

VALVES **AND** **Electron Tubes**



TECHNICAL DATA



With the compliments of

MULLARD-AUSTRALIA PTY. LTD.,

35 Clarence Street,

SYDNEY;

and at

592 Bourke Street,

MELBOURNE.

Commonwealth representatives for:—

Mullard Limited, London;

Mullard Overseas Limited.

A CATALOGUE OF
MULLARD RADIO
RECEIVING VALVES
AND SPECIAL
ELECTRON TUBES



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registered in most of the principal countries of the world.*

MULLARD OVERSEAS LTD.,
CENTURY HOUSE, SHAFTESBURY AVE., LONDON, ENGLAND.

INTRODUCTION

To millions of people throughout the world the Mullard name is associated with electronic products of the most advanced techniques and the highest quality. To those who have visited the Mullard organisation in this country, it means much more. For they have seen something of the company's extensive research facilities and great manufacturing resources.

The first few pages of this catalogue give some impression of these ramifications; we hope they will be read with interest.

For the rest, this is a catalogue of Mullard radio valves and electron tubes, and it contains descriptive details of every type in the current manufacturing programme. The most important of these to the designer of new equipment are indicated by **HEAVY PRINT** in the "Valve Data" section. These are the "Preferred Types" which embody the latest advances; which are in large scale production; and which will be available for maintenance for many years.

The remaining valves and tubes are, generally, normal maintenance types, the majority of which are in production or readily available from stock. A small number, however, are not being manufactured, but they have been included because they may still be available in the Trade. This means that inclusion in this catalogue of any particular type of valve or tube does not necessarily imply that it can be supplied.

It has, of course, only been possible to include abridged technical data but this should be adequate for normal requirements. Those who need more comprehensive information on the complete range of Mullard valves and tubes are invited to subscribe to the Technical Handbook Service, details of which will be found on page 66.

Advice on the use and applications of Mullard valves and electron tubes is freely available to designers and manufacturers of equipment, and to research workers. The world-wide network of Mullard distributors is constantly supplied with technical information from England, but where it is not possible for users to avail themselves of these services, they are invited to write direct to Head Office.

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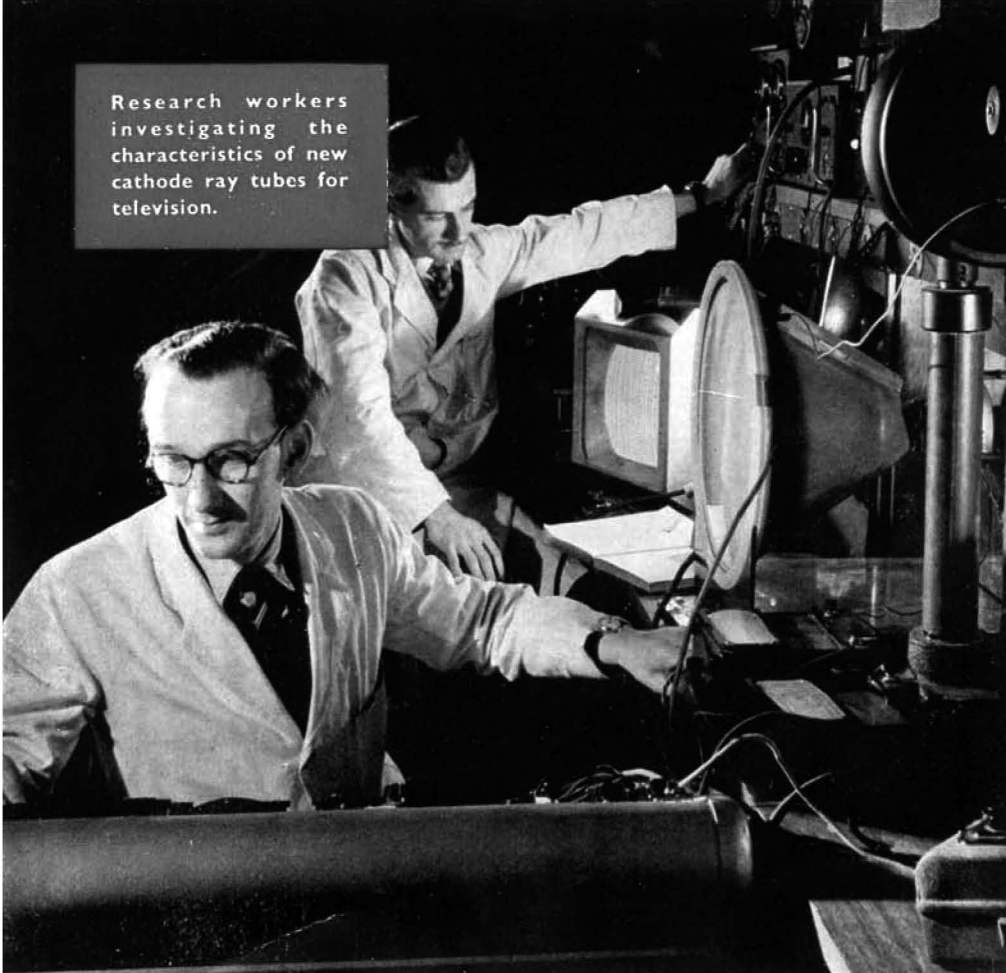
THE MULLARD ORGANISATION

The Mullard production and research organisation is the largest of its kind in the British Commonwealth. Its products range from all types of valves and electron tubes for radio, television, industry, and research to a wide variety of magnetic materials and components. For certain specialised applications complete electronic equipments are also manufactured.

The quality of these products is carefully controlled at every stage of manufacture, and in many cases processing actually starts with the raw materials. By working to these critical standards the full benefits of Mullard research are realised in the finished products.

ELECTRONICS RESEARCH

Mullard leadership in electronics is, indeed, largely due to the unceasing work of its team of research workers. Electronics research on the broadest lines is conducted in the Mullard Research Laboratory,



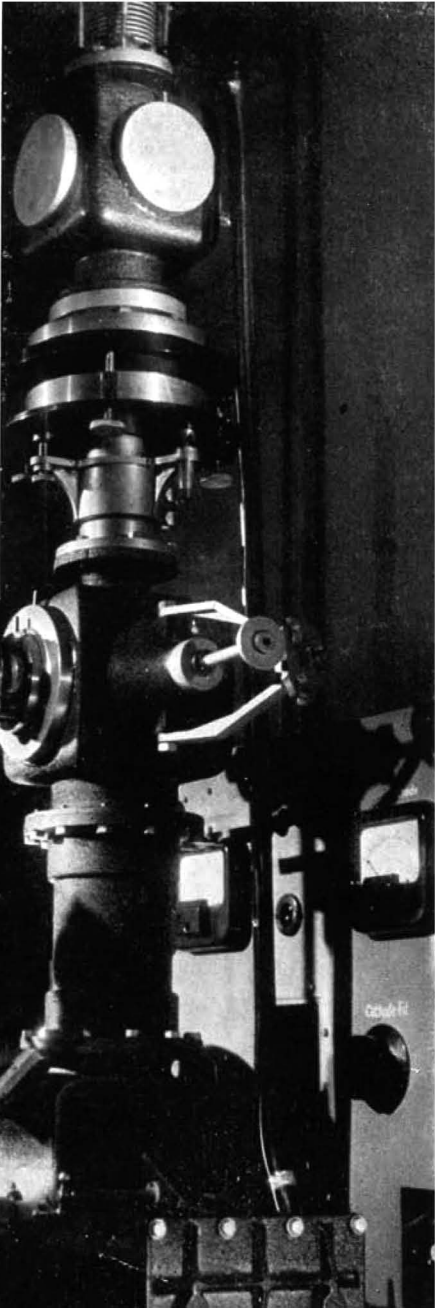
Research workers investigating the characteristics of new cathode ray tubes for television.

situated near Redhill, Surrey. Here physicists, chemists, metallurgists, mathematicians, engineers, and glass technologists collaborate in the design and development of new and special electron tubes, and new techniques and processes. Here, too, investigations are made of specific problems affecting the applications of electronics to other branches of research, and to the fields of industry, communications, and medicine.

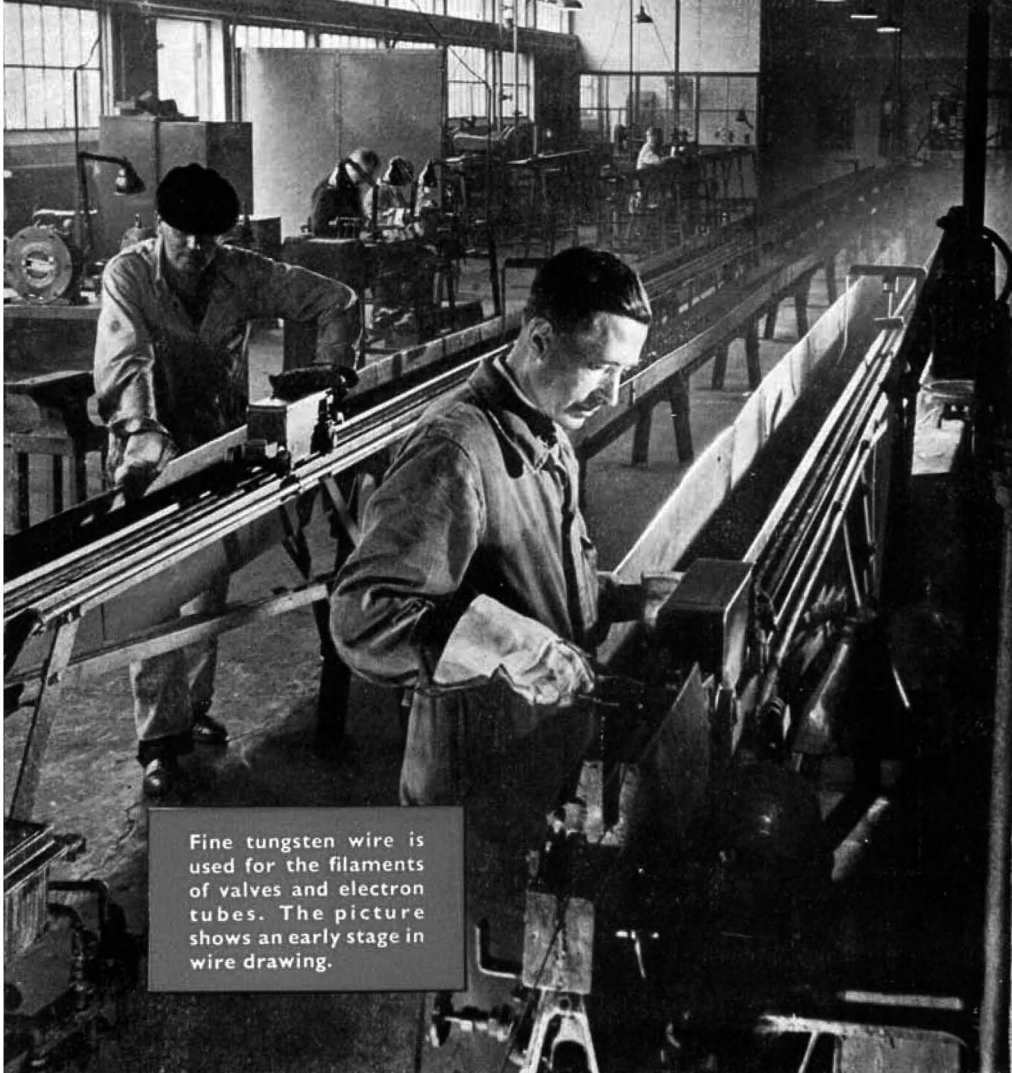
Two other vitally important links in the Mullard research organisation are the Valve Measurement and Applications Laboratory and the Materials Research Laboratory, both at Mitcham, Surrey.

The Valve Measurement and Applications Laboratory collaborates with Development Departments, in the main production units, in the design of new and improved valves and cathode ray tubes. Data and circuitry resulting from this work are distributed by the Electronic Tube Department of Mullard Overseas Limited to electronic equipment designers throughout the world.

At the Materials Research Laboratory investigations are



Examining the atomic structure of a material by means of an X-ray diffraction apparatus.



Fine tungsten wire is used for the filaments of valves and electron tubes. The picture shows an early stage in wire drawing.

made into the physical and chemical properties of the great variety of materials used in the manufacture of electron tubes. This laboratory also provides a comprehensive service on materials to the Mullard factories in solving production problems and improving manufacturing processes.

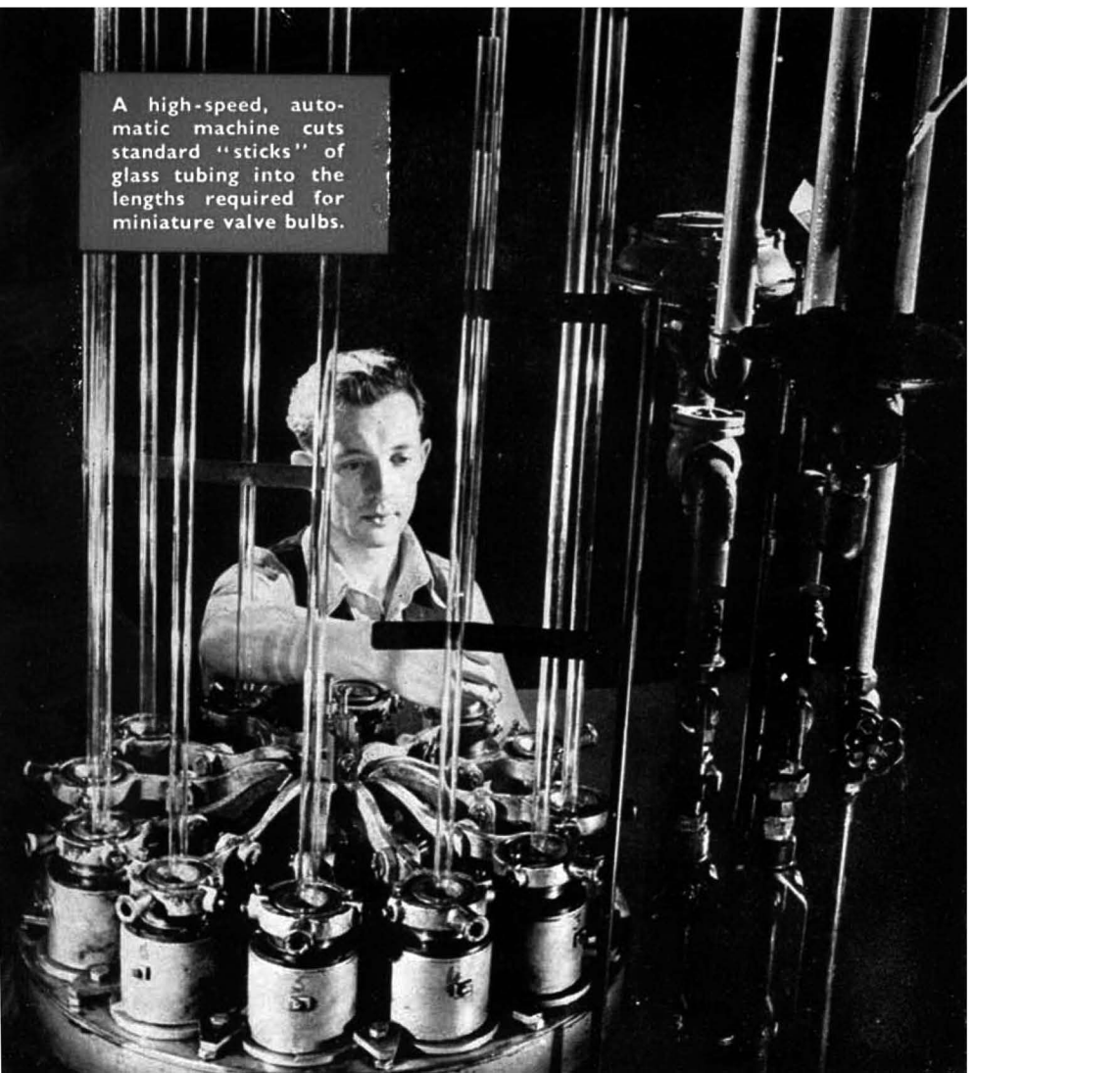
WIRE AND GLASS MANUFACTURE

This emphasis on the quality of materials is vitally necessary in view of the high performance and reliability demanded of modern valves and electron tubes. To maintain the highest possible standard in the finished products it is essential to control the quality of raw materials at the earliest possible stage. The wire and glass used in Mullard valves and tubes, for example, are produced from the actual raw materials in the company's own factories at Blackburn. In this way it is not only possible to control quality throughout every stage of manufacture, but also to ensure continuity of supply.

On an average, more than five million yards of fine wire—tungsten for valve filaments, and molybdenum for grids, filament supports, and mandrils—are produced at the Blackburn plant each week. Some of this will be less than 8 microns ($3/10,000$ th inch) diameter or $1/10$ th the thickness of an average human hair.

The manufacture of this wire is a fine example of the application of science to modern industry. Through a long and elaborate series of operations, a handful of powder is transformed into miles of wire, every inch of which conforms to the most exacting standards. To ensure that these high standards are maintained, the diamond dies, through which the finer wire is drawn, are also manufactured at Blackburn.

The manufacture of glass for electron tubes also involves a number of highly technical operations. In the Mullard glass plant, the raw materials—silica (sand), soda ash, potash and red lead—are converted into thousands



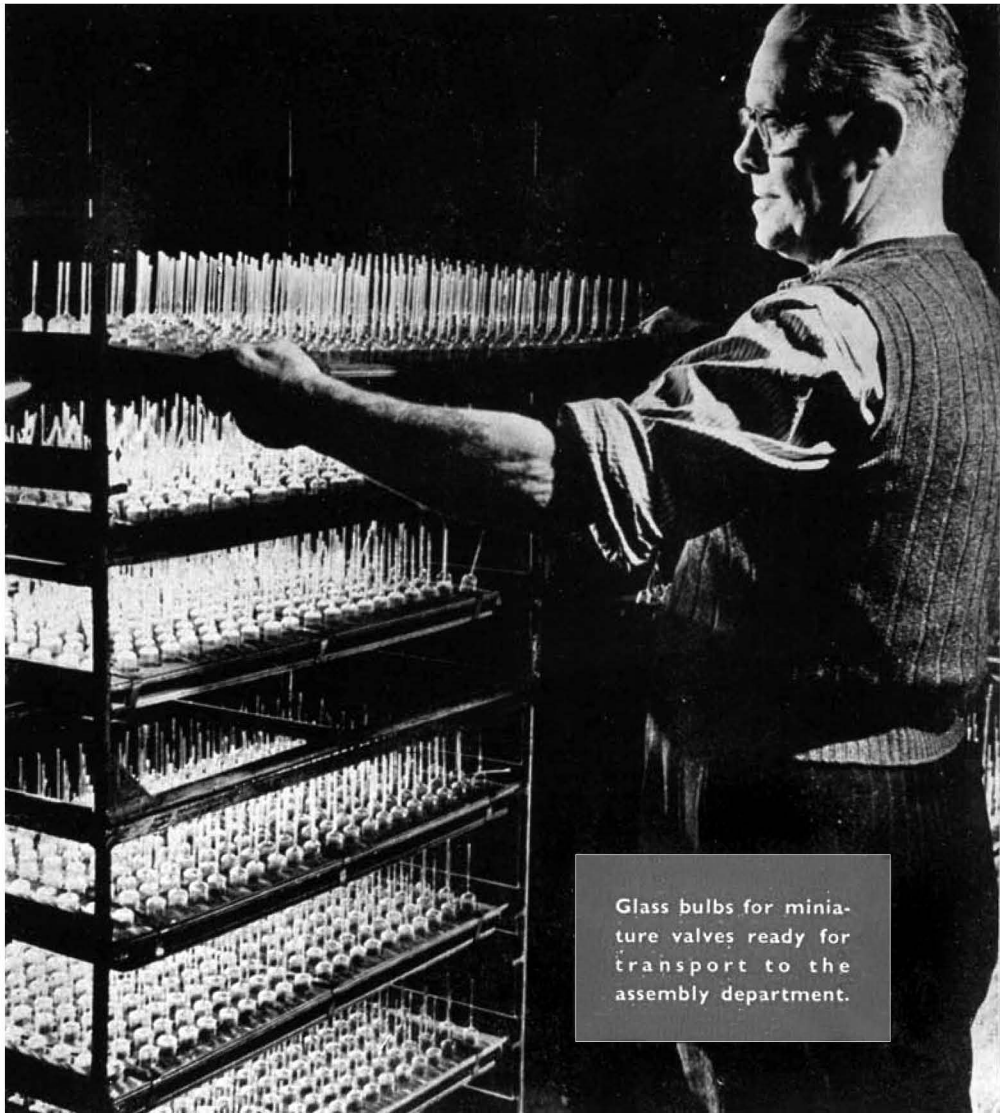
A high-speed, automatic machine cuts standard "sticks" of glass tubing into the lengths required for miniature valve bulbs.

of feet of glass tubing having a wall thickness controlled to tolerances as close as 1/500th inch.

From these standard "sticks" of tubing the bulbs and bases for the latest all-glass valves are made, as well as parts for the older, pinch-type valves. The Blackburn glass factory produces millions of glass components every year for distribution to the various valve production units within the Mullard organisation. Some of the glass parts for cathode ray tubes are also made here, and glass bulbs for the tubes are assembled in large quantities.

