EL91 (Cont.) — OUTPUT PENTODE

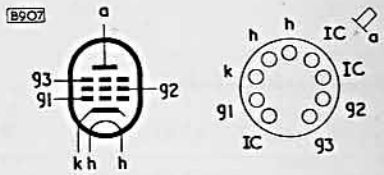
OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL
(Self Bias)

V_a	250	V
V_{g2}	250	V
$I_{a(o)}$	2×11	mA
I_a (max. sig.)	2×12.8	mA
$I_{g2(o)}$	2×1.6	mA
I_{g2} (max. sig.)	2×4.1	mA
R_k	600	Ω
R_{a-a}	24	kΩ
$V_{in(g1-g1)(r.m.s.)}$	24	V
P_{out}	4.0	W
D_{tot}	3.2	%

REPLACEMENT FOR:
N77, N144, 6AM5, 7D9—Direct.
6AK6—Rewire base.

EL820 — OUTPUT PENTODE

Output pentode suitable for use in the e.h.t. units of projection television receivers.



B9A

HEATER

V_h	6.3	V
I_h	1.05	A

DIMENSIONS

Max. Overall Length	83	mm
Max. Seated Height	76	mm
Max. Diameter	22.2	mm

LIMITING VALUES

V_a max.	300	V
*$v_{a\ (pk)}$ max.	7.0	kV
p_a max.	8.0	W
V_{g2} max.	300	V
p_{g2} max.	4.5	W
p_{a+g2} max.	10	W
I_k max.	180	mA
V_{h-k} max.	100	V

*Max. pulse duration 18% of one cycle, with a maximum of 18 μsec.

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
V_{g3}	0	V
I_a	32	mA
I_{g2}	2.4	mA
V_{g1}	–38.5	V
g_m	4.6	mA/V
μ_{g1-g2}	5.1	
r_a	15	kΩ

REPLACEMENT FOR: 6CJ6—Direct.

Mullard

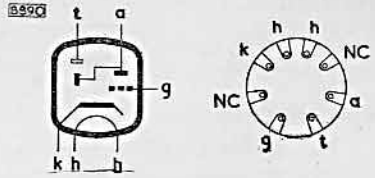
EM1 — TUNING INDICATOR (OBSOLETE)

HEATER

V_h	6.3	V
I_h	200	mA

LIMITING VALUES

V_a max.	250	V
V_t max.	275	V
V_{h-k} max.	50	V



Side Contact

OPERATING CONDITIONS

V_b	250	250	V
R_a	2.0	2.0	MΩ
V_g	0	–5.0	V
I_a	95	—	μA
I_t	130	—	μA
ø	0	90	°

DIMENSIONS

Max. Overall Length	76	mm
Max. Diameter	28	mm

REPLACED BY: EM34—Change base. Change anode resistor to 1MΩ, and connect another 1MΩ resistor from h.t.+ to Pin 6.

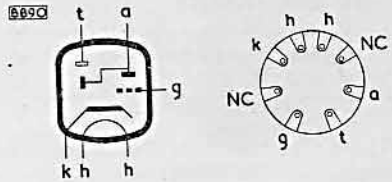
EM3 — TUNING INDICATOR (OBSOLETE)

HEATER

V_h	6.3	V
I_h	200	mA

LIMITING VALUES

V_a max.	250	V
V_t max.	250	V
V_{h-k} max.	50	V



Side Contact

OPERATING CONDITIONS

V_b	200	250	V
R_a	1.0	1.0	MΩ
V_g (ø=10°)	0	0	V
V_g (ø=90°)	–18	–21	V
I_a (V_g=0V)	175	220	μA
I_t (V_g=0V)	250	300	μA

DIMENSIONS

Max. Overall Length	76	mm
Max. Diameter	28	mm

REPLACED BY: EM34—Change base. Connect 1MΩ resistor from h.t.+ to pin 6.

