0-19	10P9	0-45	25Y6G	0-43	303	0-75	DK40	0-55	EBC135	0-63	ECC115	0-40	EY116	0-35	N339	0-44	PEN43DD	0-38	R58	0-66	UY61	0-68
6AU6	0-30	6J5GT	0-29	10P18	0-35	25Z4G	0-30	305	0-83	DK91	0-27	EBC136	0-63	ECC116	0-40	EY117	0-35	N339	0-44	PEN43DD	0-38	R59	0-66	UY62	0-68
6AV6	0-30	6J6	0-18	10L1D11	0-83	25Z5	0-40	306	0-65	DK92	0-38	EBC137	0-63	ECC117	0-40	EY118	0-35	N339	0-44	PEN43DD	0-38	R60	0-66	UY63	0-68
6AW8A	0-54	6J7G	0-24	10P13	0-64	25Z6GT	0-43	307	0-59	DK96	0-35	EBC138	0-63	ECC118	0-40	EY119	0-35	N339	0-44	PEN43DD	0-38	R61	0-66	UY64	0-68

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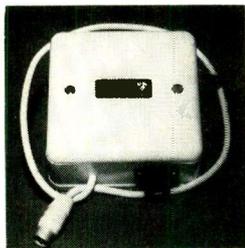
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