VALVE PRODUCTION

The strict control of quality, applied throughout the raw material stage, is continued in the manufacture of valve and cathode ray tube components—filaments, grids, anodes, mica discs, etc. With few exceptions,



Glass bulbs for miniature valves ready for transport to the assembly department.



The final inspection of gun assemblies for cathode ray tubes.

these parts are produced on intricate machines, designed and constructed in the company's own engineering department.

The highly skilled operations involved in assembling the components can only be carried out by hand. A high degree of mechanisation, however, is again employed in sealing the assemblies into their glass envelopes, and then exhausting these to a hard vacuum.

Careful inspections are made at every stage of manufacture and the finished products are subjected to rigorous production tests. Before the valves and cathode ray tubes are released for use, however, further intensive tests are carried out in specially-equipped technical departments.

The two main Mullard production units situated in Lancashire and Surrey, supported by five feeder factories, produce a major portion of the total output of valves and electron tubes made in the British Isles. Whilst radio valves and television picture tubes account for the greater part of the Mullard output, special tubes for industrial, medical, and research applications are also produced in vast quantities.

ALPHABETICAL INDEX TO VALVE DATA

TYPE	Base Diagram No.	PAGE	TYPE	Base Diagram No.	PAGE	TYPE	Base Diagram No.	PAGE
AB2	129	33	DF21	133	28	DPI3-2	163	44
ABC1	45	36	DF22	133	28	DR7-5	162	44
ABL1	50	40	DF33	67	28	DR7-6	162	44
ACO44	3	34	DF66	121	28	DW2	1	41
AF3	47	28	DF70	16	28	DW4/350	1	42
AF7	47	28	DF91	38	28	DW4/500	1	42
AK2	33	31	DF92	38	28	EA50	118	33
AL4	46	36	DG4-1	162	44	EAC91	36	36
AZ1	43	41	DG4-2	162	44	EAF42	93	31
AZ4	43	41	DG7-5	162	44	EB4	139	33
AZ11	130	41	DG7-6	162	44	EB34	58	33
AZ12	130	41	DG13-2	163	44	EB41	92	33
AZ31	55	41	DK21	134	31	EB91	37	34
AZ41	131	41	DK32	77	31	EBC3	45	36
CBL1	50	40	DK40	135	32	EBC33	62	36
CBL31	75	40	DK91	41	32	EBC41	97	36
CCH35	82	31	DK92	21	32	EBF2	140	31
CL4	48	36	DL21	136	37	EBF11	141	31
CL33	70	36	DL33	69	37	EBF32	75	31
CY1	42	41	DL35	66	37	EBF80	103	31
CY31	53	41	DL36	66	37	EBL1	50	40
DA90	113	33	DL41	137	37	EBL21	87	40
DAC21	132	36	DL66	121	37	EBL31	75	40
DAC32	65	36	DL68	121	37	EC31	60	34
DAF91	40	31	DL71	16	37	EC52	89	34
DB4-1	162	44	DL72	16	37	EC53	120	34
DB4-2	162	44	DL92	39	37	EC54	15	34
DB7-5	162	44	DL93	115	37	EC91	59	34
DB7-6	162	44	DL94	30	37	ECC31	142	34
DB13-2	163	44	DLL21	138	37	ECC32	64	34
DCC90	114	34	DP4-1	162	44	ECC33	64	34
DDR100	164	51	DP4-2	162	44	ECC34	64	34

ALPHABETICAL INDEX TO VALVE DATA

TYPE	Base Diagram No.	PAGE	TYPE	Base Diagram No.	PAGE	TYPE	Base Diagram No.	PAGE
ECC35	64	35	EK2	33	32	HLI3C	19	35
ECC40	100	35	EK32	81	32	HVR2	2	42
ECC81	63	35	EL2	48	37	HVR2A	2	42
ECC91	80	35	EL3	46	38	IW4/350	7	42
ECFI	143	28/35	EL11	146	38	IW4/500	7	42
ECH3	52	32	EL12	146	38	KB2	129	34
ECH11	144	32	EL31	73	38	KBC1	153	36
ECH21	88	32	EL32	71	38	KBC32	61	36
ECH33	82	32	EL33	70	38	KCF30	170	32
ECH35	82	32	EL34	149	38	KF3	154	29
ECH42	94	32	EL35	70	38	KF35	68	29
ECL11	145	35/37	EL37	70	38	KK2	155	33
ECL80	102	35/37	EL38	73	38	KK32	79	33
ECR30	165	44	EL41	96	38	KL4	156	38
ECR35	166	44	EL42	96	38	KL35	66	38
ECR35P	166	44	EL81	122	38	KLL32	84	38
ECR60	166	44	EL91	78	38	LSD2	167	46
EF9	47	28	EM1	150	41	LSD3	110	46
EF11	146	28	EM4	51	41	LSD3A	111	46
EF12	146	28	EM34	76	41	LSD4	112	46
EF22	86	28	EN31	83	45	LSD5	112	47
EF36	72	29	EQ80	151	40	LSD7	110	47
EF37	72	29	EY51	119	42	LSD8	168	47
EF37A	72	29	EY91	54	42	LSD9	110	47
EF39	72	29	EZ2	152	42	LSD10	—	47
EF40	98	29	EZ35	56	42	LSD12	—	47
EF41	96	29	EZ40	5	42	LSD13	—	47
EF42	95	29	EZ41	5	42	LSD14	—	47
EF50	90	29	FC2A	32	32	LSD15	—	47
EF54	91	29	FC4	34	32	LSD16	—	47
EF55	90	29	FC13	33	32	LSD17	—	47
EF80	104	29	FC13C	34	32	LSD18	—	47
EF91	74	29	FW4/500	1	42	ME1001	169	50
EF92	74	29	FW4/800	1	42	ME1005	169	50
EF95	147	29	GZ32	57	42	ME1100	—	51
EFMI	148	41	HL13	44	35	ME1101	—	51

ALPHABETICAL INDEX TO VALVE DATA

TYPE	Base Diagram No.	PAGE	TYPE	Base Diagram No.	PAGE	TYPE	Base Diagram No.	PAGE
MEI200AA	171	49	PY80	124	42	UR3C	18	43
MEI201AA	172	50	PY81	185	42	UYIN	160	43
MEI202CA	173	50	PY82	124	43	UY11	161	43
MEI400	72	51	PZ30	17	43	UY21	85	43
MEI401	174	51	QP22B	35	39	UY41	14	43
MEI503	175	45	SP2	24	29	VP2	24	30
MF13-1	176	45	SP4	13, 27	30	VP2B	28	30
MF31-22	116	45	SP4B	26	30	VP4	13, 27	30
MT17	177	46	SPI3	47	30	VP4A	13, 27	30
MT57	178	46	SPI3C	26	30	VP4B	26	30
MT105	179	46	TDD2A	10	36	VP13A	47	30
MT5544	180	46	TDD4	20	36	VP13C	26	30
MT5545	180	46	TDD13C	20	36	2D4A	8	34
MW6-2	117	45	TH4B	31	33	2D21	181	46
MW31-16	116	45	TH21C	31	33	20AV	106	48
MW36-22	116	45	TH30C	31	33	20CG	107	48
MW41 1	116	45	UAF42	93	31	20CV	107	48
PENA4	25	38	UB41	92	34	52CG	125	48
PENB4	25	38	UBC41	97	36	55CG	126	48
PEN4DD	29	40	UBF11	141	31	57CV	182	48
PEN4VA	12, 25	39	UBF80	103	31	58CG	183	48
PEN36C	25	39	UBL1	157	40	58CV	183	48
PL33	70	39	UBL21	87	40	85A1	127	43
PL38	73	39	UCH11	144	33	85A2	128	43
PL81	122	39	UCH21	88	33	90AG	108	49
PL82	123	39	UCH42	94	33	90AV	108	49
PL83	105	39	UCL11	145	35/39	90CG	109	49
PM2A	3	35	UF9	158	30	90CV	109	49
PM2HL	3	35	UF11	146	30	150B2	186	43
PM12M	4	29	UF21	86	30	354V	9	35
PM22A	11	39	UF41	96	30	1267	184	46
PM22D	11	39	UF42	95	30	4687	49	43
PM24A	11	39	UL41	96	39	4687A	23	43
PM24M	11	39	UM4	159	41	7475	23	43
PM202	3	35	UM34	76	41	13201A	23	43
PY31	53	42	URIC	6	43			

VALVE APPLICATION INDEX OF PREFERRED TYPES

TYPE	Vh or Vf (V)	Ih or If (A)	DESCRIPTION	PAGE
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VOLTAGE AMPLIFYING PENTODES

DF66	0.625	0.015	Hearing-aid pentode.	28
DF91	1.4	0.05	Variable-mu R.F. pentode.	28
DF92	1.4	0.05	Short grid base R.F. pentode.	28
EF37A	6.3	0.2	Low microphony, low hum A.F. pentode.	29
EF40	6.3	0.2	Low noise A.F. pentode.	29
EF41	6.3	0.2	Variable-mu R.F. pentode.	29
EF80	6.3	0.3	High slope R.F. pentode.	29
EF95	6.3	0.175	High slope R.F. pentode.	29
UF41	12.6	0.1	Variable-mu R.F. pentode.	30

VOLTAGE AMPLIFYING PENTODES WITH DIODES

DAF91	1.4	0.05	Short grid base A.F. pentode with single diode.	31
EBF80	6.3	0.3	Variable-mu R.F. pentode with double diode.	31
UBF80	17	0.1	Variable-mu R.F. pentode with double diode.	31

FREQUENCY CHANGERS

DK92	1.4	0.05	Heptode.	32
ECH42	6.3	0.23	Triode hexode.	32
UCH42	14	0.1	Triode hexode.	33

SINGLE AND DOUBLE DIODES

DA90	1.4	0.15	Indirectly heated single diode.	33
EB91	6.3	0.3	Double diode with separate cathodes.	34

TRIODES AND DOUBLE TRIODES

DCC90	{ 1.4 2.8 }	{ 0.22 0.11 }	R.F. double triode, suitable for portable transmitters.	34
ECC33	6.3	0.4	A.F. double triode with separate cathodes.	34
ECC35	6.3	0.4	A.F. double triode with separate cathodes.	35
ECC40	6.3	0.6	A.F. double triode with separate cathodes.	35
ECC81	{ 6.3 12.6 }	{ 0.3 0.15 }	R.F. double triode with separate cathodes.	35
ECC91	6.3	0.45	R.F. double triode with common cathode.	35
ECL80	6.3	0.3	Triode combined with output pentode.	35

TRIODES WITH DIODES

EBC41	6.3	0.23	Double diode triode.	36
UBC41	14	0.1	Double diode triode.	36

VALVE APPLICATION INDEX OF PREFERRED TYPES

TYPE	Vh or Vf (V)	Ih or If (A)	DESCRIPTION	PAGE
OUTPUT PENTODES				
DL66	1.25	0.015	Hearing-aid output pentode.	37
DL68	1.25	0.025	Hearing-aid output pentode.	37
DL92	{ 1.4 2.8	{ 0.1 0.05	A.F. output pentode.	37
DL93	{ 1.4 2.8	{ 0.2 0.1	R.F. or A.F. output pentode.	37
DL94	{ 1.4 2.8	{ 0.1 0.05	A.F. output pentode.	37
ECL80	6.3	0.3	Output pentode (pa max.=3.5 W) combined with triode	37
EL37	6.3	1.4	Output pentode (pa max.=25 W).	38
EL38	6.3	1.4	Line time base output pentode.	38
EL41	6.3	0.7	Output pentode (pa max.=9 W)	38
EL42	6.3	0.2	Output pentode (pa max.=6 W).	38
EL81	6.3	1.05	Series stabiliser and line time base output pentode.	38
PL81	21.5	0.3	Line time base output pentode.	39
PL82	16.5	0.3	Output pentode (pa max.=9 W).	39
PL83	15	0.3	Video output pentode.	39
UL41	45	0.1	Output pentode (pa max.=9 W).	39
NONODE				
EQ80	6.3	0.2	F.M. detector and limiter.	40
ELECTRON BEAM TUNING INDICATOR				
EM34	6.3	0.2	Dual sensitivity tuning indicator.	41
RECTIFIERS				
EY51	6.3	0.09	High voltage rectifier for E.H.T. supplies.	42
EZ40	6.3	0.6	Indirectly heated full-wave rectifier.	42
EZ41	6.3	0.4	Indirectly heated full-wave rectifier.	42
GZ32	5.0	2.3	Indirectly heated full-wave rectifier.	42
PY80	19	0.3	Booster diode.	42
PY81	17	0.3	Booster diode.	42
PY82	19	0.3	Indirectly heated half-wave rectifier.	43
UY41	31	0.1	Indirectly heated half-wave rectifier.	43
GAS-FILLED TRIODES AND TETRODES				
ME1503	6.3	3.75	Hydrogen-filled triode.	45
MT17	2.5	5.0	Mercury-vapour triode.	46
MT57	5.0	4.5	Mercury-vapour triode.	46
MT105	5.0	10	Mercury-vapour tetrode.	46
MT5544	2.5	12	Inert-gas-filled triode.	46
MT5545	2.5	21	Inert-gas-filled triode.	46
2D21	6.3	0.6	Inert-gas-filled tetrode.	46
1267	Cold cathode		Inert-gas-filled triode.	46

VALVE APPLICATION INDEX OF PREFERRED TYPES

TYPE	DESCRIPTION	PAGE
VOLTAGE REFERENCE AND STABILIZING TUBES		
85A1	85-volt Voltage reference tube.	43
85A2	85-volt Voltage reference tube.	43
150B2	150-volt Voltage stabilizer.	43
CATHODE RAY TUBES		
DB4-1	1 $\frac{3}{4}$ in. Oscilloscope. Blue screen. Symmetrical.	44
DB4-2	1 $\frac{3}{4}$ in. Oscilloscope. Blue screen. Asymmetrical.	44
DB7-5	2 $\frac{3}{4}$ in. Oscilloscope. Blue screen. Symmetrical.	44
DB7-6	2 $\frac{3}{4}$ in. Oscilloscope. Blue screen. Asymmetrical.	44
DB13-2	5 in. Oscilloscope. Blue screen. Symmetrical.	44
DG4-1	1 $\frac{3}{4}$ in. Oscilloscope. Green screen. Symmetrical.	44
DG4-2	1 $\frac{3}{4}$ in. Oscilloscope. Green screen. Asymmetrical.	44
DG7-5	2 $\frac{3}{4}$ in. Oscilloscope. Green screen. Symmetrical.	44
DG7-6	2 $\frac{3}{4}$ in. Oscilloscope. Green screen. Asymmetrical.	44
DG13 2	5 in. Oscilloscope. Green screen. Symmetrical.	44
DP4-1	1 $\frac{3}{4}$ in. Oscilloscope. Long afterglow. Symmetrical.	44
DP4-2	1 $\frac{3}{4}$ in. Oscilloscope. Long afterglow. Asymmetrical.	44
DP13-2	5 in. Oscilloscope. Long afterglow. Symmetrical.	44
DR7-5	2 $\frac{3}{4}$ in. Oscilloscope. Long afterglow. Symmetrical.	44
DR7-6	2 $\frac{3}{4}$ in. Oscilloscope. Long afterglow. Asymmetrical.	44
MF13-1	5 in. Radar. Orange screen. Magnetic.	45
MF31-22	12 in. Radar. Orange screen. Magnetic.	45
MW6-2	2 $\frac{1}{2}$ in. Projection television. Metal-backed.	45
MW31-16	12 in. Television. Ion-trap.	45
MW36-22	14 in. Television. Rectangular. Ion-trap.	45
MW41-1	16 in. Television. Metal cone. Ion-trap.	45
FLASH-TUBES		
LSD2	35 joule Microsecond flash-tube.	46
LSD3	100 joule Photographic flash-tube.	46
LSD5	1,000 joule Photographic flash-tube.	47
LSD7	200 joule Photographic flash-tube.	47
LSD8	Stroboscopic tube. 30 W mean dissipation.	47
PHOTOCELLS		
20CG	Gas-filled. Incandescent light and infra-red radiation.	48
20CV	Vacuum. Incandescent light and infra-red radiation.	48
52CG	Gas-filled. Incandescent light and infra-red radiation.	48
55CG	Gas-filled. Incandescent light and infra-red radiation.	48
57CV	Photometric cell.	48
58CG	End-on wire-in. Gas-filled. Incandescent light and infra-red radiation.	48
58CV	End-on wire-in. Vacuum. Incandescent light and infra-red radiation.	48
90AG	Gas-filled. Daylight and blue radiation.	49
90AV	Vacuum. Daylight and blue radiation.	49
90CG	Gas-filled. Incandescent light and infra-red radiation.	49
90CV	Vacuum. Incandescent light and infra-red radiation.	49

VALVE APPLICATION INDEX OF PREFERRED TYPES

TYPE	DESCRIPTION	PAGE
U.H.F. TUBES		
ME1001	Disc seal triode oscillator.	50
ME1005	Disc seal triode voltage amplifier.	50
ME1100	3 cm. local oscillator reflex klystron.	51
ME1101	3 cm. fixed frequency packaged magnetron.	51
IMAGE CONVERTER TUBES		
ME1200AA	Image converter. Daylight and blue radiation.	49
ME1201AA	Grid-controlled image converter. Daylight and blue radiation.	50
ME1202CA	Small image-converter. Infra-red radiation.	50
	Variants of these tubes with different photocathodes and luminescent screens are also available.	
ACCELEROMETER TUBE		
DDR100	Accelerometer double diode.	51
ELECTROMETER VALVES		
ME1400	Electrometer pentode.	51
ME1401	Subminiature electrometer triode.	51

REFERENCES

- a Anode. C.R.T. anodes marked a1, a2, etc., a1 being nearest the cathode.
- g Grid. Grids marked g1, g2, etc., g1 being nearest the cathode.
- k Cathode.
- f Filament.
- h Heater.
- s Internal shield.
- M** External metallising.
- T** Trigger electrode (Flash-tubes).
- IC** Internal connection; not to be used for external connections.
- Va** Anode voltage.
- Vg2** Screen grid voltage.
- Vg1** Control grid voltage.
- Vf** Filament voltage.
- Vh** Heater voltage.
- va(pk)** Peak anode voltage.
- P.I.V.** Peak inverse voltage.
- Ia** Anode current.
- Ig2** Screen grid current.
- If** Filament current.
- Ih** Heater current.
- It** Target current.
- Iout** Output current.
- ia(pk)** Peak anode current.
- Pout** Output power.
- pa** Anode dissipation.
- Ra** External anode load.
- Rk** Cathode bias resistor.
- ra** Internal anode impedance.
- μ Amplification factor.
- gm** Mutual conductance.
- gc** Conversion conductance.
- S** Sensitivity (cathode ray tubes).