Mullard

EM4

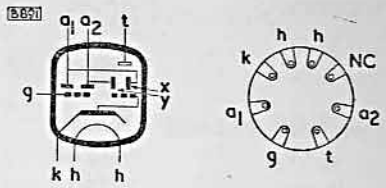
TUNING INDICATOR

HEATER

V_h	6.3	V
I_h	200	mA

DIMENSIONS

Max. Overall Length	79	mm
Max. Diameter	28	mm



Side Contact

For operating conditions and limiting values see type EM34. Except for base EM4 and EM34 are identical.

EM34

TUNING INDICATOR

Electron beam tube for use as tuning indicator in radio receivers or as null indicator in test equipment.

HEATER

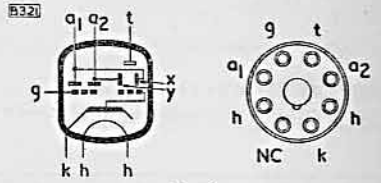
V_h	6.3	V
I_h	200	mA

DIMENSIONS

Max. Overall Length	90	mm
Max. Diameter	28	mm

LIMITING VALUES

V_{a_1} max.	275	V
V_{a_2} max.	275	V
V_t max.	275	V
V_{h-k} max.	100	V



Octal

OPERATING CONDITIONS

V_b	200	250	V
R_{a_1}	1.0	1.0	MΩ
R_{a_2}	1.0	1.0	MΩ
I_t	550	750	μA
V_g (ϕ_1 max.) (1)	0	0	V
V_g (ϕ_2 max.) (2)	0	0	V
V_g (ϕ_1 min.) (5)	–4.2	–5.0	V
V_g (ϕ_2 min.) (6)	–12.5	–16	V

(1) and (2) Max. angle of the shadows produced by the deflector plates x′, x″ and y′, y″ respectively.

(5) and (6) Min. angle (5°) of the shadows produced by the deflector plates x′, x″ and y′, y″ respectively.

REPLACEMENT FOR:

6CD7, 64ME—Direct.

Y61, Y62, Y63, 6M1, 6U5G, 63ME—Supply h.t. to pin 6 through a 1MΩ resistor Interchange connections to pins 4 and 5.

EM3, TV6, 6U5/6G5—Change base. Supply h.t. to pin 6 through 1MΩ resistor.

EM1—Change base. Change anode resistor to 1MΩ nad connect another 1MΩ resistor from h.t.+to pin 6.

TV4—Change base Raise heater voltage to 6.3V. Change anode load to 1MΩ and supply h.t.+to pin 6 through a 1MΩ resistor.

TV4A—Change base. Raise heater voltage to 6.3V. Supply h.t.+to pin 6 through a 1MΩ resistor.

EFM1 (Indicator section)—See page 126.

EN31

GAS-FILLED TRIODE

Thyratron for use in h.f. time bases and control equipment.

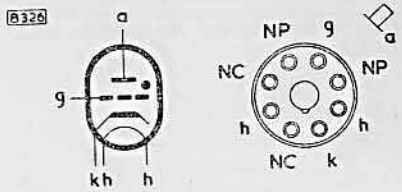
HEATER

V_h	6.3	V
I_h	1.3	A

LIMITING VALUES

$v_{a-g(pk)}$ max.	1.5	kV
$v_{a(pk)}$ max.	1.0	kV
I_a max.	10	mA
$i_{a(pk)}$ max.	750	mA
R_{g-k} min.	750	Ω/V
R_{g-k} max.	750	kΩ
*V_{h-k} max.	100	V
Valve Voltage Drop	33	V
Control Ratio	35	
Max. Operating Frequency	150	kc/s

*Cathode always positive with respect to heater.



Octal

DIMENSIONS

Max. Overall Length	114	mm
Max. Seated Height	100	mm
Max. Diameter	42	mm

REPLACEMENT FOR: EC50—Change base.