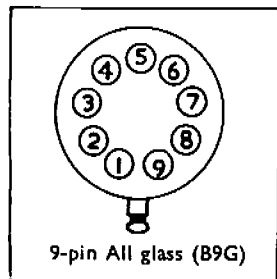
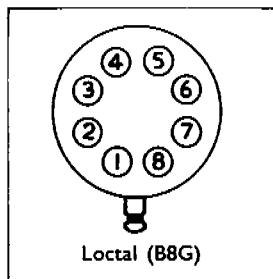
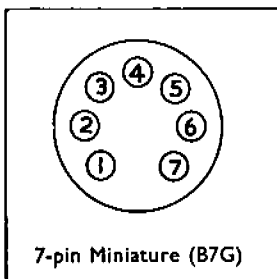
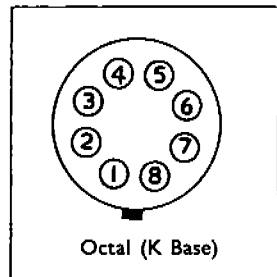
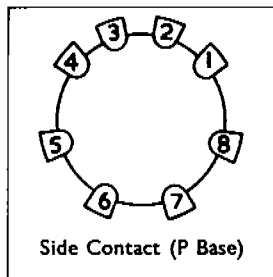
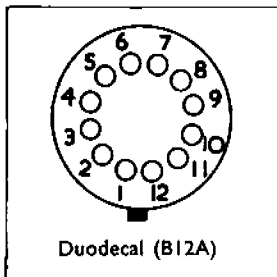
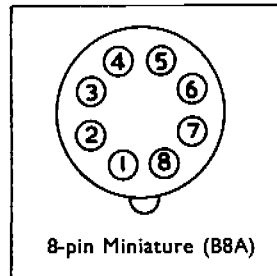
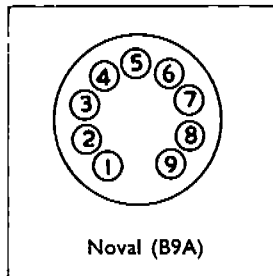
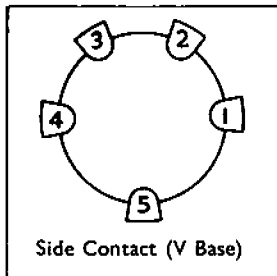
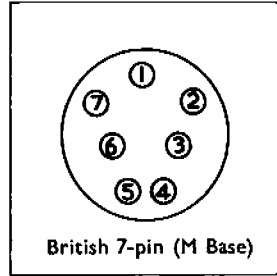
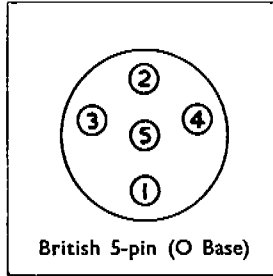
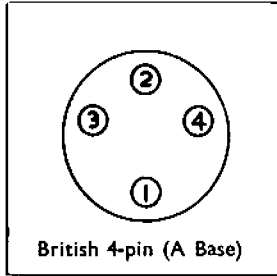
} *Not applicable to frequency changers
with additional oscillator electrodes.*

BASE REFERENCES

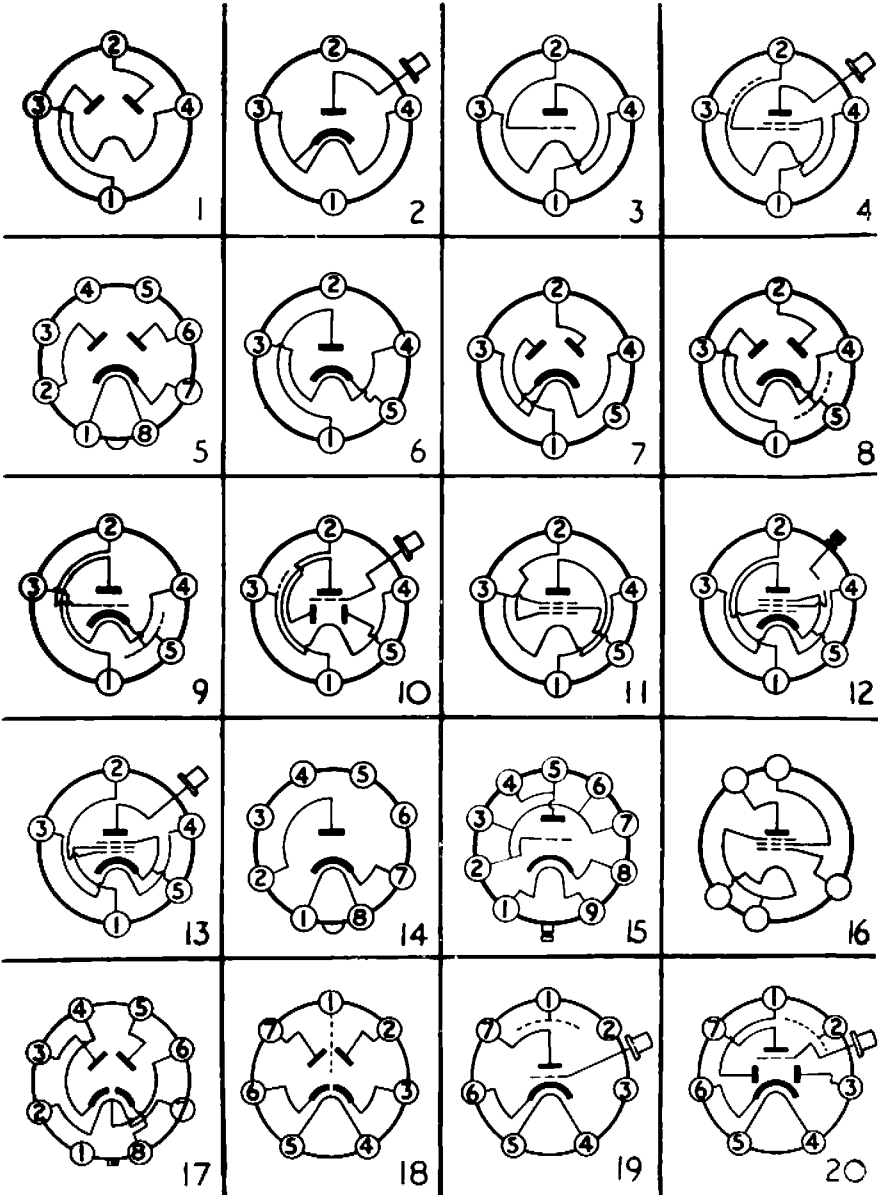
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| <ul style="list-style-type: none"> A British 4-pin. K International octal. M British 7-pin. MO Mazda octal. O British 5-pin. P Side contact (8-contact). UX American base. V Side contact (5-contact). Y European 8-pin. B2A 2 wire-in leads. B3A American Pee-wee 3-pin. | <ul style="list-style-type: none"> B3G 3-pin all-glass. B4D Super Jumbo 4-pin. B5A Flat subminiature. B7G 7-pin miniature. B8A 8-pin miniature. B8D 10 mm. round subminiature. B8G Loctal. B9A 9-pin miniature (noval). B9G 9-pin all-glass. B12A Duodecal. B14A Diheptal. |
|---|--|

VALVE BASE DIAGRAMS

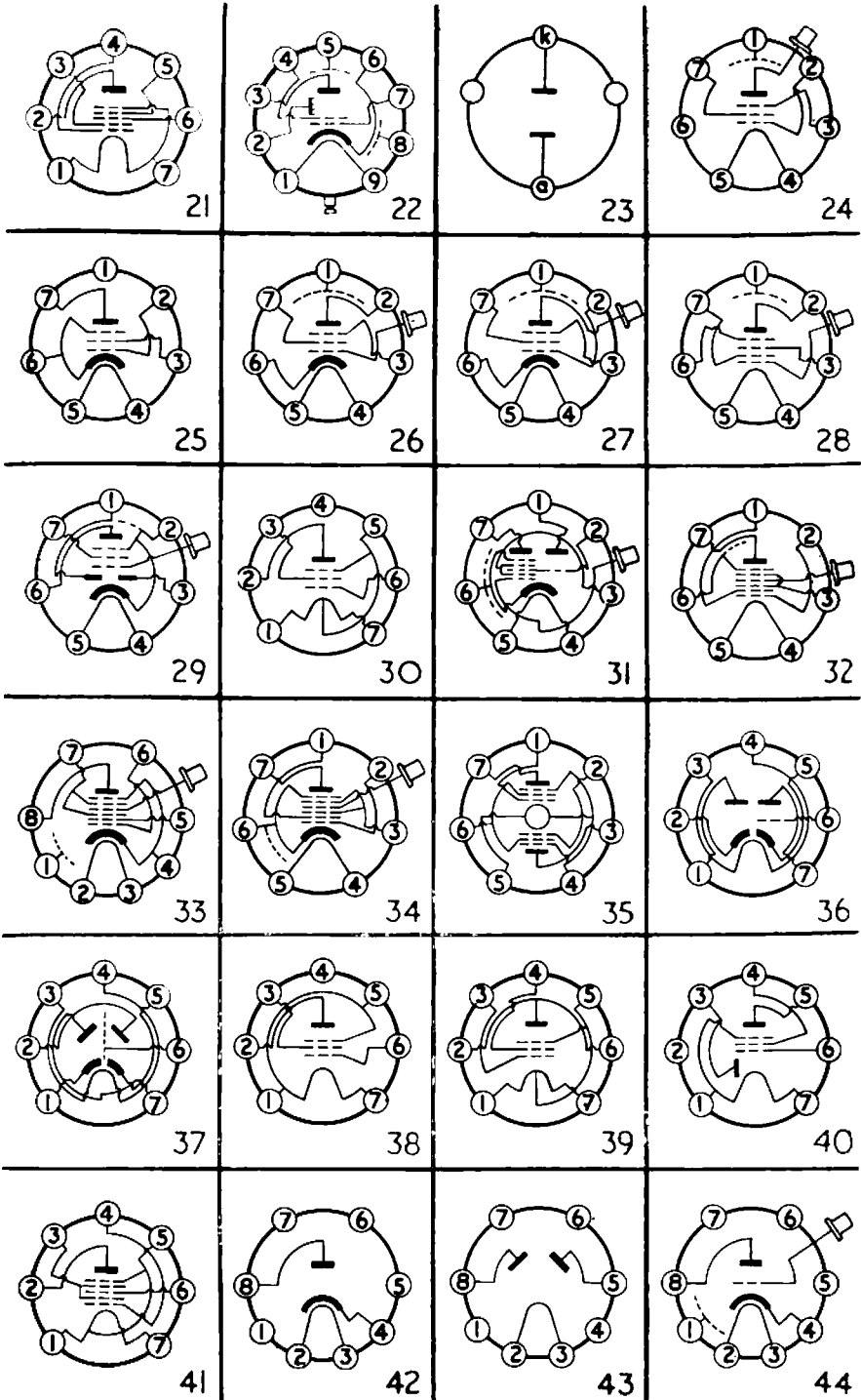
viewed from free end of pins



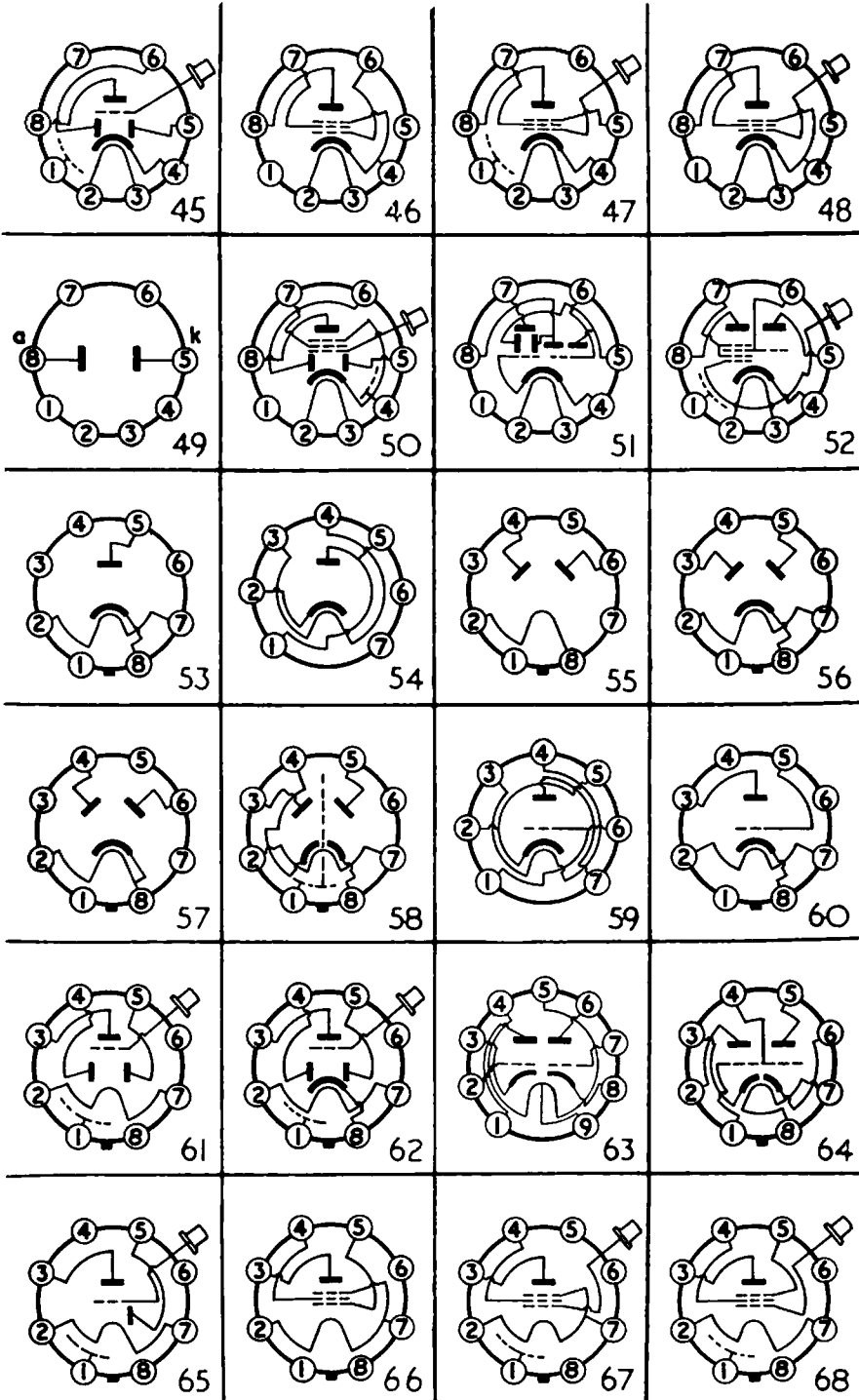
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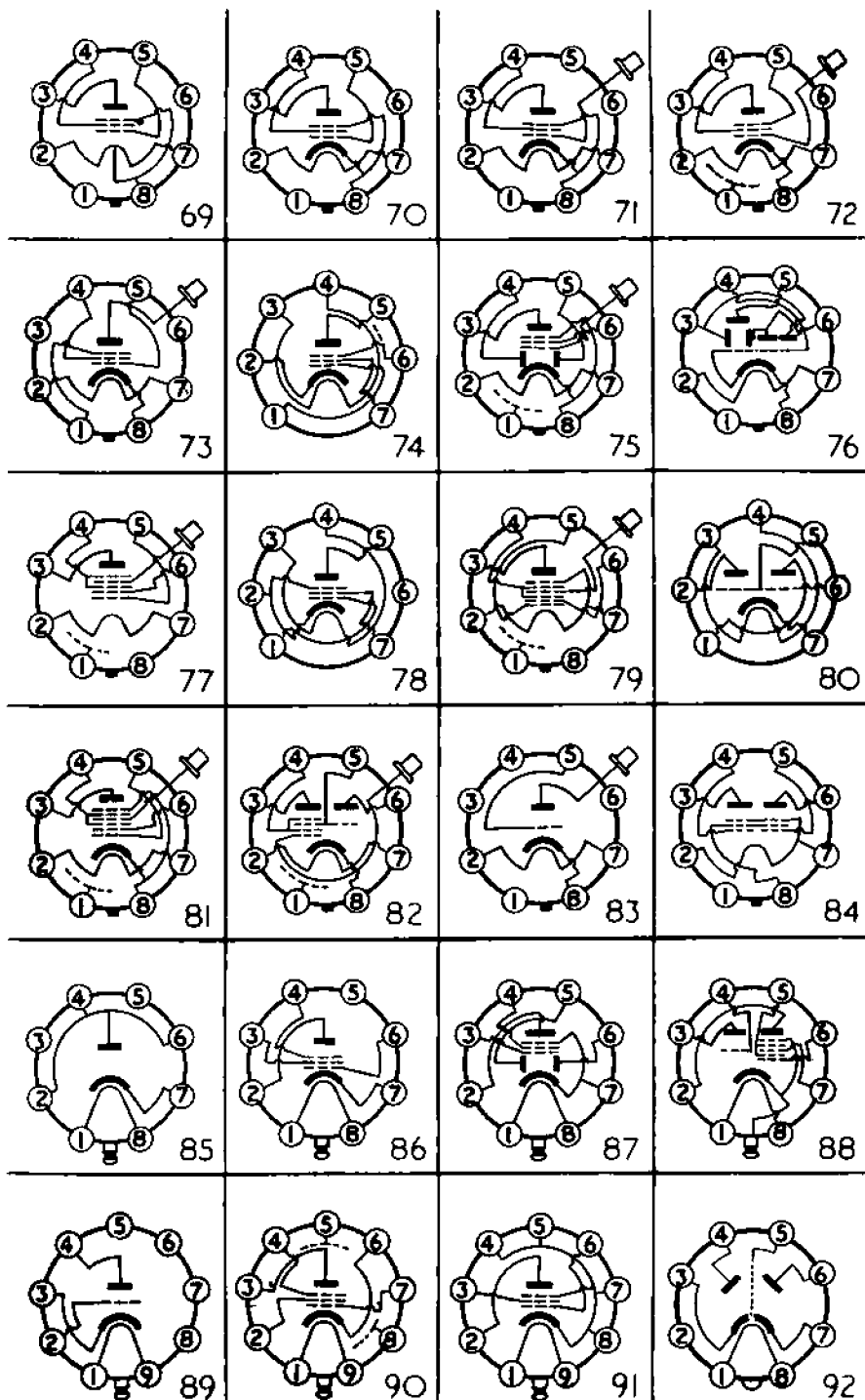
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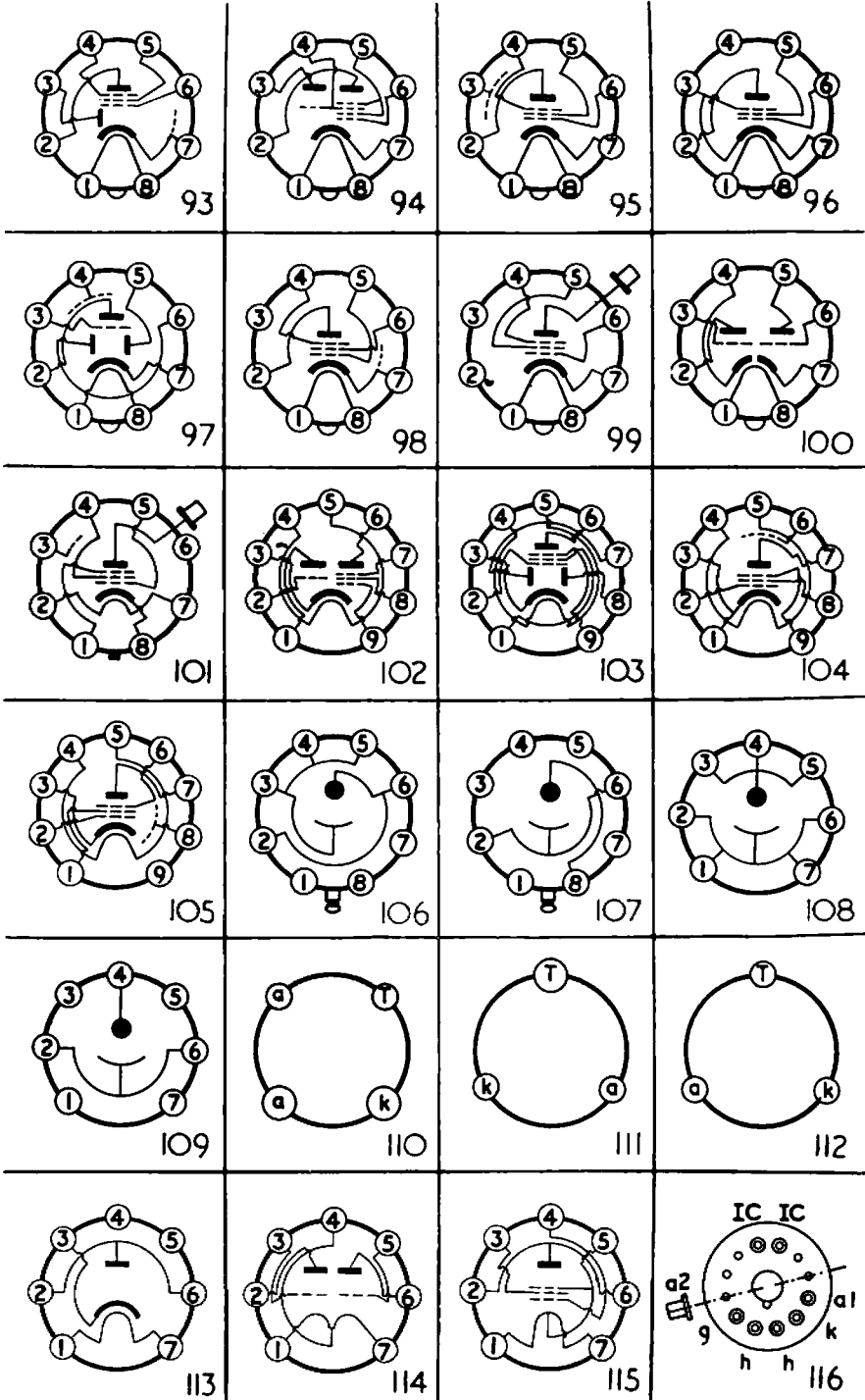
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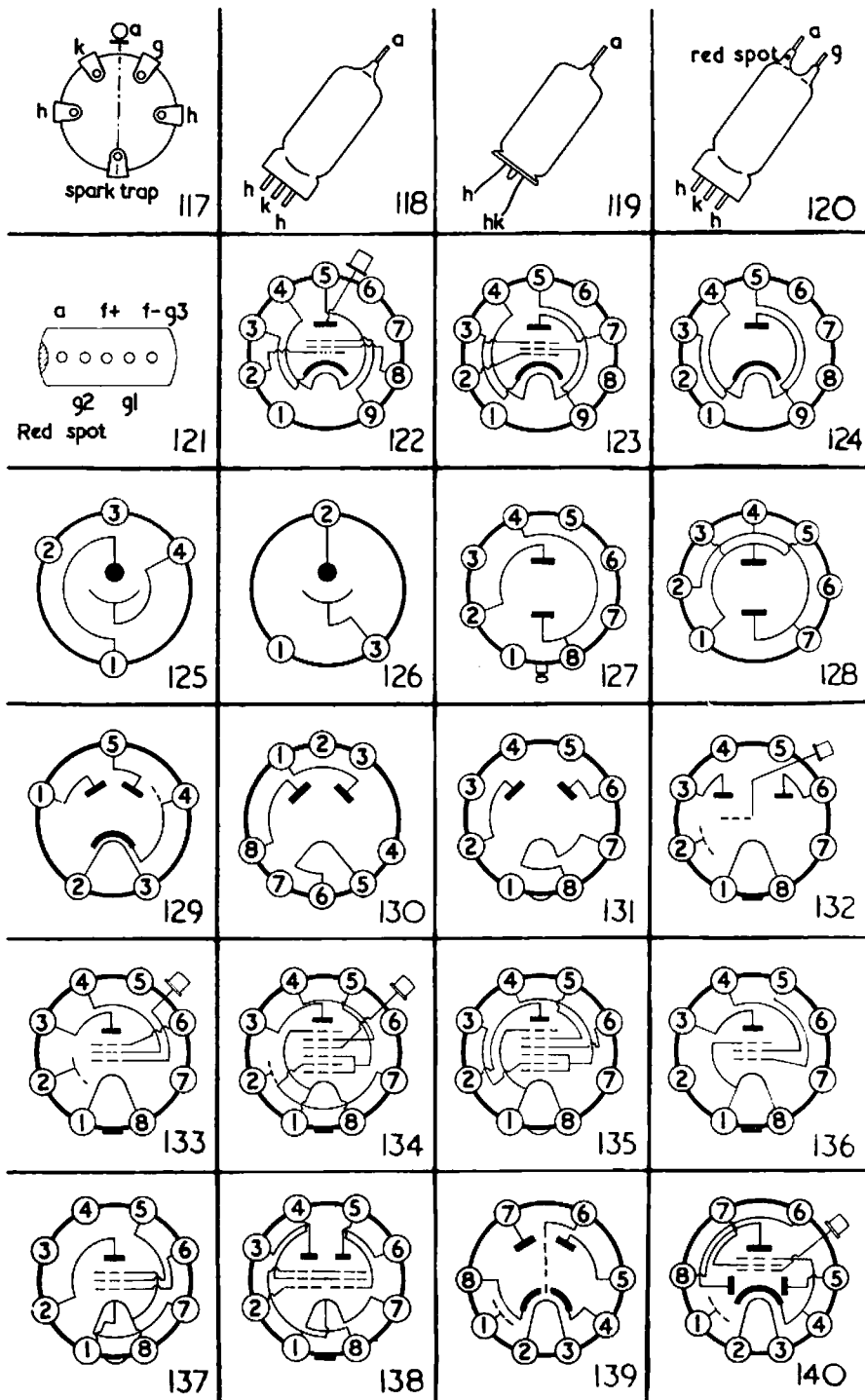
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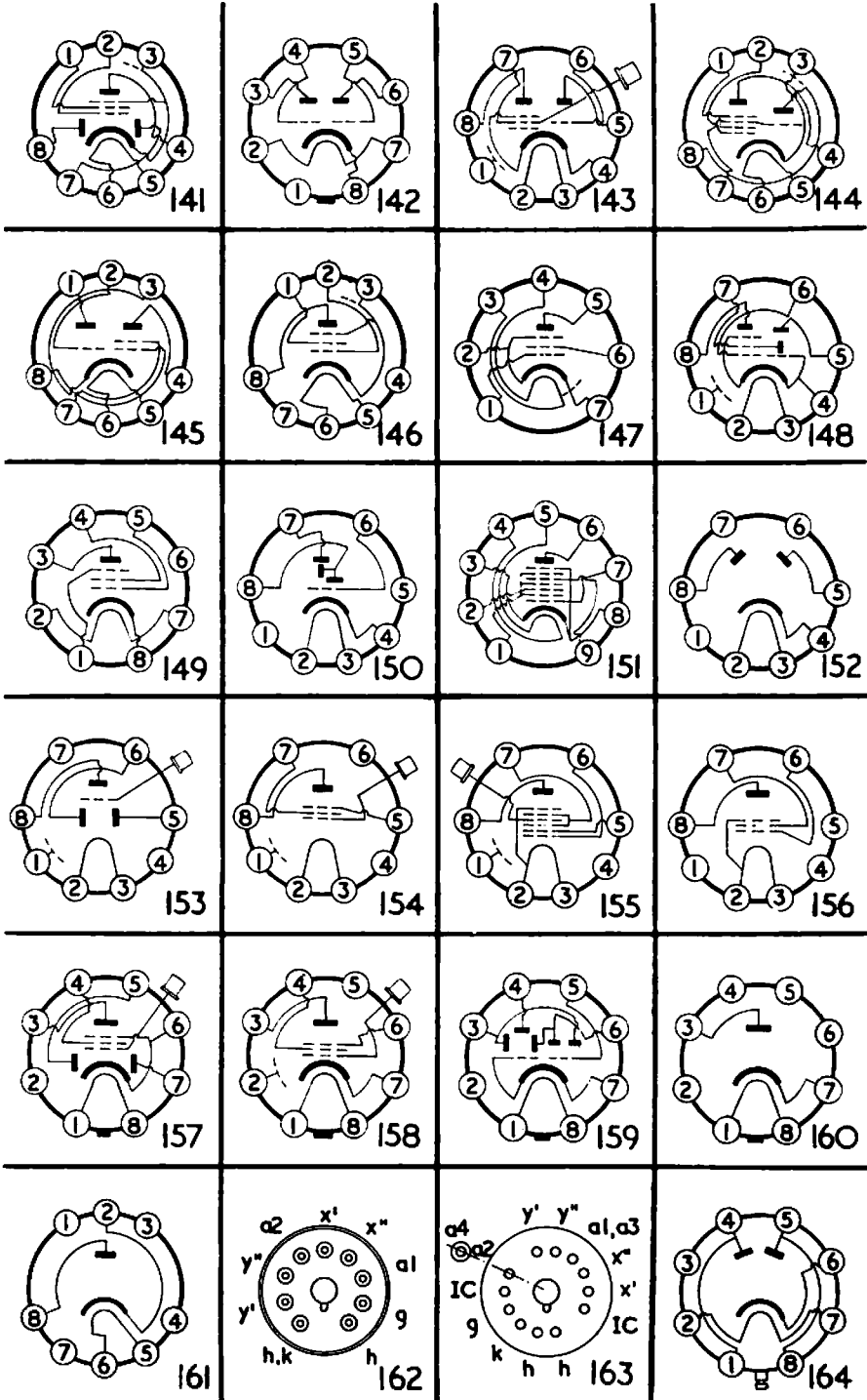
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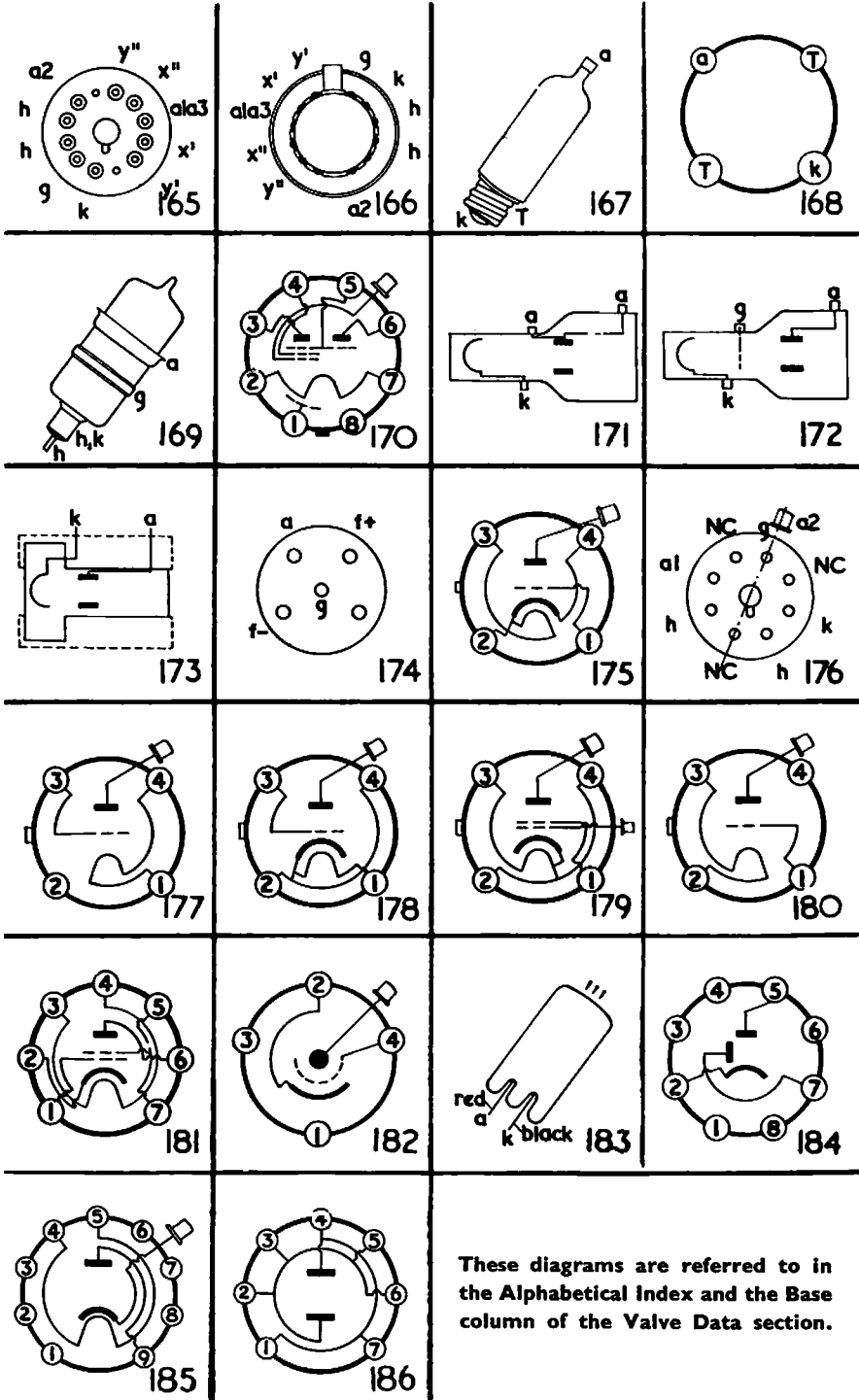
VALVE BASE DIAGRAMS



VALVE BASE DIAGRAMS



VALVE BASE DIAGRAMS



VALVE DATA

VOLTAGE AMPLIFYING PENTODES

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	ra (MΩ)
AF3	Variable- μ R.F. Pentode ..	P. (47)	4.0	0.65	250	100	3.0	8.0	2.6	1.8	1.2
AF7	Short Grid Base R.F. Pentode ..	P. (47)	4.0	0.65	250	100	2.0	3.0	1.1	2.1	2.0
DF21	Short Grid Base R.F. or A.F. Pentode ..	Octal (133)	1.4	0.025	90	90	0	1.2	0.25	0.7	2.0
DF22	Variable- μ R.F. Pentode ..	Octal (133)	1.4	0.05	90	90	1.5	1.4	0.3	1.1	1.5
DF33	Variable- μ R.F. Pentode ..	Octal (67)	1.4	0.05	90	90	0	1.2	0.3	0.75	1.5
DF66	Hearing-aid Pentode ..	B5A (121)	0.625	0.015	22.5	22.5	1.05	0.05	0.015	0.1	2.0
DF70	Hearing-aid Pentode ..	B8D (16)	0.625	0.025	30	30	0	0.375	0.125	0.22	0.5
DF91	Variable- μ R.F. Pentode ..	B7G (38)	1.4	0.05	90	67.5	0	3.5	1.4	0.9	0.5
DF92	Short Grid Base R.F. Pentode ..	B7G (38)	1.4	0.05	90	67.5	0	3.7	1.4	1.0	0.5
ECF1	Variable- μ R.F. Pentode combined with Triode (for Triode data see p. 35) ..	P. (143)	6.3	0.2	250	100	2.0	5.0	2.0	2.0	1.6
EF9	Variable- μ R.F. Pentode ..	P. (47)	6.3	0.2	250	Rg2 = 90 KΩ	2.5	6.0	1.7	2.2	1.25
EF11	Variable- μ R.F. Pentode ..	Y. (146)	6.3	0.2	250	Rg2 = 75 KΩ	2.0	6.0	2.0	2.2	2.0
EF12	Short Grid Base R.F. Pentode ..	Y. (146)	6.3	0.2	250	100	2.0	3.0	1.0	2.1	2.0
EF22	Variable- μ R.F. Pentode ..	B8G (86)	6.3	0.2	250	Rg2 = 90 KΩ	2.5	6.0	1.7	2.2	1.2

VOLTAGE AMPLIFYING PENTODES- continue!

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	ra (MΩ)
EF36	Short Grid Base R.F. or A.F. Pentode ..	Octal (72)	6.3	0.2	250	100	2.0	3.0	0.8	1.8	2.5
EF37	Low Microphony A.F. Pentode ..	Octal (72)	6.3	0.2	250	100	2.0	3.0	0.8	1.8	2.5
EF37A	Low Microphony, Low Hum A.F. Pentode	Octal (72)	6.3	0.2	250	100	2.0	3.0	0.8	1.8	2.5
EF39	Variable-mu R.F. Pentode ..	Octal (72)	6.3	0.2	250	Rg2= 90 KΩ	{ 2.5 39	6.0	1.7	2.2	1.25 >10
EF40	Low Noise A.F. Pentode ..	B9A (98)	6.3	0.2	250	140	2.0	3.0	0.55	1.85	2.5
EF41	Variable-mu R.F. Pentode ..	B8A (96)	6.3	0.2	250	Rg2= 90 KΩ	{ 2.5 39	6.0	1.7	2.2	1.0 >10
EF42	High Slope R.F. Pentode ..	B8A (95)	6.3	0.33	250	250	2.0	10	2.3	9.5	0.44
EF50	High Slope R.F. Pentode ..	B9G (90)	6.3	0.3	250	250	2.0	10	3.0	6.5	1.0
EF54	High Slope R.F. Pentode ..	B9G (91)	6.3	0.3	250	250	1.7	10	1.45	7.7	0.5
EF55	High Slope R.F. Pentode for use in Video Amplifiers ..	B9G (90)	6.3	1.0	250	250	4.5	40	5.5	12	0.055
EF80	High Slope R.F. Pentode ..	B9A (104)	6.3	0.3	170	170	2.0	10	2.5	7.4	0.4
EF91	High Slope R.F. Pentode ..	B7G (74)	6.3	0.3	250	250	2.0	10	2.5	7.6	1.0
EF92	Variable-mu R.F. Pentode ..	B7G (74)	6.3	0.2	250	200	2.5	8.0	2.1	2.5	0.5
EF95	High Slope R.F. Pentode ..	B7G (147)	6.3	0.175	180	120	2.0	7.7	2.4	5.1	0.69
KF3	Variable-mu R.F. Pentode ..	P. (154)	2.0	0.045	135	135	0.5	2.0	0.6	0.65	1.3
KF35	Variable-mu R.F. Pentode ..	Octal (68)	2.0	0.05	120	60	1.5	1.45	0.5	1.0	—
PM12M	Variable-mu R.F. Tetrode ..	British 4-pin	2.0	0.18	150	90	0	2.5	0.5	1.4	—
SP2	Short Grid Base R.F. Pentode ..	British 7-pin (24)	2.0	0.18	135	135	0	3.0	1.0	1.8	0.7

VOLTAGE AMPLIFYING PENTODES—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	ra (M Ω)
SP4	Short Grid Base R.F. Pentode	British 5- or 7-pin (13 or 27)	4-0	1-0	200	100	2-0	3-0	1-1	2-3	2-2
SP4B	Sharp Cut-off R.F. Pentode	British 7-pin (26) (47)	4-0	0-65	250	250	2-4	4-0	1-5	3-4	2-0
SPI3	Sharp Cut-off R.F. Pentode	P. (47)	13	0-2	200	100	2-0	3-3	1-2	2-2	1-3
SPI3C	Sharp Cut-off R.F. Pentode	British 7-pin (26) Octal (158)	13	0-2	200	200	2-2	2-5	0-9	2-8	2-5
UF9	Variable-mu R.F. Pentode	Y. (146)	12-6	0-1	200	Rg2= 60 K Ω	2-5	6-0	1-7	2-2	1-2
UF11	Variable-mu R.F. Pentode	Y. (146)	15	0-1	200	Rg2= 70 K Ω	2-0	6-0	1-7	2-2	1-5
UF21	Variable-mu R.F. Pentode	B8G (86)	12-6	0-1	200	Rg2= 60 K Ω	2-5	6-0	1-7	2-2	1-0
UF41	Variable-mu R.F. Pentode	B8A (96)	12-6	0-1	170	Rg2= 39 K Ω	{ 2-5 28 2-0	6-0	1-75	2-2 0-022	1-0 >10
UF42	High Slope R.F. Pentode	B8A (95)	21	0-1	170	170	2-0	10	2-8	8-5	0-2
VP2	Variable-mu R.F. Pentode	British 7-pin (24)	2-0	0-18	135	135	0	3-0	1-25	1-5	0-4
VP2B	Variable-mu R.F. Hexode	British 7-pin (28)	2-0	0-135	135	60*	1-5	2-0	0-95	1-4	1-3
VP4	Variable-mu R.F. Pentode	British 5- or 7-pin (13 or 27)	4-0	1-0	200	100	2-0	4-5	1-9	2-3	1-0
VP4A	Variable-mu R.F. Pentode	British 5- or 7-pin (13 or 27)	4-0	1-2	200	100	2-0	4-25	1-8	2-5	1-4
VP4B	Variable-mu R.F. Pentode	British 7-pin (26) P. (47)	4-0	0-65	250	250	3-0	11-5	4-25	2-0	—
VPI3A	Variable-mu R.F. Pentode	P. (47)	13	0-2	200	100	2-0	4-0	1-4	2-2	—
VPI3C	Variable-mu R.F. Pentode	British 7-pin (26)	13	0-2	200	200	2-0	9-0	3-6	2-2	—

* Vg3 = Vg2, Vg4 = 0

VOLTAGE AMPLIFYING PENTODES WITH DIODE(S)

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	ra (MΩ)
DAF91	Short Grid Base A.F. Pentode with Single Diode	B7G (40)	1.4	0.05	90	90	0	2.7	0.5	0.72	0.5
EAF42	Variable-mu R.F. Pentode with Single Diode	B8A (93)	6.3	0.2	250	Rg2=110 KΩ	{ 2.0 4.3	5.0	1.5	2.0	1.4
EBF2	Variable-mu R.F. Pentode with Double Diode	P. (140)	6.3	0.2	250	Rg2=95 KΩ	2.0	5.0	1.6	1.8	1.3
EBF11	Variable-mu R.F. Pentode with Double Diode	Y. (141)	6.3	0.2	250	Rg2=85 KΩ	2.0	5.0	1.8	1.8	2.0
EBF32	Variable-mu R.F. Pentode with Double Diode	Octal (75)	6.3	0.2	250	Rg2=95 KΩ	2.0	5.0	1.6	1.8	1.3
EBF80	Variable-mu R.F. Pentode with Double Diode	B9A (103)	6.3	0.3	250	Rg2=95 KΩ	{ 2.0 4.5	5.0	1.75	2.2	1.5
UAF42	Variable-mu R.F. Pentode with Single Diode	B8A (93)	12.6	0.1	170	Rg2=56 KΩ	{ 2.0 2.8	5.0	1.5	2.0	0.9
UBF11	Variable-mu R.F. Pentode with Double Diode	Y. (141)	20	0.1	200	Rg2=70 KΩ	2.0	5.0	1.7	1.8	1.5
UBF80	Variable-mu R.F. Pentode with Double Diode	B9A (103)	17	0.1	170	Rg2=47 KΩ	{ 2.0 2.5	5.0	1.75	2.2	0.9

∞

FREQUENCY CHANGERS

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Vg2+4 (V)	-Vg1 (V)	Ia (mA)	Ig2+4 (mA)	gc (mA/V)	ra (KΩ)
AK2	Octode	P. (33)	4.0	0.65	250	70 (Vg3+5)	1.5 (Vg4)	1.6	3.8 (lg3+5)	0.6	1,600
CCH35	Triode Hexode	Octal (82)	7.0	0.2	● { 200 100 △ 120	100 (Vg3+5)	2.0 (Vg4)	3.0	3.0	0.65	900
DK21	Octode	Octal (134)	1.4	0.05	90	Rg5=120 KΩ	0 (Vg4)	1.5	0.25 (lg5)	0.5	500
DK32	Heptode	Octal (77)	1.4	0.05	90	45 (Vg3+5)	0 (Vg4)	0.6	0.7 (lg3+5)	0.25	600

● Mixer Section.

△ Triode Section.