EY51

HIGH VOLTAGE HALF-WAVE RECTIFIER

Miniature high voltage half-wave rectifier with wired-in connections for use in cathode ray tube e.h.t. supply units.

HEATER

V_h	6.3	V
I_h	90	mA

LIMITING VALUES

1. *Sinusoidal Input* (50 c/s)

$V_{tr(r.m.s.)}$ max.	5.0	kV
I_{out} max.	3.0	mA
C max.	0.1	μF
R_{11m} min.	100	kΩ

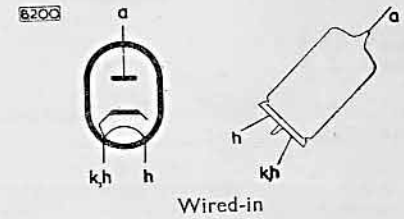
2. *Sinusoidal Input* (10 kc/s to 500 kc/s)

P.I.V. max.	17	kV
I_{out} max.	500	μA
$i_{k(pk)}$ max.	4·0	mA
C max.	0.01	μF

3. *Pulsed Input*

P.I.V. max.	17	kV
I_{out} max.	350	μA
*$i_{k(pk)}$ max.	80	mA
C max.	5,000	pF

*Max. pulse duration 5.0% of the time between two pulses, with a maximum of 5μ sec.



Wired-in

DIMENSIONS

Max. Bulb Length	53	mm
Max. Bulb Diameter	14.5	mm

Soldering recommendations:—

The anode lead should not be soldered closer than 10mm from the seal and the heaters not closer than 5mm from the end of bulb. Great care should be taken not to bend the anode lead near its seal.

REPLACEMENT FOR: R12, R12A, SU61, U43, U151, 6X2—Direct.

EY86

HIGH VOLTAGE HALF-WAVE RECTIFIER

High voltage rectifier for television e.h.t. supplies.

HEATER

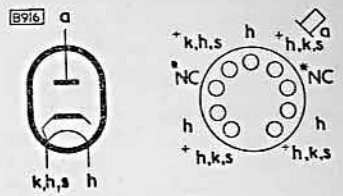
V_h	6.3	V
I_h	90	mA

LIMITING VALUES

††P.I.V. max.	22	kV
I_{out} max.	800	μA
**$i_{k(pk)}$ max.	40	mA
C max.	2000	pF

††Max. duration 18% of a line scanning cycle with a maximum of 18 μsec.

**Max. duration 10% of a line scanning cycle with a maximum of 10 μsec.



B9A

†Pins 1, 4, 6 and 9 may be used for fitting an anti-corona shield.

*Pins 3 and 7 may only be connected to points in the heater circuit and must not be earthed.

DIMENSIONS

Max. Overall Length	74	mm
Max. Seated Height	67	mm
Max. Diameter	22.2	mm

EY91

INDIRECTLY HEATED HALF-WAVE RECTIFIER

HEATER

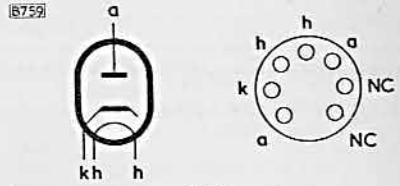
V_h	6.3	V
I_h	420	mA

DIMENSIONS

Max. Overall Length	54.5	mm
Max. Seated Height	47.5	mm
Max. Diameter	19	mm

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	75	mA
$v_{h-k(pk)}$ max.	300	V
C max.	32	μF



B7G

OPERATING CONDITIONS

V_a ($V_{r.m.s.}$)	Cmax (μF)	R_{11m} (Ω)
250	32	100
250	16	50
250	8	0
200	32	70
200	16	30

Mullard

EZ1

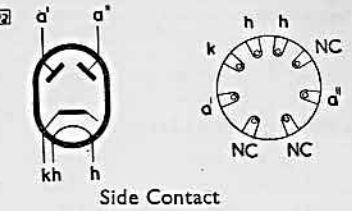
INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

V_h	6.3	V
I_h	400	mA

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×250	V
I_{out} max.	60	mA
V_{h-k} max.	350	V



Side Contact

REPLACED BY: EZ80—Change base. EZ80 requires 600mA heater current.

EZ2

INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

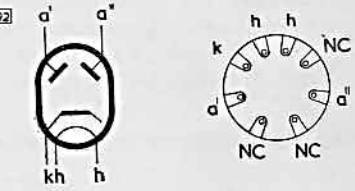
V_h	6.3	V
I_h	400	mA

DIMENSIONS

Max. Overall Length	85	mm
Max. Diameter	37	mm

LIMITING VALUES

$V_{a(r.m.s.)}$	2×300	2×350	V
I_{out} max.	60	60	mA
C max.	32	16	μF
V_{h-k} max.	500	350	V
R_{11m} min. (per anode)	500	500	Ω



Side Contact

REPLACED BY: EZ80—Change base. EZ80 requires 600mA heater current.

EZ3

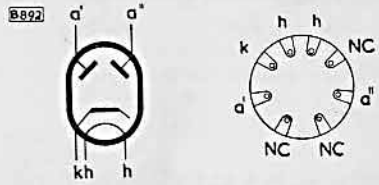
INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

V_h	6.3	V
I_h	650	mA

DIMENSIONS

Max. Overall Length	85	mm
Overall Diameter	37	mm



Side Contact

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×300	2×350	2×400	V
I_{out} max.	100	100	100	mA
C max.	32	16	16	μF
R_{11m} min. (per anode)	200	250	300	Ω

REPLACED BY: EZ80 (providing h.t. current does not exceed 90mA)—Change base.

Mullard

EZ35

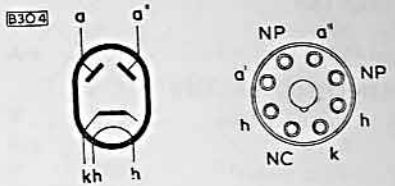
INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

V_h	6.3	V
I_h	600	mA

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×325	V
I_{out} max.	70	mA
$v_{h-k(pk)}$ max.	350	V
C max.	16	μF
R_{IIm} min. (per anode)	350	Ω



Octal

DIMENSIONS

Max. Overall Length	93	mm
Max. Diameter	33	mm

REPLACEMENT FOR: U70, U147, 6X5G, 6X5GT—Direct.
PVB6s, U149—Change base. Heater current differs.
6ZY5G—Heater current differs.
U82, 7Y4, 84/6Z4—Change base.

EZ40

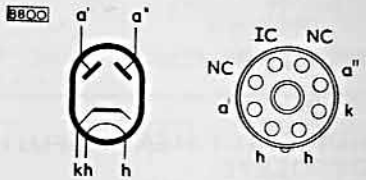
INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

V_h	6.3	V
I_h	600	mA

LIMITING VALUES

$V_{a\ (r.m.s.)}$ max.	2×350	V
I_{out} max.	90	mA
C max.	50	μF
$v_{h-k(pk)}$ max.	500	V



B8A

DIMENSIONS

Max. Overall Length	81	mm
Max. Seated Height	74	mm
Max. Diameter	22	mm

MINIMUM VALUES FOR LIMITING RESISTORS (per anode) (Ω)

$V_{a(r.m.s.)}$ (V)	C=50 μF	C=32 μF	C=16 μF
2×350	300	200	100
2×300	215	140	70
2×275	175	110	55
2×250	125	80	40

REPLACEMENT FOR: U150, UU9, 66KU—Direct.

Mullard

EZ41

INDIRECTLY HEATED FULL-WAVE RECTIFIER

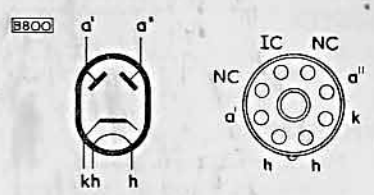
Indirectly heated full-wave rectifier primarily intended for use in car radio receivers.