FREQUENCY CHANGERS — continued

TYPE	DESCRIPTION	BASE	V _f or V _h (V)	I _f or I _h (A)	V _a (V)	V _{g2+4} (V)	-V _{g1} (V)	I _a (mA)	I _{g2+4} (mA)	g _c (mA/V)	r _a (KΩ)
DK40	Octode ..	B8A (135)	1.4	0.05	135	R _{g5} = 270 KΩ	0 (V _{g4})	1.0	0.25 (I _{g5})	0.425	1,000
DK91	Heptode ..	B7G (41)	1.4	0.05	90	67.5	0 (V _{g3})	1.6	3.2	0.3	600
DK92	Heptode ..	B7G (21)	1.4	0.05	90	60 (V _{g4})	0 (V _{g3})	0.7	0.15 (I _{g4})	0.325	650
ECH3	Triode Hexode ..	P. (52)	6.3	0.2	● {250 △ {100	—	2.0 0	3.0	3.0	0.65	1,300 8.6
ECH11	Triode Hexode ..	Y. (144)	6.3	0.2	● {250 △ {150	—	2.0 0	2.3	3.0	0.65	1,200 6.0
ECH21	Triode Heptode ..	B8G (88)	6.3	0.33	● {250 △ {100	—	2.0 0	3.0	6.2	0.75	1.4 6.5
ECH33	Triode Hexode ..	Octal (82)	6.3	0.2	● {250 △ {100	—	2.0 0	3.0	3.0	0.65	1,300 8.6
ECH35	Triode Hexode ..	Octal (82)	6.3	0.3	● {250 △ {100	—	2.0 0	3.0	3.0	0.65	1,300 8.6
ECH42	Triode Hexode ..	B8A (94)	6.3	0.23	● {250 △ {100	—	2.0 0	3.0	3.0	0.75	1,000 8.0
EK2	Octode ..	P. (33)	6.3	0.2	250	50 (V _{g3+5})	2 (V _{g4})	1.0	0.8 (I _{g3+5})	0.55	2,000
EK32	Octode ..	Octal (81)	6.3	0.2	250	50 (V _{g3+5})	2 (V _{g4})	1.0	0.8 (I _{g3+5})	0.55	2,000
FC2A	Octode ..	British 7-pin (32)	2.0	0.13	135	45 (V _{g3+5})	0.5 (V _{g4})	0.7	0.7 (I _{g3+5})	0.27	2,500
FC4	Octode ..	British 7-pin (34)	4.0	0.65	250	70 (V _{g3+5})	1.5 (V _{g4})	1.6	3.8 (I _{g3+5})	0.6	—
FC13	Octode ..	P. (33)	13	0.2	200	70 (V _{g3+5})	1.5 (V _{g4})	1.6	3.8 (I _{g3+5})	0.6	—
FC13C	Octode ..	British 7-pin (34)	13	0.2	200	70 (V _{g3+5})	1.5 (V _{g4})	1.6	3.8 (I _{g3+5})	0.6	—
KCF30	Triode Pentode ..	Octal (170)	2.0	0.2	● {120 △ {100	60 (V _{g2})	1.5 0	0.53 5.5	1.0 (I _{g2})	0.26	10.5

● Mixer Section.

△ Triode Section.

FREQUENCY CHANGERS—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Vg2+4 (V)	-Vg1 (V)	Ia (mA)	Ig2+4 (mA)	gc (mA/V)	ra (KΩ)
KK2	Octode	P. (155)	2.0	0.13	135	45 (Vg3+5)	0.5 (Vg4)	0.7	0.7 (Ig3+5)	0.27	2,500
KK32	Octode	Octal (79)	2.0	0.13	135	45 (Vg3+5)	0.5 (Vg4)	0.7	0.7 (Ig3+5)	0.27	—
TH4B	Triode Heptode	British 7-pin (31)	4.0	1.45	● {250 △ {100	100	2.5	3.25 9.5	6.0	0.75	1,500
TH21C	Triode Hexode	British 7-pin (31)	2.1	0.2	● {250 △ {125	70	1.5	1.6 6.0	3.8	0.6	—
TH30C	Triode Heptode	British 7-pin (31)	2.9	0.2	● {250 △ {100	100	2.5	3.25 9.5	6.0	0.75	1,500
UCH11	Triode Hexode	Y. (144)	20	0.1	● {200 △ {150	80	2.0	2.5 19	3.0	0.75	1,000
UCH21	Triode Heptode	B8G (88)	20	0.1	● {200 △ {100	100	2.0	3.5 12	6.5	0.75	1,000
UCH42	Triode Hexode	B8A (94)	14	0.1	● {170 △ {100	70	1.85 0	2.1 10	2.6	0.67	1,000 8.0

● Mixer Section. △ Triode Section.

DIODES

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va max. (V)	Ia max. (mA)
AB2	Double Diode	V. (129)	4.0	0.65	200	0.8
DA90	Indirectly-heated Single Diode	B7G (113)	1.4	0.15	330 (P.I.V. max.)	0.5
EA50	Single Diode	B3G (118)	6.3	0.15	50	5.0
EB4	Double Diode with separate Cathodes	P. (139)	6.3	0.2	200	0.8
EB34	Double Diode with separate Cathodes	Octal (58)	6.3	0.2	200	0.8
EB41	Double Diode with separate Cathodes	B8A (92)	6.3	0.3	150	9.0

DIODES—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va max. (V)	Ia max. (mA)
EB91	Double Diode with separate Cathodes	B7G (37)	6.3	0.3	420 (P.I.V. max.)	9.0
KB2	Double Diode	V. (129)	2.0	0.095	125	0.5
UB41	Double Diode with separate Cathodes	B8A (92)	19	0.1	150	9.0
2D4A	Double Diode	British 5-pin (8)	4.0	0.65	200	0.8

TRIODES AND DOUBLE TRIODES

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	-Vg (V)	Ia (mA)	μ	gm (mA/V)	ra (K Ω)
ACO44	Directly-heated Output Triode	British 4-pin (3)	4.0	1.0	300	38	50	6.0	5.0	1.2
DCC90	R.F. Double Triode suitable for portable transmitters	B7G (114)	{ 1.4 2.8	{ 0.22 0.11	90	2.5	3.7	15	1.8	8.3
EC31	Low Impedance Triode	Octal (60)	6.3	0.65	250	16	20	10.5	3.2	3.3
EC52	Low power V.H.F. Oscillator Triode	B9G (89)	6.3	0.43	250	2.6	10	60	6.5	9.2
EC53	Low power U.H.F. Oscillator Triode	B3G (120)	6.3	0.25	200	3.3	7.5	33	4.0	11.4
EC54	Earthed Grid Triode	B9G (15)	6.3	0.43	250	1.5	10	98	9.0	11.1
EC91	Earthed Grid Triode	B7G (59)	6.3	0.3	250	1.5	10	100	8.5	12
ECC31	Medium Impedance Double Triode	Octal (142)	6.3	0.95	250	4.6	6.0	32	2.3	14
ECC32	Medium Impedance Double Triode with separate Cathodes	Octal (64)	6.3	0.95	250	4.6	6.0	32	2.3	14
ECC33	High Slope, Low Impedance Double Triode with separate Cathodes	Octal (64)	6.3	0.4	250	4.0	9	35	3.6	9.7
ECC34	Low Impedance Double Triode with separate Cathodes	Octal (64)	6.3	0.95	250	16	10	11.5	2.2	5.2

TRIODES AND DOUBLE TRIODES—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	-Vg (V)	Ia (mA)	μ	gm (mA/V)	ra (K Ω)
ECC35	High-gain Double Triode with separate Cathodes	Octal (64)	6.3	0.4	250	2.5	2.3	68	2.0	34
ECC40	Low Microphony Double Triode with separate Cathodes	B8A (100)	6.3	0.6	250	5.2	6.0	30	2.7	11
ECC81	Double Triode with separate Cathodes for use as Frequency Changer or R.F. Amplifier	B9A (63)	{ 6.3 12.6	{ 0.3 0.15	170	1.5	7.0	57	4.8	12
ECC91	Double Triode for use as R.F. Amplifier or Oscillator	B7G (80)	6.3	0.45	100	0.85	8.5	38	5.3	7.1
ECF1	Triode combined with R.F. or I.F. Pentode (for Pentode data see page 28)	P. (143)	6.3	0.2	150	3.0	8.0	20	2.2	9.0
ECL11	Triode combined with an Output Tetrode (for Tetrode data see page 37)	Y. (145)	6.3	1.0	250	2.5	2.0	70	2.0	35
ECL80	Triode combined with an Output Pentode (for Pentode data see page 37)	B9A (102)	6.3	0.3	100	2.3	4.0	17.5	1.4	12.5
HL13	Medium Impedance Triode	P. (44)	13	0.2	200	3.7	5.0	40	3.3	12
HL13C	Medium Impedance Triode	British 7-pin (19)	13	0.2	200	3.7	5.0	40	3.3	12
PM2A	Output Triode	British 4-pin (3)	2.0	0.2	135	6.0	5.0	12	2.0	6.0
PM2HL	Medium Impedance Triode	British 4-pin (3)	2.0	0.1	135	1.5	2.2	30	1.4	21.5
PM202	Power Triode	British 4-pin (3)	2.0	0.2	150	14	14	7	3.5	2.0
UCL11	Triode combined with Output Tetrode (for Tetrode data see page 39)	Y. (145)	60	0.1	200	2.0	2.0	65	2.1	30
354V	Medium Impedance Triode	British 5-pin (9)	4.0	0.65	250	4.5	6.5	40	3.5	11.5

TRIODES WITH DIODES

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	-Vg1 (V)	Ia (mA)	μ	gm (mA/V)	ra (K Ω)
ABC1	Double Diode Triode	P. (45)	4.0	0.65	250	7.0	4.0	27	2.0	13.5
DAC21	Single Diode Triode	Octal (132)	1.4	0.025	90	0	0.45	40	0.3	130
DAC32	Single Diode Triode	Octal (65)	1.4	0.05	90	0	0.15	65	0.275	240
EAC91	Single Diode Triode with separate Cathode for Diode	B7G (36)	6.3	0.3	200	2.8	7.5	36	2.8	12.8
EBC3	Double Diode Triode	P. (45)	6.3	0.2	250	5.5	5.0	30	2.0	15
EBC33	Double Diode Triode	Octal (62)	6.3	0.2	250	5.5	5.0	30	2.0	15
EBC41	Double Diode Triode	B8A (97)	6.3	0.23	250	3.0	1.0	70	1.3	54
KBC1	Double Diode Triode	P. (153)	2.0	0.115	135	4.5	2.5	16	1.0	16
KBC32	Double Diode Triode	Octal (61)	2.0	0.05	100	0	2.4	25	1.2	21
TDD2A	Double Diode Triode	British 5-pin (10)	2.0	0.12	135	1.5	1.95	30	1.2	25
TDD4	Double Diode Triode	British 7-pin (20)	4.0	0.65	250	7.0	4.0	27	2.0	13.5
TDD13C	Double Diode Triode	British 7-pin (20)	13.0	0.2	200	5.0	4.0	27	2.0	13.5
UBC41	Double Diode Triode	B8A (97)	14.0	0.1	170	1.6	1.5	70	1.65	42

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OUTPUT PENTODES

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va = Vg2 (V)	-Vg1 (V)	Ia (mA)	gm (mA/V)	Pout (W)	Ra (K Ω)
AL4	Output Pentode (pa max.=9 W)	P. (46)	4.0	1.75	250	6.0	36	9.0	4.5	7.0
CL4	Output Pentode (pa max.=9 W)	P. (48)	33.0	0.2	200	8.5	45	8.0	4.0	4.5
CL33	Output Pentode (pa max.=9 W)	Octal (70)	33.0	0.2	200	8.5	45	8.0	4.0	4.5

OUTPUT PENTODES —continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va = Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	Pout (W)	Ra (KΩ)
DL21	Output Pentode	Octal (136)	1.4	0.05	120	4.8	5.0	0.9	1.4	0.27	24
DL33	Output Pentode	Octal (69)	{ 1.4 2.8	0.1 0.05	90 90	90 90	4.5 4.5	9.5 8.0	1.3 1.0	0.27 0.23	8.0 8.0
DL35	Output Pentode	Octal (66)	1.4	0.1	90	7.5	7.8	3.5	1.55	0.24	8.0
DL36	Output Pentode	Octal (66)	1.4	0.1	90	4.5	9.5	1.3	2.2	0.27	8.0
DL41	Output Pentode	B8A (137)	{ 1.4 2.8	0.1 0.05	90 90	3.6 3.6	8.0 6.0	1.3 0.95	2.45 2.2	0.36 0.235	11.3 15
DL66	Hearing-aid Output Pentode	B5A (121)	1.25	0.015	22.5	1.4	0.3	0.075	0.35	0.0027	75
DL68	Hearing-aid Output Pentode	B5A (121)	1.25	0.025	22.5	2.2	0.6	0.15	0.43	0.005	37.5
DL71	Hearing-aid Output Pentode	B8D (16)	1.25	0.025	45	1.25	0.6	0.15	0.55	0.0063	100
DL72	Hearing-aid Output Pentode	B8D (16)	1.25	0.025	45	4.5	1.25	0.4	0.5	0.0195	30
DL92	Output Pentode	B7G (39)	{ 1.4 2.8	0.1 0.05	90* 90*	7.0 7.0	7.4 6.1	1.4 1.1	1.57 1.42	0.27 0.235	8.0 8.0
DL93	Output Pentode suitable for R.F. or A.F. applications	B7G (115)	{ 1.4 2.8	0.2 0.1	150†	8.4	13.3	2.2	1.9	0.7‡	8.0
DL94	Output Pentode	B7G (30)	{ 1.4 2.8	0.1 0.05	90 90	4.5 4.5	9.5 7.7	2.1 1.7	2.15 2.0	0.27 0.24	10 10
DLL21	Double Output Pentode	Octal (138)	{ 1.4 2.8	0.2 0.1	135 135	9.4 9.5	2 × 8.8 2 × 8.2	2 × 2.3 2 × 2.4	—	1.5 1.5	15§ 15§
ECL11	Output Tetrode (pa max. = 9 W) combined with Triode (for Triode data see page 35)	Y. (145)	6.3	1.0	250	6.0	36	4.0	9.0	3.8	7.0
ECL80	Output Pentode (pa max. = 35 W) combined with Triode (for Triode data see page 35)	B9A (102)	6.3	0.3	170	6.7	15	2.8	3.2	1.0	11
EL2	Output Pentode (pa max. = 8 W)	P. (48)	6.3	0.2	250	18	32	5.0	2.8	3.6	8.0

* Vg2 = 67.5 V.

† Vg2 = 90 V.

‡ Pout = 1.2 W as R.F. Power Amplifier at 50 Mc/s (intermittent operation).

§ Ra-a.

OUTPUT PENTODES *continued*

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va = Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	Pout (W)	Ra (KΩ)
EL3	Output Pentode (pa max.=9 W) ..	P. (46)	6.3	0.9	250	6.0	36	4.0	9.0	4.5	7.0
EL11	Output Pentode (pa max.=9 W) ..	Y. (146)	6.3	0.9	250	6.0	36	4.0	9.0	4.5	7.0
EL12	Output Pentode (pa max.=18 W) ..	Y. (146)	6.3	1.2	250	7.0	72	8.0	15	8.0	3.5
EL31	Output Pentode (pa max.=25 W) ..	Octal (73)	6.3	1.4	275	9.0	91	11	14	120*	10*
EL32	Output Pentode (pa max.=8 W) ..	Octal (71)	6.3	0.2	250	18	32	5.0	2.8	3.6	8.0
EL33	Output Pentode (pa max.=9 W) ..	Octal (70)	6.3	0.9	250	6.0	36	4.0	9.0	4.5	7.0
EL34	Output Pentode (pa max.=25 W) ..	Octal (149)	6.3	1.5	250	13.5	100	14	11	12	2.0
EL35	Output Pentode (pa max.=18 W) ..	Octal (70)	6.3	1.35	250	15.5	72	8.0	5.0	6.0	2.5
EL37	Output Pentode (pa max.=25 W) ..	Octal (70)	6.3	1.4	250	13.5	100	13.5	11	69*	3.25*
EL38	Line Time Base Output Pentode (pa max.=25 W)	Octal (73)	6.3	1.4	275	9.0	91	11	14	va(pk) max.=8 KV	7.0
EL41	Output Pentode (pa max.=9 W) ..	B8A (96)	6.3	0.7	250	7.0	36	5.2	10	4.2	7.0
EL42	Output Pentode (pa max.=6 W) ..	B8A (96)	6.3	0.2	225	10.5	26	4.1	3.2	2.5	9.0
§EL81	Line Time Base Output Pentode (pa max.=8 W)	B9A (122)	6.3	1.05	250	38.5	32	2.4	4.6	va(pk) max.=7 KV	max.=
EL91	Output Pentode (pa max.=4 W) ..	B7G (78)	6.3	0.2	250	12.5	16	2.4	2.6	1.4	16
KL4	Output Pentode ..	P. (156)	2.0	0.15	135	5.0	7.0	1.1	2.1	0.44	19
KL35	Output Pentode ..	Octal (66)	2.0	0.15	135	4.8	5.0	—	2.2	0.31	20
KLL32	Double Output Pentode ..	Octal (84)	2.0	0.3	120	10.2	3.3	—	2.6†	0.94	16
PenA4	Output Pentode (pa max.=9 W) ..	British 7-pin (25)	4.0	1.95	250	5.8	36	5.0	9.5	3.8	8.0
PenB4	Output Pentode (pa max.=18 W) ..	British 7-pin (25)	4.0	2.1	250‡	12	72	7.0	8.5	8.8	3.5

* Two valves in push-pull (fixed bias).

† gm at Va = Vg2 = 100 V, Vg1 = 0 V.

‡ Vg2 = 275 V.

§ Provisional information.

OUTPUT PENTODES—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va = Vg2 (V)	-Vg1 (V)	Ia (mA)	Ig2 (mA)	gm (mA/V)	Pout (W)	Ra (K Ω)
Pen4VA	Output Pentode (pa max.=9 W)	British 5- or 7-pin (12 or 25)	4-0	1-35	250	19-5	36	3-0	2-8	3-8	6-0
Pen36C	Output Pentode (pa max.=9 W)	British 7-pin (25)	33	0-2	200	8-5	45	6-0	8-0	4-0	4-5
PL33	Output Pentode (pa max.=9 W)	Octal (70)	19	0-3	225	5-3	32	3-4	9-0	3-3	7-0
PL38	Line Time Base Output Pentode (pa max.=25 W)	Octal (73)	30	0-3	200	5-5	75	9-0	13-5	va(pk) max.=8 KV	
PL81	Line Time Base Output Pentode (pa max.=8 W)	B9A (122)	21-5	0-3	170	22	45	3-0	6-2	va(pk) max.=7 KV	
PL82	Output Pentode (pa max.=9 W)	B9A (123)	16-5	0-3	170	10-4	53	10	9-0	4-0	3-0
PL83	Video Output Pentode (pa max.=9 W)	B9A (105)	15	0-3	170	2-3	36	5-0	10	Vout(pk) into CRT cathode=70 V at Vb=170 V	
PM22A	Output Pentode	British 5-pin (11)	2-0	0-15	135	4-5	5-6	—	2-2	0-34	19
PM22D	Output Pentode	British 5-pin (11)	2-0	0-3	135	2-4	5-0	0-8	3-0	0-3	24
PM24A	Output Pentode	British 5-pin (11)	4-0	0-275	300*	22-5	20	—	1-7	2-8	15
PM24M	Output Pentode (pa max.=7-5 W)	British 5-pin (11)	4-0	1-1	250	17	30	5-6	3-0	2-8	7-0
QP22B	Double Output Pentode	British 7-pin (35)	2-0	0-3	135	11-7	3-8	0-5	—	1-33	14-7
UCL11	Output Tetrode (pa max.=9 W) combined with Triode (for Triode data see page 35)	Y. (145)	60	0-1	200	8-5	45	6-0	9-0	4-0	4-5
UJL41	Output Pentode (pa max.=9 W)	B8A (96)	45	0-1	170	10-4	53	10	9-5	4-0	3-0

* Vg2=200 V.