HEATER

V_h	6.3	V
I_h	400	mA

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm



B8A

Pins 3 and 5 are internal connections and must not be connected externally.

LIMITING VALUES

$V_{a(r.m.s.)}$ max.				2×250	V
I_{out} max.				60	mA
$v_{h-k(pk)}$ max.				350	V
C max.	8	16	32	50	μF
R_{IIm} min. (per anode)	150	250	300	325	Ω

EZ80

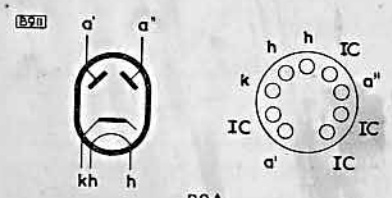
INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

V_h	6.3	V
I_h	600	mA

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×350	V
I_{out} max.	90	mA
C max.	50	μF
$i_{a(pk)}$ max. (per anode)	270	mA
$v_{h-k(pk)}$ max.	500	V



B9A

DIMENSIONS

Max. Overall Length	67.5	mm
Max. Seated Height	60.5	mm
Max. Diameter	22.2	mm

OPERATING CONDITIONS

$V_{a(r.m.s.)}$	2×250	2×275	2×300	2×350	V
C	50	50	50	50	μF
R_{IIm} min. (per anode)	125	175	215	300	Ω
I_{out}	90	90	90	90	mA
V_{out}	265	285	310	360	V

REPLACEMENT FOR: 6V4—Direct.
EZ1, EZ2—Change base. EZ80 requires more heater current.
EZ3—Providing h.t. current does not exceed 90mA—Change base.

Mullard

EZ90

INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

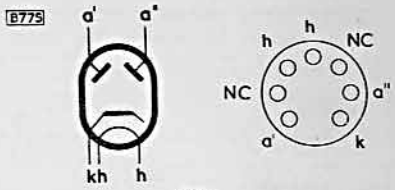
V_h	6.3	V
I_h	600	mA

DIMENSIONS

Max. Overall Length	67.5	mm
Max. Seated Height	60.5	mm
Max. Diameter	19	mm

LIMITING VALUES

P.I.V. max.	1.25	kV
I_{out} max.	70	mA
$i_{a\ (pk)}$ max.	210	mA
V_{h-k} max.	450	V



B7G

OPERATING CONDITIONS

$V_{a(r.m.s.)}$	2×325	V
C	8	μF
R_{l1m} (per anode)	520	Ω
I_{out}	70	mA
V_{out}	300	V

REPLACEMENT FOR: U78, U78/6X4, 6X4—Direct.

FC2

OCTODE FREQUENCY CHANGER

FILAMENT

V_f	2.0	V
I_f	100	mA

DIMENSIONS

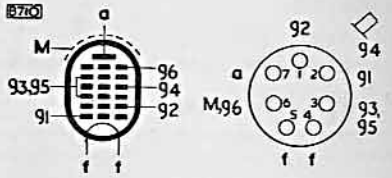
Max. Overall Length	132	mm
Max. Diameter	46	mm

CAPACITANCES

c_{in}	9.9	pF
c_{out}	14.5	pF
c_{a-g4}	0.057	pF
c_{g1-g4}	0.11	pF

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	150	V
V_{g3+g5} max.	70	V



Brit. 7-Pin

CHARACTERISTICS

V_a	135	V
V_{g2}	135	V
V_{g3+g5}	70	V
I_a	950	μA
$I_{g2+g3+g5}$	3.75	mA
g_c	200	μA/V

REPLACEMENT FOR: K80A, O202, VHT2, X22, 210PG, 210SPG—Direct.

TH2—Redesign circuit.