OUTPUT PENTODES WITH DIODES

TYPE	DESCRIPTION	BASE	V _h (V)	I _h (A)	V _a = V _{g2} (V)	-V _{g1} (V)	I _a (mA)	I _{g2} (mA)	g _m (mA/V)	P _{out} (W)	R _a (KΩ)
ABL1	Double Diode Output Pentode (pa max. = 9 W) ..	P. (50)	4.0	2.4	250	6.0	36	4.0	9.0	4.5	7.0
CBL1	Double Diode Output Pentode (pa max. = 9 W) ..	P. (50)	44	0.2	200	8.5	45	6.0	8.0	4.0	4.5
CBL31	Double Diode Output Pentode (pa max. = 9 W) ..	Octal (75)	44	0.2	200	8.5	45	6.0	8.0	4.0	4.5
EBL1	Double Diode Output Pentode (pa max. = 9 W) ..	P. (50)	6.3	1.2	250	6.0	36	5.0	9.5	4.3	7.0
EBL21	Double Diode Output Pentode (pa max. = 11 W) ..	B8G (87)	6.3	0.8	250	6.0	36	5.0	9.0	4.5	7.0
EBL31	Double Diode Output Pentode (pa max. = 9 W) ..	Octal (75)	6.3	1.2	250	6.0	36	5.0	9.5	4.3	7.0
Pen4DD	Double Diode Output Pentode (pa max. = 9 W) ..	British 7-pin Octal (157)	4.0	2.25	250	6.0	36	5.0	9.5	4.3	7.0
UBL1	Double Diode Output Pentode (pa max. = 11 W) ..	B8G (87)	55	0.1	200	11.5	55	11	8.5	5.2	3.5
UBL21	Double Diode Output Pentode (pa max. = 11 W) ..	B8G (87)	55	0.1	200	13	55	9.5	8.0	4.8	3.5

NONODE

TYPE	DESCRIPTION	BASE	V _h (V)	I _h (A)	TYPICAL OPERATION						
EQ80	Nonode for use as F.M. Detector and Limiter	B9A (151)	6.3	0.2	V _b 170 V V _{g2} +g ₄ +g ₆ 20 V V _{g5} -4 V V _{g3} -4 V V _{g1} 0 V I _a 0.28 mA I _{g2} +g ₄ +g ₆ 1.5 mA I _{g3} 0.09 mA I _{g5} 0.03 mA R _a 5.0 MΩ	Vin(g ₃) r.m.s. 12 V Vin(g ₅) r.m.s. 12 V Phase angle between signals on g ₃ and g ₅ = 90° R _a 0.33 MΩ					

TUNING INDICATORS

TYPE	DESCRIPTION	BASE	Vh (V)	Ih (A)	Va (V)	-Vg1 (V)	Ic (mA)	Optimum Load (MΩ)
EFM1	Tuning Indicator combined with A.F. Pentode	P. (148)	6.3	0.2	250	2-20	0.65	0.13
EM1	Tuning Indicator	P. (150)	6.3	0.2	250	0-5	0.13	2.0
EM4	Dual Sensitivity Tuning Indicator	P. (51)	6.3	0.2	{ 250 250	{ 0-16 0-5	0.75	1.0*
EM34	Dual Sensitivity Tuning Indicator	Octal (76)	6.3	0.2	{ 250 250	{ 0-16 0-5	0.75	1.0*
UM4	Dual Sensitivity Tuning Indicator	Octal (159)	12.6	0.1	{ 200 200	{ 0-12.5 0-4.2	1.4	1.0*
UM34	Dual Sensitivity Tuning Indicator	Octal (76)	12.6	0.1	{ 200 200	{ 0-12.5 0-4.2	1.4	1.0*

* Each Anode.

RECTIFIERS

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va max. (V r.m.s.)	Iout max. (mA)
AZ1	Directly Heated Full Wave Rectifier	P. (43)	4.0	1.1	2×300	100
AZ4	Directly Heated Full Wave Rectifier	P. (43)	4.0	2.3	2×300	200
AZ11	Directly Heated Full Wave Rectifier	Y. (130)	4.0	1.1	2×300	100
AZ12	Directly Heated Full Wave Rectifier	Y. (130)	4.0	2.3	2×300	200
AZ31	Directly Heated Full Wave Rectifier	Octal (55)	4.0	1.1	2×300	100
AZ41	Directly Heated Full Wave Rectifier	B8A (131)	4.0	0.72	2×300	70
CY1	Indirectly Heated Half Wave Rectifier	P. (42)	20	0.2	250	120
CY31	Indirectly Heated Half Wave Rectifier	Octal (53)	20	0.2	250	120
DW2	Directly Heated Full Wave Rectifier	British 4-pin (1)	4.0	1.0	2×250	60

RECTIFIERS—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va max. (V r.m.s.)	Iout max. (mA)
DW4/350	Directly Heated Full Wave Rectifier ..	British 4-pin (1)	4-0	2-0	2×350	120
DW4/500	Directly Heated Full Wave Rectifier ..	British 4-pin (1)	4-0	2-0	2×500	120
EY51	Indirectly Heated H.V. Rectifier suitable for C.R.T., E.H.T. supplies ..	Wired-in B2A (119)	6-3 For pulsed input:— P.I.V. max. = 17 KV	0-09	5,000 Iout max. = 0-35 mA Ii(pk) max. = 80 mA	3-0
EY91	Indirectly Heated Half Wave Rectifier ..	B7G (54)	6-3	0-42	250	75
EZ2	Indirectly Heated Full Wave Rectifier ..	P. (152)	6-3	0-4	2×350	60
EZ35	Indirectly Heated Full Wave Rectifier ..	Octal (56)	6-3	0-6	2×325	70
EZ40	Indirectly Heated Full Wave Rectifier ..	B8A (5)	6-3	0-6	2×350	90
EZ41	Indirectly Heated Full Wave Rectifier ..	B8A (5)	6-3	0-4	2×250	60
FW4/500	Directly Heated Full Wave Rectifier ..	British 4-pin (1)	4-0	3-0	2×500	250
FW4/800	Directly Heated Full Wave Rectifier ..	British 4-pin (1)	4-0	3-0	2×850	125
GZ32	Indirectly Heated Full Wave Rectifier ..	Octal (57)	5-0	2-3	2×300	300
HVR2	Indirectly Heated Half Wave Rectifier ..	British 4-pin (2)	4-0	0-65	6,000	3-0
HVR2A	Indirectly Heated Half Wave Rectifier ..	British 4-pin (2)	2-0	1-5	6,000	3-0
IW4/350	Indirectly Heated Full Wave Rectifier ..	British 4-pin (7)	4-0	2-0	2×350	120
IW4/500	Indirectly Heated Full Wave Rectifier ..	British 4-pin (7)	4-0	2-5	2×500	120
PY31	Indirectly Heated Half Wave Rectifier ..	Octal (53)	17	0-3	250	125
PY80	Indirectly Heated Booster Diode for use in Energy Recovery Circuits ..	B9A (124)	19 P.I.V. max. = 4 KV Ia(pk) max. = 400 mA	0-3	Ia(av) max. = 180 mA Vh-k(pk) max. = 650 V	
*PY81	Indirectly Heated Booster Diode for use in Energy Recovery Circuits ..	B9A (185)	17 P.I.V. max. = 4-5 KV Ia(pk) max. = 450 mA	0-3	Ia(av) max. = 150 mA Vh-k(pk) max. = 4-5 KV	

* Provisional information.

RECTIFIERS—Continued

TYPE	DESCRIPTION	BASE	V _h (V)	I _h (A)	V _a max. (V r.m.s.)	I _{out} max. (mA)
PY82	Indirectly Heated Half Wave Rectifier ..	B9A (124)	19	0.3	250	180
PZ30	Indirectly Heated Rectifier with two separate Half Wave Sections, suitable for use as Half Wave or Voltage Doubling Rectifier ..	Octal (17)	52	0.3	240	200*
URIC	Indirectly Heated Half Wave Rectifier ..	British 5-pin (6)	20	0.2	250	75
UR3C	Indirectly Heated Multiple Rectifier ..	British 7-pin (18)	30	0.2	2×250	120
UYIN	Indirectly Heated Half Wave Rectifier ..	Octal (160)	50	0.1	250	140
UY11	Indirectly Heated Half Wave Rectifier ..	Y. (161)	50	0.1	250	140
UY21	Indirectly Heated Half Wave Rectifier ..	B8G (85)	50	0.1	250	140
UY41	Indirectly Heated Half Wave Rectifier ..	B8A (14)	31	0.1	250	100

* As voltage doubler V_{out} = 480 V.

VOLTAGE REFERENCE AND STABILIZING TUBES

TYPE	DESCRIPTION	BASE	V Ignition max. (V)	V Burning (V)	I max. (mA)	I Quiescent (mA)	A.C. Resistance max. (Ω)
85A1	Neon-filled Voltage Reference Tube	B8G (127)	125	83-87	8.0	1.0	450
85A2	Neon-filled Voltage Reference Tube	B7G (128)	125	83-87	10	1.0	450
*150B2	Inert-gas-filled Voltage Stabilizer ..	B7G (186)	180	143-157	15	5.0	500
4687	Neon-filled Voltage Stabilizer ..	P. (49)	130	90-110	40	10	250
4687A	Neon-filled Voltage Stabilizer ..	British 4-pin (23)	130	90-110	40	10	250
7475	Neon-filled Voltage Stabilizer ..	British 4-pin (23)	140	90-110	8	1.0	300
13201A	Neon-filled Voltage Stabilizer ..	British 4-pin (23)	135	90-110	200	15	80

* Provisional information.

CATHODE RAY TUBES

TYPE	DESCRIPTION	LUMINESCENT COLOUR	PER-SISTENCE	BASE	Vh (V)	Ih (A)	MAXIMUM FINAL† ANODE VOLTAGE	DEFLECTION SENSITIVITY
DB4-1 DG4-1 DP4-1	1½" Electrostatic Oscillograph Tubes for symmetrical operation	Blue Green with Green afterglow	Short Medium Long	B9G (162)	6.3	0.3	1,000	Sx = 0.13 mm/V Sy = 0.21 mm/V
DB4-2 DG4-2 DP4-2	1½" Electrostatic Oscillograph Tubes X plates suitable for asymmetrical operation	Blue Green with Green afterglow	Short Medium Long	B9G (162)	6.3	0.3	1,000	Sx = 0.13 mm/V Sy = 0.21 mm/V
DB7-5 DG7-5 DR7-5	2½" Electrostatic Oscillograph Tubes for symmetrical operation	Blue Green with Green afterglow	Short Medium Long	B9G (162)	6.3	0.3	1,000	Sx = 0.16 mm/V Sy = 0.26 mm/V
DB7-6 DG7-6 DR7-6	2½" Electrostatic Oscillograph Tubes. X plates suitable for asymmetrical operation	Blue Green with Green afterglow	Short Medium Long	B9G (162)	6.3	0.3	1,000	Sx = 0.16 mm/V Sy = 0.26 mm/V
*DB13-2† *DG13-2 *DP13-2	5" Electrostatic Oscillograph Tubes with post-deflection accelerator. Suitable for symmetrical operation	Blue Green with Green afterglow	Short Medium Long	B14A (163)	6.3	0.3	2,500 (Va4 max. = 5 KV)	Sx = 0.3 mm/V Sy = 0.35 mm/V (with acceleration)
ECR30	3" Electrostatic Oscillograph Tube for symmetrical operation	Green	Medium	B12B (165)	4.0	1.0	1,000	Sx = 0.21 mm/V Sy = 0.21 mm/V
ECR35 ECR35P	3½" Electrostatic Oscillograph Tubes for symmetrical or asymmetrical operation	Green with Green afterglow	Medium Long	B12D (166)	4.0	1.0	2,500	Sx = 0.3 mm/V Sy = 0.65 mm/V
ECR60	6" Electrostatic Oscillograph Tube for symmetrical or asymmetrical operation	Green	Medium	B12D (166)	4.0	1.0	2,500	Sx = 0.3 mm/V Sy = 0.575 mm/V

* Provisional information.

† Design centre ratings.

CATHODE RAY TUBES — continued

TYPE	DESCRIPTION	LUMINESCENT COLOUR	PER-SISTENCE	BASE	Vh (V)	Ih (A)	MAXIMUM FINAL† ANODE VOLTAGE	DEFLECTION SENSITIVITY
*MF13-1	5" Magnetic Radar Tube with metal-backed screen	Orange with Orange afterglow	Long	Octal (176)	6.3	0.3	11,000 (absolute)	$0.3 \frac{P.c.L}{\sqrt{Va_2}} \text{ cm./gauss}$ <p>Where— P is the distance of effective centre of the deflector coils from the screen centre. L is the length in cm. of the electron path through the field of the deflector coils. c is a correction factor depending upon the shape of the coils, normally about 0.5.</p>
*MF31-22	12" Magnetic Radar Tube with metal-backed screen	Orange with Orange afterglow	Long	B12A (116)	6.3	0.3	12,000 (absolute)	
MW6-2	2½" Magnetic Projection Tube with metal-backed screen	White	Medium	V (117)	6.3	0.3	25,000	
MW31-16	12" Magnetic Television Tube incorporating an ion trap and with external conductive coating	White	Medium	B12A (116)	6.3	0.3	9,000	
*MW36-22	14" Rectangular Television Tube incorporating an ion trap and with external conductive coating	White	Medium	B12A (116)	6.3	0.3	14,000	
MW41-1	16" Metal Cone Television Tube incorporating an ion trap	White	Medium	B12A (116)	6.3	0.3	14,000	

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† Design centre ratings unless otherwise specified.

* Provisional information.

THYRATRONS

TYPE	DESCRIPTION	BASE	Vh (V)	Ih (A)	va(pk) max. (KV)	P.I.V. max. (KV)	ia(pk) max. (A)	Ia max. (A)	VALVE VOLTAGE DROP (V)
EN31	Helium-filled Triode ..	Octal (83)	6.3	1.3	1.0	1.5	0.75	0.01	33
*ME1503	Hydrogen-filled Triode ..	B4D (175)	6.3	3.75	8.0	8.0	60	0.015	—

* Provisional information.

THYRATRONS—continued

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	va(pk) max. (KV)	P.I.V. max. (KV)	ia(pk) max. (A)	Ia max. (A)	VALVE VOLTAGE DROP (V)
MT17	Mercury Vapour Triode ..	4-pin UX (177)	2.5	5.0	2.5	5.0	2.0	0.5	16
MT57	Mercury Vapour Triode ..	4-pin UX (178)	5.0	4.5	1.0	1.0	15	2.5	16
*MT105	Mercury Vapour Tetrode	B4D (179)	5.0	10	2.5	2.5	40	6.4	16
*MT5544	Inert-gas-filled Triode ..	B4D (180)	2.5	12	1.5	1.5	40	3.2	16
*MT5545	Inert-gas-filled Triode ..	B4D (180)	2.5	21	1.5	1.5	80	6.4	16
2D21	Inert-gas-filled miniature Tetrode	B7G (181)	6.3	0.6	0.65	1.3	0.5	0.1	8
I267	Cold Cathode Gas-filled Triode	Octal (184)	Cold Cathode		0.225	—	0.1	0.025	70

* Provisional information.

FLASH-TUBES

TYPE	DESCRIPTION	BASE	MAX. ENERGY OF DISCHARGE (Joules)	ANODE VOLTAGE RANGE (KV)	MIN. TRIGGER VOLTAGE (KV)	APPROX. FLASH DURATION (μ secs.)	PEAK LIGHT OUTPUT (Megalumens)	INTEGRATED LIGHT OUTPUT (Lumen-secs.)
LSD2	Microsecond Flash-Tube	Edison Screw (167)	35	7-10	8	1.0 (peak)	100	1,500
LSD3	Flash-Tube for portable equipment	4-pin UX (110) 3-pin. 5amp.(111)	100	2-2.7	4	100	35	3,000
LSD3A								
LSD4	Flash-Tube for studio photography	3-pin special (112)	400	2-2.7	4	300	66	26,000

FLASH-TUBES—continued

TYPE	DESCRIPTION	BASE	MAX. ENERGY OF DISCHARGE (Joules)	ANODE VOLTAGE RANGE (KV)	MIN. TRIGGER VOLTAGE (KV)	APPROX. FLASH DURATION (μ secs.)	PEAK LIGHT OUTPUT (Megalumens)	INTEGRATED LIGHT OUTPUT (Lumen-secs.)
LSD5	Flash-Tube for studio set, stage, and commercial colour photography	3-pin special (112)	1,000	2-2.7	6	500	80	40,000
LSD7	Flash-Tube for studio or portable equipment	4-pin UJX (110)	200	2-2.7	5	200	44	7,000
*LSD8	Stroboscopic Flash-Tube	4-pin UX (168)	30W†	2-2.7	4	50	0.06	—
*LSD9	Quartz Flash-Tube for ultraviolet operation	4-pin UX (110)	1,000	2-2.7	4	600	40	25,000
LSD10	Flash-Tube for stage, studio set, and colour photography	Wired-in	10,000	2.5-4	17	3,000	250	500,000
LSD12	9" Linear Glass Tube	Wired-in	100	2-2.7	External trigger required	80	60	4,500
LSD13	18" Linear Glass Tube	Wired-in	600	2-2.7	"	400	65	27,000
LSD14	24" Linear Glass Tube	Wired-in	2,500	2-2.7	"	1,300	70	150,000
LSD15	12" Linear Glass Tube	Wired-in	200	2-2.7	"	200	50	8,000
LSD16	9" Linear Quartz Tube	Wired-in	500	2-2.7	"	150	140	16,000
LSD17	12" Linear Quartz Tube	Wired-in	1,000	2-2.7	"	500	100	45,000
LSD18	18" Linear Quartz Tube	Wired-in	2,500	2-2.7	"	1,200	43	95,000

* Provisional information.

† Mean power dissipation.

Max. repetition rate 500 c/s (30,000 r.p.m.).

PHOTOCELLS

TYPE	DESCRIPTION	BASE	MAX. ANODE SUPPLY VOLTAGE (V)	MAX. DARK CURRENT AT MAX. ANODE SUPPLY VOLTAGE (μ A)	MAX. CATHODE CURRENT (μ A)	SENSITIVITY* (μ A/Lumen)	MAX. GAS AMPLIFICATION FACTOR	PROJECTED CATHODE AREA (sq. cm.)
20AV	Vacuum Photocell with caesium/antimony cathode	B8G (106)	150	0.05	10	45	—	11
20CG	Gas-filled Photocell with caesium/oxidised silver cathode	B8G (107)	90	0.1	5.0	150	10	6.7
20CV	Vacuum Photocell with caesium/oxidised silver cathode	B8G (107)	150	0.05	20	25 ($V_a=100$ V)	—	6.7
52CG	Gas-filled Photocell with caesium/oxidised silver cathode	British 4-pin (125)	90	0.1	3.0	125	10	4.0
55CG	Gas-filled Photocell with caesium/oxidised silver cathode	B3A (American Pee-Wee) (126)	90	0.1	2.0	125	10	2.2
57CV	Photometric Cell with caesium/oxidised silver cathode	British 4-pin (182)	100	10 ⁻⁴ ($V_a=50$ V)	0.5	13 ($V_a=50$ V)	—	4.5
58CG	Gas-filled Photocell with caesium/oxidised silver cathode for end-on incidence of illumination	Wired-in (183)	90	0.1	1.5	100	9	1.1
58CV	Vacuum Photocell with caesium/oxidised silver cathode for end-on incidence of illumination	Wired-in (183)	100	0.05	3.0	20 ($V_a=50$ V)	—	1.1

* Sensitivity measured at max. anode supply voltage with the whole cathode area illuminated by a lamp of colour temperature 2700° K and with a series resistor of 1 M Ω

PHOTOCELLS—continued

TYPE	DESCRIPTION	BASE	MAX. ANODE SUPPLY VOLTAGE (V)	MAX. DARK CURRENT AT MAX. ANODE SUPPLY VOLTAGE (μ A)	MAX. CATHODE CURRENT (μ A)	SENSITIVITY* (μ A/Lumen)	MAX. GAS AMPLIFICATION FACTOR	PROJECTED CATHODE AREA (sq. cm.)
90AG	Gas-filled Photocell with caesium/antimony cathode	B7G (108)	90	0.1	2.5	150	7	4.0
90AV	Vacuum Photocell with caesium/antimony cathode	B7G (108)	100	0.05	5.0	45	—	4.0
90CG	Gas-filled Photocell with caesium/oxidised silver cathode	B7G (109)	90	0.1	2.0	125	10	3.1
90CV	Vacuum Photocell with caesium/oxidised silver cathode	B7G (109)	100	0.05	10	20 ($V_a=50V$)	—	3.1

* Sensitivity measured at max. anode supply voltage with the whole cathode area illuminated by a lamp of colour temperature 2700°K and with a series resistor of 1 M Ω .

NOTE.—Caesium/antimony cathode is particularly sensitive to daylight and bluish light.

Caesium/oxidised silver cathode is particularly sensitive to incandescent light and to near infra-red radiation.

IMAGE CONVERTERS

TYPE	DESCRIPTION	BASE NO.	PHOTO-CATHODE	SENSITIVITY OF PHOTOCATHODE (μ A/Lumen)	LUMINESCENT SCREEN	V _a -k max. (KV)	LINEAR MAGNIFICATION OF IMAGE	SCREEN RESOLUTION (Lines/cm.)
*MEI200AA	Magnetically focused Image-converter sensitive to daylight and bluish light	171	Caesium/Antimony	20	Blue Short persistence	6	3-7	200

* Provisional information.

IMAGE CONVERTERS . continued

TYPE	DESCRIPTION	BASE NO.	PHOTO-CATHODE	SENSITIVITY OF PHOTOCATHODE ($\mu\text{A}/\text{Lumen}$)	LUMINESCENT SCREEN	Va-k max. (KV)	LINEAR MAGNIFICATION OF IMAGE	SCREEN RESOLUTION (Lines/cm.)
*MEI201AA	Grid controlled magnetically focused image-converter sensitive to daylight and bluish light	172	Caesium/Antimony	20 For typical operation, Vg-k = 3 KV For extinction of image Vg-k = -20 V	Blue Short persistence	6	2.5-3.5	200
*MEI202CA	Magnetically focused Image-converter sensitive to near infra-red radiation	173	Caesium/oxidised silver	15	Blue short persistence	6	1	200

Variants of these tubes with different photocathodes and luminescent screens are also available, and are distinguished by the last two letters of the type number.

* Provisional information.

U.H.F. VALVES

TYPE	DESCRIPTION	BASE NO.	Vh (V)	Ih (A)	CHARACTERISTICS
ME1001	Disc Seal Triode for use as a common-grid earthed-anode concentric line oscillator	169	6.3	0.4	Va = 250 V Vg = -3.5 V Ia = 20 mA μ = 30 gm = 6 mA/V
*ME1005	Disc Seal Triode for use as a voltage amplifier	169	6.3	0.4	Va = 250 V Vg = -1.3 V Ia = 10 mA μ = 70 gm = 6.5 mA/V

* Provisional information.