Mullard

OCTODE FREQUENCY CHANGER

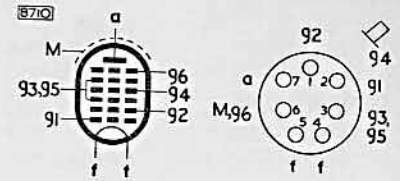
FC2A

FILAMENT

V_f	2.0	V
I_f	130	mA

DIMENSIONS

Max. Overall Length	135	mm
Max. Diameter	46	mm



Brit. 7-Pin

CAPACITANCES

$c_{in\ (g1)}$	6.6	pF
$c_{in\ (g4)}$	9.1	pF
$c_{in\ (g2)}$	8.5	pF
c_{out}	13.6	pF
c_{g1-g4}	<0.12	pF
c_{a-g4}	<0.07	pF
c_{g2-g4}	<0.35	pF

LIMITING VALUES

V_a max.	150	V
p_a max.	500	mW
V_{g2} max.	150	V
p_{g2} max.	600	mW
V_{g3+g5} max.	100	V
p_{g3+g5} max.	400	mW
I_k max.	11	mA

OPERATING CONDITIONS

Normal Operation

V_a	90	135	V
V_{g2}	90	135	V
V_{g3+g5}	45	45	V
V_{g4}	−0.5	−0.5	V
I_a	700	700	μA
$V_{osc(r.m.s.)}$	8.5	8.5	V
I_{g2}	1.3	2.1	mA
I_{g3+g5}	600	700	μA
g_c	270	270	μA/V
r_a	2.0	2.5	MΩ
*V_{g4}	−12	−12	V

*For 100 : 1 reduction in g_c

Short Wave Operation

V_a	135	V
V_{g2}	135	V
V_{g3+g5}	60	V
V_{g4}	−1.5	V
$V_{osc(r.m.s.)}$	4.0	V
I_a	1.0	mA
I_{g2}	2.3	mA
I_{g3+g5}	1.0	mA
g_c	67	μA/V
r_a	1.7	MΩ

REPLACEMENT FOR:

K80B, VHT2A, VO2, X21—Direct.

KK2, VO2s—Change base.

Mullard

FC4

OCTODE FREQUENCY CHANGER

HEATER

V_h	4.0	V
I_h	650	mA

DIMENSIONS

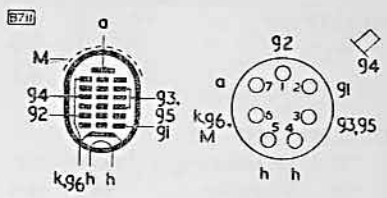
Overall Length	135	mm
Overall Diameter	47	mm

CAPACITANCES

c_{a-g_4}	0.06	pF
c_{in}	9.0	pF
c_{out}	12.5	pF
c_{g_1-h}	9.4	pF
c_{g_2-h}	6.1	pF
$c_{g_1-g_4}$	<0.35	pF
$c_{g_2-g_4}$	<0.25	pF

LIMITING VALUES

V_a max.	250	V
V_{g_2} max.	90	V
V_{g3+g5} max.	70	V
R_{g_4-k} max.	2.5	MΩ



Brit. 7-Pin

OPERATING CONDITIONS

V_a	250	V
V_{g_2}	90	V
V_{g3+g5}	70	V
I_a	1.6	mA
I_{g_2}	2.0	mA
I_{g3+g5}	3.8	mA
V_{g_4}	−1.5	V
g_c	600	μA/V
R_k	250	Ω

At V_a=200V, V_{g_2}=V_{g3+g5}=70V and $V_{ose(pk)}$=12 V, the grid current (I_{g_1}) reaches a value of 1.0 μA for V_{g_4}=−0.1 to −0.95 V.

REPLACEMENT FOR:

A80A, O406, VHT4, VO4, 41MPG.
15A2—Check that V_{g_2} does not exceed 90V.
X42—Bias may require adjustment and receiver realigning.
AK2 and VO4s—Change base.

FC13

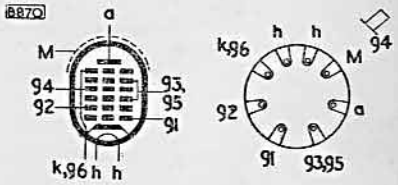
OCTODE FREQUENCY CHANGER

HEATER

I_h	200	mA
V_h	13	V

DIMENSIONS

Max. Overall Length	118	mm
Max. Diameter	47	mm



Side Contact

For limiting values and operating conditions, see type FC13C. Except for dimensions and base connections, types FC13 and FC13C are identical.

REPLACEMENT FOR:

CK1, O1307 (P-base), VO13s—Direct.
VHTA—Adjust screen voltage to 90V. Receiver may need realigning.

Mullard

OCTODE FREQUENCY CHANGER

FC13C

HEATER

I_h	200	mA
V_h	13	V

DIMENSIONS

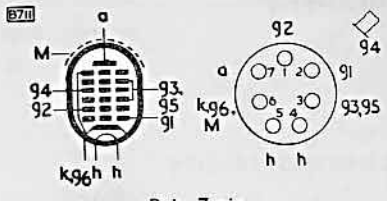
Max. Overall Length	135	mm
Max. Diameter	47	mm

CAPACITANCES

c_{a-g_4}	<0.1	pF
$c_{in(g_4)}$	9.0	pF
c_{out}	12.5	pF
$c_{in(g_1)}$	9.4	pF
$c_{in(g_2)}$	6.1	pF
$c_{g_1-g_4}$	<0.35	pF
$c_{g_2-g_4}$	<0.25	pF

LIMITING VALUES

V_a max.	200	V
V_{g_2} max.	90	V
V_{g3+g5} max.	90	V



Brit. 7-pin

OPERATING CONDITIONS

V_a	200	V
V_{g_2}	90	V
V_{g3+g5}	70	V
V_{g_4}	−1.5	V
I_a	1.6	mA
I_{g_2}	2.0	mA
I_{g3+g5}	3.8	mA
$V_{ose(r.m.s.)}$	8.5	V
R_k	250	Ω
g_c	600	μA/V

REPLACEMENT FOR:

C80B, O1307 (7-pin), VO13—Direct.
13PGA, 15D1—Check that V_{g_2} does not exceed 90V.

DIRECTLY HEATED FULL-WAVE RECTIFIER

FW4-500

FILAMENT

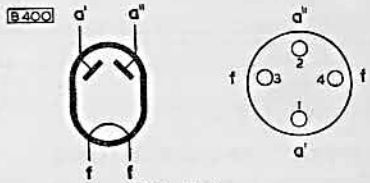
V_f	4.0	V
I_f	3.0	A

DIMENSIONS

Max. Overall Length	146	mm
Max. Diameter	51	mm

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×500	V
I_{out} max.	250	mA
P.I.V. max.	1.6	kV



Brit. 4-pin

OPERATING CONDITIONS

$V_{a(r.m.s.)}$	2×350	2×500	V
C max.	32	16	μF
$R_{lim\ (min.)}$ (per anode)	150	200	Ω

REPLACEMENT FOR:

4/100BU—Direct.
RV200/600, U18/20—Providing $V_{a(r.m.s.)}$ does not exceed 500V.
AX50—Check value of limiting resistors.
R43, UU10, 45IU (Indirectly heated)—Check that electrolytic capacitors will withstand a voltage of 1.4×r.m.s. input.
AZ2, AZ32—Change base. Filament current for FW4-500=3.0A.
AZ50—Change base.