U.H.F. VALVES -continued

TYPE	DESCRIPTION	BASE NO.	Vh (V)	Ih (A)	CHARACTERISTICS
*ME1100	Mechanically Tuned Reflex Klystron for use as a 3 cm. local oscillator	—	6.3	0.6	Frequency Range = 8,500-9,660 Mc/s. Max. resonator voltage = 350 V Max. resonator current = 30 mA Max. reflector voltage = -350 V Min. power output = 20 mW Base:—Octal with coaxial line at pin 4
*ME1101	3 cm. Fixed Frequency Packaged Magnetron	—	6.3	0.5	Frequency range = 9,345-9,405 Mc/s. Va max. = 5.7 KV } pulsed Ia max. = 7 A } Max. duty cycle = 0.001 Max. pulse length = 2.5 μ sec. Max. power output = 14 KW

* Provisional information.

ACCELEROMETER TUBE

TYPE	DESCRIPTION	BASE	Vh (V)	Ih (A)	CHARACTERISTICS
DDR100	Accelerometer Double Diode	B8G (164)	6.3	0.6	Va max. = 10 V †Sensitivity = 7.5 mv/g Max. acceleration = 100 g

† Across resistance bridge.

ELECTROMETERS

TYPE	DESCRIPTION	BASE	Vf or Vh (V)	If or Ih (A)	Va (V)	Ig2 (V)	-Vg1 (V)	Ia (μA)	Igl (A)	gm (μA/V)	μ
ME1400	Electrometer Pentode	Octal (72)	4.5	0.16	Δ45 ●45	45	2.0 2.0	80 100	<10 ⁻¹¹ <10 ⁻¹¹	240 300	— 20
*ME1401	Subminiature Electrometer Triode	Wired-in (174)	1.25	0.013	9	—	2.5	100	<12.5 × 10 ⁻¹¹	80	1.7

* Provisional information. Δ Pentode connected. ● Triode connected.

DIRECT REPLACEMENT GUIDE

(including obsolete Mullard Valves)

Types marked with asterisk (*) are replacements in AC receivers only. In AC/DC receivers it will be necessary to shunt the heater of the replacement valve, as the heater current of this valve differs from that of the original type.

The data provided on this chart assumes that the valve to be substituted was being operated under the manufacturer's recommended conditions.

Type Number	Replacement	Type Number	Replacement	Type Number	Replacement
ABI	†	AZ3	†	CB1	†
AC/DD (Hivac)	2D4A	AZ32	†	CB2	†
AC/DD (Mazda)	†	AZ33	†	CBC1	†
AC/DDT	TDD4	A11B	IW4/350	CC2	HL13
AC/HL	354V	A11C	IW4/500	CF1	SPI3
AC/HLDD	TDD4	A11D	IW4/350	CF2	VPI3A
AC/HP	SP4	A20B	2D4A	CF3	†
AC/PEN	PEN4VA	A23A	TDD4	CF7	SPI3
AC/Q	†	A27D	PEN4DD	CK1	FC13
AC/Qa	†	A30D	354V	CL6	†
AC/SG	†	A36A	TH4	CY1C	URIC
AC/SGVM	†	A36B	TH4B	CY2	†
AC/SH	†	A36C	TH4B	CY32	†
AC/SL	SP4	A40M	†	C10B	URIC
AC/SIVM	VP4	A50A	SP4	C12FM	MW31-16
AC/S2	SP4	A50B	SP4B	C20C	†
AC/S2PEN	†	A50M	VP4 (7-pin)	C23B	TDD13C
AC/TH1	TH4B	A50N	VP4A	C27D	†
AC/VH	†	A50P	(7-pin)	C30B	HL13C
AC/VP (5-pin)	†	A70B	VP4B	C36A	TH21C
AC/VP (7-pin)	VP4A	A70C	PEN4VA	C36C	TH30C
AC/VPB	VP4B	A70D	(7-pin)	C50B	SPI3C
AC/VP1	†	A70E	PENA4	C50N	VPI3C
AC/VP2	VP4B	A80A	PENA4	C70D	PEN36C
AC/Y	†	A80A	PENB4	C80B	FC13C
AC/Z	PENA4	A430N	FC4	DA	†
AC/2DD	†	BVA211	354V	DAC1	†
AC2/PEN	PENA4	BVA214	DW4/350	DD4	2D4A
AC2/PENDD	†	BVA215	or	DD4s	AB2
AC4/PEN	PENB4	BVA216	IW4/350	DD6 {	EB91
AF2	†	BVA243	}	DD6 {	
AL5	†	BVA246		DD6	(Tungsram)
AL60	†	BVA247	}	DD6ds	
APP4A	PEN4VA	BVA264		}	DD13
APP4As	†	BVA265	}		DD13s
APP4B	PENA4	BVA266		}	DD465
APP4Bs	AL4	BVA267	}		DD620
APP4E	PENB4	BVA274		}	DDA1
APV4	IW4/350	BVA275	}		DDL4
AS4120	SP4	BVA276		}	DDPP4B
AS4125	†	B228	}		DDPP4Bs
AZ2	†			PM2HL	ABLI

† No direct replacement available. Please refer to Near Equivalent Guide.

DIRECT REPLACEMENT GUIDE

Type Number	Replacement	Type Number	Replacement	Type Number	Replacement
DDPP4M	PEN4DD	ECH41	†	HP210nc (4-pin)	†
DDPP6B	†	EF2	†	HP211c	VP2
DDPP6Bs	EBL1	EF5	EF9	HP215 (Hivac)	†
DDPP39	†	EF6	†	HP4101c	SP4
DDPP39M	†	EF8	EF9	HP4105	VP4
DDPP39s	CBL1	EF38	EF39	HP4106c	VP4
DDT	†	EK3	†	HP4115c (5-pin)	†
DDT2	TDD2A	EL3N	EL3	HP4115c (7-pin)	VP4A
DDT4	TDD4	EL5	†	HR210	PM2HL
DDT4s	ABC1	EL6	†	H2	PM2HL
DDT6s	EBC3	EL36	†	H2D	TDD2A
DDT13	TDD13C	EZ1	†	H4D	†
DDT13s	†	E220B	PM2B	H210	PM2HL
DDT215	†	E235	PM202	IW3	IW4/350
DDT220	TDD2A	FG17	MT17	IW4	IW4/500
DET22	ME1001	FG57	MT57	KT2	PM22A
DF1	†	FG105	MT105	KT24	PM22A
DH42	TDD4	GN24	DW4/350	KT41	†
DH63	†	G431	DW2	KT42	PEN4VA
DH63M	EBC33*	G470	DW2	KT61	†
DH142	UBC41	G2080 (5-pin)	URIC	KT63	†
DH147	EBC33	G2080 (P base)	CY1	KT66	EL37
DH150	EBC41	G4120	DW4/500	KTW61	†
DK1	†	G4120N	IW4/500	KTW61M	†
DL2	†	HAD	†	KTW63	†
DL63	EBC33*	HD14	DAC32	KTZ63	†
DL91	†	HD22	TDD2A	K23B	TDD2A
DN41	†	HD23	TDD2A	K30A	PM2HL
DN143	EBL21	HD24	TDD2A	K30B	†
DO42	PEN4DD	HL2	PM2HL	K30C	PM2HL
DP61	EF95	HL2K	PM2HL	K30D	PM2HL
DP495	PEN4DD	HL4	354V	K30G	PM2A
DP4480	†	HL4g	†	K30K	PM2HL
DT41	TDD4	HL4gs	†	K40B	†
DT436	TDD4	HL13	HL13C	K40N	PM12M
DT1336 (7-pin)	TDD13C	(Tungsram)	†	K50M	VP2
DTUI	TDD13C	HL13 (Hivac)	†	K50N	VP2B
DW3	DW4/350	HL13s	HL13	K70B	PM22A
DW4	DW4/500	HL21DD	TDD2A	K70D	PM22D
D4	354V	HL22	†	K77B	QP22B
D41	2D4A	HL23DD	†	K80A	FC2
D63	EB34*	HL41	†	K80B	FC2A
D77	EB91	HL41DD	†	K435/10	ACO44
D152	EB91	HL133DD	†	LD210	†
D400	2D4A	HL210	PM2HL	LL2	PM2HL
D1300	†	HLA2	354V	LL2s	†
EAF41	†	HLB1	†	LNI52	ECL80
EC50	†	HL/DD1320	†	LP2 (Osram)	PM2A
EC55	ME1001	HP13	†	LP2 (Ferranti)	PM202
ECH2	†	HP13s	VP13A	LP4	ACO44
ECH4	†	HP210nc (7-pin)	SP2	LP220	PM2A

* See note at beginning of section. † No direct replacement available. Please refer to Near Equivalent Guide.

DIRECT REPLACEMENT GUIDE

Type Number	Replacement	Type Number	Replacement	Type Number	Replacement
L2 (Ferranti)	PM2A	OM5	EF36	PP6BG	EL33
L2 (Mazda)	PM2HL	OM5A	EF37	PP6Bs	EL3
L2/B	PM2HL	OM5B	EF37A	PP34	†
L2/DD	†	OM6	EF39	PP34s	CL4
L21	PM2HL	OM7	EF39	PP35	PEN36C
L21/DD	TDD2A	OM9	EL32	PP36	†
L210	PM2HL	OM10	ECH35*	PP220	PM202
ME6s	EM1	OP41	PENB4	PP3/250	ACO44
MH4	354V	OP42	PENA4	PT2	PM22A
MHD4	†	O202	FC2	PT4 { Marconi } { Osram }	PM24M
MHL4	†	O406	FC4		PT4 (Ferranti)
MKT4	PEN4VA	O1307 (P base)	FC13	PT4D	†
MM4V	†	O1307 (7-pin)	FC13C	PT41	PM24M
MP4106c	VP4	PB1	PM2A	PTZ	†
MP/PEN	PEN4VA	PEN4V	†	PV4	DW4/350
MPT4	PEN4VA	PEN4VB	PENA4	PV29s	†
MS4B	SP4	PEN24	†	PV30	UR3C
MS4C	SP4	PEN25	†	PV30s	†
MSG/HA	SP4	PEN26	†	PV495	DW2
MSG/LA	SP4	PEN40DD	†	PV4200	DW4/500
MSP4	SP4	PEN220	PM22A	PVB6s	†
MS/PEN	SP4	PEN230	†	PX4	ACO44
MS/PENA	SP4	PEN231	PM22D	PX230	PM202
MUI2	IW4/350	PEN3520	PEN36C	P2	PM202
MUI2/I4	IW4/500	PENA1	PM24M	P12/250	ACO44
MUI4	IW4/500	PENB1	PM22A	P220	†
MV/SG	†	PENDD4020	†	(Tungsram)	
MVS/PEN	†	PL17	MT17		P220 { Mazda } { Hivac }
MVS/PEN (5-pin)		PL21	2D21	P220A	
MVS/PEN (7-pin)	VP4A	PL57	MT57	P225 (5-pin)	PM22A
MVS/PENB	†	PL105	MT105	P240	PM202
N14	DL35	PL1267	I267	P435	PM24M
N15	†	PM1A	PM2HL	P440N	PEN4VA
N16	DL33	PM1HF	PM2HL	P441N	PEN4VA
N17	DL92	PM1HL	PM2HL	P495	PENA4
N19	DL94	PM1LF	†	QP230	QP22B
N40	†	PM2	†	QP240 (Mazda)	†
N41	PENA4	PM2DL	PM2HL	QP240 (Hivac)	†
N41	PENA4	PM2DX	PM2HL	QPT2	†
N63	†	PM12	†	QS83/3	85A2
N66	EL37	PM12A	†	RV120/350	DW4/350
N77	EL91	PM22	†	RV120/350s	AZI
N142	UL41	PM24	†	RV120/500	DW4/500
N144	EL91	PM24B	†	RV120/500s	†
N147	EL33	PM24C	†	RV200/600	FW4/800
N150	EL41	PM252	†	RZ	URIC
N151	EL42	PP2	PM22A	R1	DW2
N152	PL81	PP2s	KL4	R2	IW4/350
OM1	CY31	PP4	PM24M	R3	IW4/500
OM3	EB34	PP4s	†		
OM4	EBC33	PP6As	EL2		

* See note at beginning of section.

† No direct replacement available. Please refer to Near Equivalent Guide.

DIRECT REPLACEMENT GUIDE

Type Number	Replacement	Type Number	Replacement	Type Number	Replacement
R4	DW4/350	S1324	†	U84	†
R4A	DW4/500	S1328	SPI3	U101	†
R12	EY51	TDD2	†	U142	UY41
R14	PZ30	TDD13	†	U143	AZ31
R41	DW4/500	TH4	†	U145	UY41
R42	IW4/350	TH4A	TH4B	U147	EZ35
R52	GZ32	TH22C	TH30C	U149	†
SD2	PM2HL	TH29	TH30C	U150	EZ40
SE211c	PM12M	TH30	TH30C	U151	EY51
SG215	PM12M	TH41	†	U152	PY80
SG215A	PM12M	TH62	†	U201	CY31
SP4 (Tungsram)	†	TH233	†	U403	†
SP4C	†	TH2321	TH30C	U404	UY41
SP4s	AF7	TP25	†	U4020	†
SP6	EF91	TT4	†	VHT2	FC2
SP6s	†	TV4	†	VHT2A	FC2A
SP13	†	TV6	EMI	VHT4	FC4
(Tungsram)		TX4	†	VHTA	†
SP13B	SPI3C	TX21	TH21C	VM4V	†
SP13s	SPI3	TX41	TH4B	VMP4	VP4
SP22	†	T41 (Ekco)	354V	VMP4G	†
SP210	SP2	UAF41	†	VMS4	†
SP215	†	UCH4	†	VMS4B	†
SP220	PM202	UCH41	†	VO2	FC2A
SP1320	SPI3C	UD2	PM202	VO2s	KK2
SPT2	SP2	UR1	CY1	VO4	FC4
SPT4A	SP4 (7-pin)	UR2	†	VO4s	AK2
SS210	†	UR3	†	VO6s	EK2
SU61	EY51	UU3	IW4/350	VO13	FC13C
S4V	SP4	UU4	IW4/350	VO13s	FC13
S4VA	SP4	UU5	IW4/500	VP4C	†
S4VB	SP4	UU6	†	VP6	EF92
S11A	DW2	UU8	†	VP13	†
S11D	DW4/350	UU9	EZ40	VP13B	VP13C
S21	†	UU60/250	IW4/350	VP22	†
S22	†	UU120/350	DW4/350	VP41 (Mazda)	†
S23	†	UU120/350A	IW4/350	VP41 (Ekco)	VP4B
S24	†	UU120/500	DW4/500	VP133	†
S30C	ACO44	(Mazda)		VP210	†
S30D	†	UU120/500	IW4/500	VP215	†
S213	PM12M	(Hivac)		VP1321	†
S215	†	UY31	†	VP1322	VP13C
S215A	†	U10	DW2	VPT2	†
S215B	†	U12/13	DW4/350	VPT4	VP4 (5-pin)
S215VM	PM12M	U14	DW4/500	VPT4B	VP4A
S217	VP2	U18/20	FW4/500	VPUI	VP13C
S218	SP2		FW4/800	VS2	PM12M
S420	VP4B	U31	PY31	VS24	PM12M
S434N (5-pin)	†	U50	†	VS24K	PM12M
S434N (7-pin)	VP4A	U70	EZ35	VS210	PM12M
S435N	SP4	U82	†	VS215	PM12M

† No direct replacement available. Please refer to Near Equivalent Guide.

DIRECT REPLACEMENT GUIDE

Type Number	Replacement	Type Number	Replacement	Type Number	Replacement
VX2	VP2B	IA7VG	DK32	4D1	†
VX2s	†	IAC6	DK92	4G/280K	2D21
VX32	ME1401	ICI (Mazda)	DK91	4THA	†
V20	URIC	IC5G	DL35	4XP	ACO44
V20s	CY1	IC5GT/G	DL35	4/100BU	FW4/500
V30	†	IC6	†	5CP1-A	DG13-2
WD142	UAF42	IC7G	†	5CP7-A	DP13-2
WD150	EAF42	ID5	†	5FP7-A	MF13-1
W17	DF91	ID6	†	5V4G	GZ32
W21	†	ID7G	†	5Y3G	†
W42	†	ID13	DA90	5Y4G	†
W63	†	IE5G	†	5Z4G	GZ32
W77	EF92	IF2	DF92	6A6	†
W142	UF41	IF3	DF91	6A7	†
W143	EF22	IF4	†	6A7E	†
W147	EF39	IF5G	KL35	6A8G	†
W150	EF41	IFD9	DAF91	6A8GT	†
X14	DK32	IH5G	DAC32	6AB8	ECL80
X17	DK91	IH5GT/G	DAC32	6AG6G	EL33
X21	FC2	IH6G	†	6AK5	EF95
X22	FC2	IL4	DF92	6AK6	†
X42	†	ILA6	†	6AL5	EB91
X61M	ECH35	ILC5	†	6AM5	EL91
X65	†	ILD5	†	6AM6	EF91
X142	UCH42	ILH4	†	6AT6	†
X143	ECH21	ILN5	†	6BD6	†
X147	ECH35	IN5G	†	6BE7	EQ80
X150	ECH42	IN5GT/G	DF33	6BT6	†
YD2	†	IN5VG	DF33	6BX6	EF80
Y61	†	IP10	DL92	6C6	†
Y62	†	IP11	DL94	6C10	ECH42
Y63	†	IQ5GT	DL36	6CJ6	EL81
Y220	†	IR5	DK91	6D1 (Mazda)	EA50
ZD17	DAF91	IS4	†	6D2	EB91
ZD152	EBF80	IS5	DAF91	6D6	†
Z14	DF33	IT4	DF91	6E8G	ECH35
Z21	†	IU5	†	6F12	EF91
Z22	SP2	2D4	†	6F16	EF41
Z77	EF91	2D13	†	6H6GT	EB34*
Z90	EF50	2D13A	†	6J6	ECC91
Z142	UF42	2D13C	†	6J7G	†
Z150	EF42	2D21	2D21	6J7GT	EF37A*
Z152	EF80	2J42	ME1101	6J8G	†
0A4G	I267	3A4	DL93	6K7G	†
0E3	85A1	3A5	DCC90	6K7GT	EF39*
IA3	DA90	3NP4	MW6-2	6K8G	†
IA4E	†	3Q4	†	6K8GT	†
IA4P	†	3Q5GT/G	DL33	6L6G	†
IA7G	†	3S4	DL92	6L34	EC91
IA7GT/G	DK32	3V4	DL94	6M6G	EL33

* See note at beginning of section. † No direct replacement available. Please refer to Near Equivalent Guide.

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Type Number	Replacement	Type Number	Replacement	Type Number	Replacement
6N7GT/G	†	16A5	PL82	210SPG	FC2
6N8	EBF80	17Z3	PY81	210SPT	†
6P8G	ECH35*	19X3	PY80	210VPT (4-pin)	†
6P28	†	19Y3	PY82	210VPT (7-pin)	†
6Q7G	†	20A1	TH4B	215P	†
6Q7GT	†	20A3	2D2I	215SG	PM12M
6S7	EF39*	21A6	PL8I	220HPT	PM22A
6S7G	†	25RE	†	220/OT	PM22A
6S7C7	†	25Y5	†	220P	†
6SJ7	†	25Z4G	†	220PA	PM2A
6SK7	†	25Z5	†	220SG	†
6SL7GT	ECC35*	25Z6G	†	220VS	PM12M
6SN7GT	†	35RE	†	220VSG	PM12M
6U5/6G5	†	36	†	230PT	†
6U7G	†	39/44	†	230XP	†
6V6G	†	40SUA	†	240QP	QP22B
6W7G	†	41E	†	244V	354V
6X2	EY51	41/MHF	354V	302THA	TH30C
6X5G	EZ35	41/MHL	354V	332PEN	CL33
6X5GT/G	EZ35	41/MPG	FC4	408BU	DW2
6ZY5G	†	41/MPL	354V	442BU	DW4/350
7A2	PEN4VA	41/MSG	SP4	460BU	DW4/500
7A3	PENA4	41/MTL	354V	484V	†
7A7	†	41STH	†	506BU	DW2
7B7	†	42/42E	†	723A/B	ME1100
7C5	†	42MP/PEN	PENA4	927	55CG
7D6	PEN36C	42/OT	PENA4	1267	1267
7D9	EL9I	43IU	IW4/350	1561	DW4/500
7F7	†	44IU	IW4/500	1821	DW2
7K7	†	45IU	†	1861	IW4/500
7S7	†	54KU	GZ32	1867	IW4/350
7Y4	†	62DDT	EBC41	1877	HVR2
8A1	SP4	62TH	ECH42	1881	IW4/350
8D2	†	62VP	EF41	2101	†
8D3	EF91	63SPT	EF50	2102	†
9A1	VP4	64ME	EM34	4065	ME1401
9D2	†	66KU	EZ40	5544	MT5544
9D6	EF92	67PT	EL41	5545	MT5545
10D1	†	77/77E	†	5557	MT17
11A2	†	78/78E	†	5559	MT57
12AT7	ECC81	80	†	5802	ME1401
12XP4	MW31-16	84/6Z4	†	5861	ME1001
12Z3	†	121K	MW31-16	55035	ME1101
13PGA	†	202DDT	TDD13C		
13SPA	†	202STH	TH21C		
13VPA	†	210DDT	TDD2A		
15	†	210DET	PM2HL		
15A2	†	210HF	PM2HL		
15A6	PL83	210LF	†		
15D1	†	210PG	FC2		

* See note at beginning of section. † No direct replacement available. Please refer to Near Equivalent Guide.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
AB1	O	2D4A	O	No circuit change. 2D4A has no top cap.
AC/DD (Mazda)	O	2D4A	O	No circuit change. 2D4A has no top cap.
AC/Q	M	PENB4	M	Bias may require adjustment.
AC/Qa	K	EL37	K	Bias may require adjustment.
AC/SG	O/M	SP4	O/M	Raise Vg2 to 100V for R.F. amplifier.
AC/SGVM	O/M	VP4	O/M	Raise Vg2 to 100V for R.F. amplifier.
AC/SH	M	SP4	M	Bias may require adjustment.
AC/S2PEN	M	SP4	M	Bias may require adjustment.
AC/VH	O	VP4	O	Bias may require adjustment.
AC/VP (5-pin)	O	VP4A	M	Change base.
AC/VPI	M	VP4B	M	Rewire base.
AC/Y	O/M	PEN4VA	O/M	Bias may require adjustment.
AC/2DD	M	PEN4DD	M	Interchange connections to pins 2 and 6.
AC2/PENDD	M	PEN4DD	M	Rewire base.
AF2	O	VP4A	M	Change base.
AL5	P	PENB4	M	Change base.
AL60	M	PENB4	M	Rewire base. Change Rk to 175Ω.
APP4As	P	PEN4VA	O/M	Change base.
AS4125	O	VP4	O	Volume control will be less gradual in operation.
AZ2	P	FW4/500	A	Change base.
AZ3	P	IW4/350	A	Change base.
AZ32	K	FW4/500	A	Change base.
AZ33	K	IW4/350	A	Change base.
A40M	O	VP4	O	Volume control will be less gradual in operation.
CB1	V	EB34	K	Change base. When rewiring connect separate cathodes of EB34 together. EB34 : Vh=6·3V.
CB2	V			
CBC1	P	TDD13C	M	Change base.
CF3	P	VPI3C	M	Raise Vg2 to Va.
CL6	P	CL4	P	Change Rk to 170Ω. Raise Vg2 to 200V.
CY2	P	UR3C	M	Change base.
CY32	K	UR3C	M	Change base.
C20C	O	EB34	K	Change base. When rewiring connect separate cathodes of EB34 together. EB34 : Vh=6·3V.
C27D	M	CBL31	K	Change base.
DA	M	HL13C	M	Bias may require adjustment.
DAC1	P	DAC32	K	Change base.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
DD6 (Tungsram)	O	EB34	K	Change base.
DD13 DD13s	O } V }	EB34	K	Change base. When rewiring connect separate cathodes of EB34 together. EB34 : Vh=6.3V.
DD465	O	2D4A	O	Rewire base.
DD620	O	EB34	K	Change base.
DDPP4B	M	PEN4DD	M	Rewire base.
DDPP6B	M	EBL31	K	Change base.
DDPP39	M	CBL31	K	Change base.
DDPP39M	M	CBL31	K	Change base.
DDT	M	TDD4	M	Bias may require adjustment.
DDT13s	P	TDD13C	M	Change base.
DDT215	O	TDD2A	O	Bias may require adjustment.
DF1	P	DF33	K	Change base.
DH63	K	EBC33*	K	Earth pin 1.
DK1	P	DK32	K	Change base.
DL2	P	DL35	K	Change base.
DL91	B7G	DL92	B7G	Rewire base so that Vf is between pin 5 and pins 1 and 7 connected together.
DN41	M	PEN4DD	M	Rewire base. Raise Vg2 to Va. Increase Rk to 140Ω.
DP4480	M	CBL31	K	Change base.
DI300	P	EB34	K	Change base. When rewiring connect separate cathodes of EB34 together. EB34 : Vh=6.3V.
EAF41	B8A	EAF42	B8A	Connect pins 4 and 7 together.
EC50	P	EN31	K	Change base.
ECH2	P	ECH3	P	ECH3 : Ih=0.3A.
ECH4	P	ECH21	B8G	Change base.
ECH41	B8A	ECH42	B8A	Screen grid resistors may need alteration.
EF2	P	EF9	P	Bias may require adjustment.
EF6	P	EF36	K	Change base.
EK3	P	EK2	P	Raise Vg2 to 200V. EK2 : Ih=0.2A.
EL5	P	EL35	K	EL35 : Vg2=250V max. Change Rk to 180Ω. Change base.
EL6	P	EL35	K	EL35 : Vg2=250V max. Change Rk to 180Ω. Change base.
EL36	K	EL35	K	EL35 : Vg2=250V max. Change Rk to 180Ω.
EZ1	P	EZ35	K	Change base. EZ35 : Ih=0.6A.
HAD	M	TDD13C	M	Bias may require adjustment.
HL4g	M	354V	O	Change base.
HL4gs	P	354V	O	Change base.
HL13 (Hivac)	M	HL13C	M	Shunt heater with 130Ω, 2W resistor.
HL22	MO	PM2HL	A	Change base.
HL23DD	MO	KBC32	K	Change base.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
HL41	MO	354V	O	Change base.
HL41DD	MO	TDD4	M	Change base.
HL133DD	MO	TDD13C	M	Change base.
HLB1	A	PM2HL	A	Bias may require adjustment.
HL/DD1320	M	TDD13C	M	Bias may require adjustment.
HPI3	M	VP13A	P	Change base.
HP210nc (4-pin)	A	SP2	M	Change base.
HP215 (Hivac)	M	SP2	M	Raise Vg2 to Va.
HP4115c (5-pin)	O	VP4A	M	Change base.
H4D	M	TDD4	M	Bias may require adjustment.
KT41	M	PENA4	M	Bias may require adjustment.
KT61	K	EL33	K	Bias may require adjustment.
KT63	K	EL32	K	Rewire base.
KTW61	K	EF39*	K	Earth pin 1. Bias may require adjustment.
KTW61M	K	EF39*	K	Bias may require adjustment.
KTW63	K	EF39*	K	Earth pin 1.
KTZ63	K	EF37A*	K	Connect pin 5 to pin 8.
K30B	A	PM2HL	A	Change Vg1 to -1.5V.
K40B	A	PM12M	A	Raise Vg2 to 90V.
LD210	A	PM2HL	A	Bias may require adjustment.
LL2s	P	PM2HL	A	Change base.
L2/DD	O	TDD2A	O	Change Vg1 to -1.5V. Not suitable as Class B driver.
MHD4	M	TDD4	M	Bias may require adjustment.
MHL4	O	354V	O	Bias may require adjustment.
MM4V	O	VP4	O	Volume control less gradual in operation.
MV/SG	O	VP4	O/M	Bias may require adjustment.
MVS/PEN (5-pin)	O	VP4A	M	Change base.
MVS/PENB	M	VP4B	M	Raise Vg2 to Va.
NI5	K	DL33	K	Increase bias.
N40	O	PEN4VA	O/M	Bias may require adjustment.
N63	K	EL32	K	Rewire base.
PEN4V	O	PEN4VA	O	Change Vg1 to -22V. No change with automatic bias.
PEN24	MO	KL35	K	Change base. Change Vg1 to -4.5V.
PEN25	MO	KL35	K	Change base.
PEN26	P	CL4	P	Change Rk to 170Ω. CL4 : Vg2=200V.
PEN40DD	M	CBL31	K	Change base.
PEN230	A/O	PM22A	A/O	Change Vg1 to -4.5V at Va=Vg2=135V and Ra to approximately 19KΩ.
PENDD4020	M	CBL31	K	Change base.
PM1LF	A	PM2HL	A	Change Vg1 to -1.5V.
PM2	A	PM2A	A	Change Vg1 to -6V.
PM12	A	PM12M	A	Raise Vg2 to 90V.

*See note at beginning of Direct Replacement Guide.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
PM12A	A	PM12M	A	Raise Vg2 to 90V.
PM22	A/O	PM22A	A/O	Change Vg1 to -4.5V at Va=Vg2=135V and Ra to approximately 19K Ω.
PM24	A/O	PM24A	O	Change base, if necessary.
PM24B	O	PM24M	O	Redesign circuit. PM24M : Va=Vg2=250V max.
PM24C	O	PM24M	O	Redesign circuit. PM24M : Va=Vg2=250V max.
PM252	A	PM2A	A	Change Vg1 to -6V. Ra=7K Ω.
PP4s	P	PM24M	O	Change base.
PP34	M	PEN36C	M	Connect g1 to T.C.
PP36	M	PEN36C	M	Rewire base.
PT4D	M	PEN4DD	M	Rewire base.
PTZ	M	PEN36C	M	Rewire base.
PV29s	P	UR3C	M	Change base.
PV30s	P	UR3C	M	Change base.
PVB6s	P	EZ35	K	Change base. Check lh when series heated.
P220 (Tungsram)	A	PM202	A	Bias may require adjustment.
QP240 (Mazda)	9-pin	QP22B	M	Change base.
QP240 (Hivac)	M	QP22B	M	Bias may require adjustment.
QPT2	M	QP22B	M	Bias may require adjustment.
RV120/500s	P	DW4/500	A	Change base.
SP4 (Tungsram)	M	SP4	M	Rewire base.
SP4C	P	SP4B	M	Change base.
SP6s	P	EF37A	K	Change base.
SPI3 (Tungsram)	M	SPI3	P	Change base.
SP22	MO	SP2	M	Change base.
SP215	M	SP2	M	Bias may require adjustment.
SS210	A	PM12M	A	Raise Vg2 to 90V.
S21	A	PM12M	A	Raise Vg2 to 90V.
S22	A	PM12M	A	Raise Vg2 to 90V.
S23	A	PM12M	A	Raise Vg2 to 90V.
S24	A	PM12M	A	Raise Vg2 to 90V.
S30D	A	ACO44	A	Change Vf to 4V.
S215	A	PM12M	A	Raise Vg2 to 90V.
S215A	A	PM12M	A	Raise Vg2 to 90V.
S215B	A	PM12M	A	Raise Vg2 to 90V.
S434N (5-pin)	O	VP4A	M	Change base.
S1324	M	SPI3C	M	Raise Vg2 to Va.
TDD2	O	TDD2A	O	Change Vg1 to -1.5V. Not suitable as Class B driver.
TDD13	P	TDD13C	M	Change base.
TH4	M	TH4B	M	Change Rk to 140 Ω. Grid leak to be increased to 50K Ω between grid and cathode.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
TH41	MO	TH4B	M	Change base. Receiver may require re-aligning.
TH62	K	{ CCH35 ECH35 }	K	For AC/DC receivers—CCH35. For AC receivers—ECH35.
TH233	MO	TH30C	M	Change base. Receiver may require re-aligning.
TP25	MO	KCF30	K	Change base.
TT4	O	EC31	K	Change base. Raise Vh to 6·3V.
TV4	P	EMI	P	Raise Vh to 6·3V.
TX4	M	TH4B	M	Change Rk to 140Ω. Grid leak to be increased to 50KΩ between grid and cathode.
UAF41	B8A	UAF42	B8A	Connect pins 4 and 7 together.
UCH4	K	UCH21	B8G	Change base.
UCH41	B8A	UCH42	B8A	Screen grid resistor may need alteration.
UR2	P	UR3C	M	Change base.
UR3	P	UR3C	M	Change base.
UU6	MO	IW4/350	A	Change base.
UU8	MO	GZ32	K	Change base. GZ32, Vh=5V.
UY31	K	UY21	B8G	Change base.
U50	K	GZ32	K	GZ32 has indirectly heated cathode.
U82	B8G	EZ35	K	Change base.
U84	B8G	AZ31	K	Change base.
UI01	B8G	UY21	B8G	Join pins 2, 4 and 6 together.
UI49	B8G	EZ35	K	Change base.
U403	MO	CY31	K	Change base. Check Ih=0·2A.
U4020	O	UR1C	O	Check Ih=0·2A.
VHTA	M	FC13C	M	Vg2 max.=90V. Receiver may require re-aligning.
VM4V	O	VP4	O	Volume control less gradual in operation.
VMP4G	M	VP4A	M	Bias may require adjustment.
VMS4	O	VP4	O	Volume control will be less gradual in operation.
VMS4B	O	VP4	O	Volume control will be less gradual in operation.
VP4C	M	VP4B	M	Rewire base.
VP13	M	VPI3A	P	Change base.
VP22	MO	KF35	K	Change base.
VP41 (Mazda)	MO	VP4B	M	Change base.
VPI33	MO	VPI3C	M	Change base. Bias may require adjustment.
VP210	M	KF35	K	Change base.
VP215	M	VP2	M	Increase Vg2 to Va.
VPI321	M	VPI3C	M	Change base connections.
VPT2	M	VP2	M	Increase Vg2 to Va.
VX2s	P	VP2B	M	Change base.
V30	O	UR1C	O	Check Ih=0·2A.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
W21	M	VP2	M	Join pins 3 and 4 together.
W42	M	VP4A	M	Rewire base.
W63	K	EF39*	K	Bias may require adjustment.
X42	M	FC4	M	Bias may require adjustment.
X65	K	ECH35	K	Earth pin 1. Receiver may require re-aligning.
YD2	A	PM2A	A	Bias may require adjustment.
Y61	K	EM34	K } K } K }	Supply a2 (pin 6) from H.T., through 1MΩ resistor. Interchange connections, to pins 4 and 5.
Y62	K	EM34		
Y63	K	EM34		
Y220	O	PM22A	O	Bias may require adjustment.
Z21	M	SP2	M	Earth pin 3.
IA4E	UX	KF35	K	Change base.
IA4P	UX	KF35	K	Change base.
IA7G	K	DK32	K	Earth pin 1.
IC6	UX	KK32	K	Change base.
IC7G	K	KK32	K	Earth pin 1.
ID5	O	UR1C	O	Check $I_h = 0.2A$.
ID6	UX	PY31	K	Change base. Check $I_h = 0.3A$.
ID7G	K	KK32	K	Earth pin 1.
IE5G	K	KF35	K	Earth pins 1 and 5.
IF4	UX	KL35	K	Change base.
IH6G	K	KBC32	K	Rewire base.
ILA6	B8G	DK32	K	Change base.
ILC5	B8G	DF33	K	Change base.
ILD5	B8G	DAF91	B7G	Change base.
ILH4	B8G	DAC32	K	Change base.
ILN5	B8G	DF33	K	Change base.
IN5G	K	DF33	K	Change base.
IS4	B7G	DL92	B7G	Rewire base so that V_f is between pin 5 and pins 1 and 7 connected together.
IU5	B7G	DAF91	B7G	Rewire base.
2D4	O	2D4A	O	Rewire base. 2D4A has no top-cap.
2D13	V	EB34	K } K } K }	Change base, when rewiring connect cathodes of EB34 together. EB34 : $V_h = 6.3V$.
2D13A	V	EB34		
2D13C	O	EB34		
3Q4	B7G	DL94	B7G	Rewire base.
4D1	M	HL13C	M	Earth pin 1.
4THA	M	TH4B	M	Receiver may require realigning.
5Y3G	K	GZ32	K	GZ32 is indirectly heated.
5Y4G	K	GZ32	K	Rewire base. GZ32 is indirectly heated.
6A6	UX	ECC33	K	Change base. ECC33 unsuitable for use as Class B output valve.
6A7	UX	EK32*	K } K }	Change base. Earth pin 1. Receiver may require realigning.
6A7E	UX	EK32*		

* See note at the beginning of Direct Equivalent Guide.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
6A8G	K	EK32*	K	Earth pin 1. Receiver may require re-aligning.
6A8GT	K	EK32*	K	Receiver may require realigning.
6AK6	B7G	EL91	B7G	Rewire base.
6AT6	B7G	EBC41	B8A	Change base.
6BD6	B7G	EF41*	B8A	Change base.
6BT6	B7G	EBC41*	B8A	Change base.
6C6	UX	EF37A*	K	Change base.
6D6	UX	EF39*	K	Change base.
6J7G	K	EF37A*	K	Earth pin 1.
6J8G	K	ECH35	K	Earth pin 1. Bias may require adjustment.
6K7G	K	EF39*	K	Earth pin 1.
6K8G	K	ECH35	K	Earth pin 1. Receiver may require re-aligning.
6K8GT	K	ECH35	K	Receiver may require realigning.
6L6G	K	EL37	K	Bias may require adjustment.
6N7GT/G	K	ECC33	K	Rewire base. ECC33 unsuitable as Class B output valve.
6P28	K	EL38	K	Rewire base.
6Q7G	K	EBC33*	K	Earth pin 1. Bias may require adjustment.
6Q7GT	K	EBC33*	K	Bias may require adjustment.
6S7G	K	EF39*	K	Earth pin 1.
6SC7	K	ECC35*	K	Rewire base.
6SJ7	K	EF36*	K	Rewire base.
6SK7	K	EF41*	B8A	Change base.
6SN7GT	K	ECC33	K	Bias may require adjustment.
6U5/6G5	UX	EM34*	K	Change base. Supply a2 from H.T. through 1M Ω resistor.
6U7G	K	EF39*	K	Earth pin 1.
6V6G	K	EL33	K	Bias may require adjustment.
6W7G	K	EF37A*	K	Earth pin 1.
6ZY5G	K	EZ35	K	EZ35 I _h =0.6A, 6ZY5G I _h =0.3A.
7A7	B8G	EF22*	B8G	Bias may require adjustment.
7B7	B8G	EF22*	B8G	Bias may require adjustment.
7C5	B8G	EL41	B8A	Change base. Bias may require adjustment.
7F7	B8G	ECC35*	K	Change base.
7K7	B8G	EBC41	B8A	Change base.
7S7	B8G	ECH21*	B8G	Rewire base. Receiver may require re-aligning.
7Y4	B8G	EZ35	K	Change base.
8D2	M	SPI3C	M	Increase V _{g2} to V _a .
9D2	M	VPI3C	M	Earth pin 1. Raise V _{g2} to 200V.
10D1	O	EB34	K	Change base. When rewiring connect cathodes of EB34 together. EB34 : V _h = 6.3V.

*See note at the beginning of Direct Equivalent Guide.

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Type Number	BASE	Mullard Replacement	BASE	CONVERSION
11A2	M	TDD4	M	Earth pin 2. Bias may require adjustment.
12Z3	UX	PY31	K	Change base. Check $I_h=0.3A$.
13PGA	M	FC13C	M	$V_{g2 \text{ max.}}=90V$.
13SPA	M	SPI3C	M	Increase V_{g2} to V_a .
13VPA	M	VPI3C	M	Increase V_{g2} to V_a .
15	UX	KF35	K	Change base.
15A2	M	FC4	M	$V_{g2 \text{ max.}}=90V$.
15D1	M	FC13C	M	$V_{g2 \text{ max.}}=90V$.
25RE	UX	PY31	K	Change base. Check $I_h=0.3A$. Only suitable as half-wave rectifier.
25Y5	UX	PY31	K	Change base. Check $I_h=0.3A$. Only suitable as half-wave rectifier.
25Z4G	K	PY31	K	Check $I_h=0.3A$.
25Z5	UX	PY31	K	Change base. Check $I_h=0.3A$. Only suitable as half-wave rectifier.
25Z6G	K	PY31	K	Rewire base. Check $I_h=0.3A$. Only suitable as half-wave rectifier.
35RE	UX	PZ30	K	Change base. Check $I_h=0.3A$.
36	UX	EF36*	K	Change base.
39/44	UX	EF39*	K	Change base.
40SUA	O	URIC	O	Check $I_h=0.2A$.
41E	UX	EL32	K	Change base.
41STH	M	TH4B	M	Bias may require adjustment.
42/42E	UX	EL32	K	Change base.
45IU	A	FW4/500	A	FW4/500 is directly heated.
77/77E	UX	EF37*	K	Change base.
78/78E	UX	EF39*	K	Change base.
80	UX	GZ32	K	Change base.
84/6Z4	UX	EZ35	K	Change base.
210LF	A	PM2HL	A	Bias may require adjustment.
210SPT	M	SP2	M	Increase V_{g2} to V_a .
210VPT (4-pin)	O	VP2	M	Change base. Increase V_{g2} to V_a .
210VPT (7-pin)	M	VP2	M	Increase V_{g2} to V_a .
215P	A	PM2A	A	Increase V_{g1} to $-6V$.
220P	A	PM2A	A	Bias will require adjustment.
220SG	A	PM12M	A	Increase V_{g2} to $90V$.
230PT	A/O	PM22A	A/O	Change V_{g1} to $-4.5V$ at $V_a=V_{g2}=135V$ and R_a to approximately $19K\Omega$.
230XP	A	PM202	A	Bias may require adjustment.
484V	O	354V	O	Change V_{g1} to $-4.5V$ or R_k to 700Ω .
2101	UX	KL35	K	Change base.
2102	UX	KBC32	K	Change base.

* See note at the beginning of Direct Equivalent Guide.