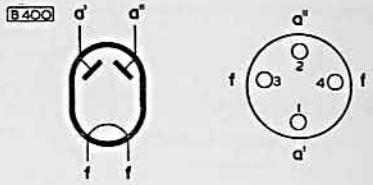
Mullard

FW4-800

DIRECTLY HEATED FULL-WAVE RECTIFIER

FILAMENT

V_f	4.0	V
I_f	3.0	A



Brit. 4-pin

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×850	V
I_{out} max.	125	mA
C max.	4	μF
$R_{llm\ (min.)}$ (per anode)	150	Ω

DIMENSIONS

Max. Overall Length	146	mm
Max. Diameter	51	mm

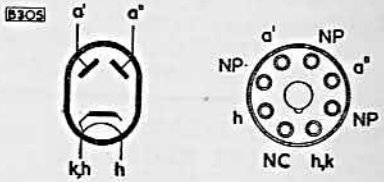
REPLACEMENT FOR: RV200/600, U18/20—Direct.

GZ30

INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

V_h	5.0	V
I_h	2.0	A



Octal

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	375	mA
I_{out} max.	125	mA
C max.	50	μF
L min.	5.0	H

DIMENSIONS

Max. Overall Length	86	mm
Max. Seated Height	72	mm
Max. Diameter	31	mm

OPERATING CONDITIONS

Capacitor Input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	$R_{llm\ (min.)}$ (per anode) (Ω)	V_{out} (V)
2×250	125	8	190	242
2×300	125	8	260	292
2×350	125	8	300	344
2×250	125	50	240	236
2×300	125	50	310	282
2×350	125	50	380	327

Choke Input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×250	125	10	205
2×300	125	10	249
2×350	125	10	295
2×400	125	10	340
2×450	125	10	384
2×500	125	10	429

REPLACEMENT FOR: R52, 5Z4, 5Z4G, 5Z4GT—Direct.

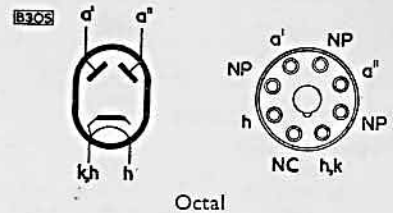
Mullard

INDIRECTLY HEATED FULL-WAVE RECTIFIER

GZ32

HEATER

V_h	5.0	V
I_h	2.3	A



Octal

DIMENSIONS

Max. Overall Length	120	mm
Max. Diameter	46	mm

LIMITING VALUES—CAPACITOR INPUT

$V_{a(r.m.s.)}$ max.	2×300	2×350	2×500 V
I_{out} max.	300	250	125 mA
C (μF)	60	32	16
R_{llm} min. (per anode) (Ω)	150	100	50

LIMITING VALUES—CHOKE INPUT

$V_{a(r.m.s.)}$ max.	2×400	2×500 V
I_{out} max.	300	250 mA

REPLACEMENT FOR:

54KU—Direct.

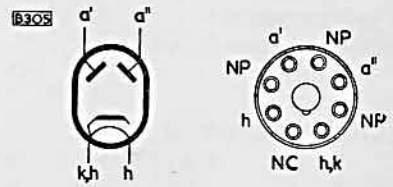
UU8—Change base. Raise heater voltage to 5.0V.

INDIRECTLY HEATED FULL-WAVE RECTIFIER

GZ33

HEATER

V_h	5.0	V
I_h	2.8	A



Octal

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×500	V
I_{out} max.	250	mA
P.I.V. max.	1.25	kV

DIMENSIONS

Max. Overall Length	142	mm
Max. Diameter	57.5	mm

REPLACEMENT FOR: U54, 53KU—Direct.

Mullard

HBC90

DOUBLE DIODE TRIODE

HEATER

I_h	150	mA
V_h	12.6	V

LIMITING VALUES

Triode Section

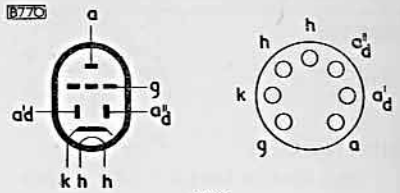
V_a max.	300	V
p_a max.	1.0	W
V_{h-k} max.	90	V

Diode Sections (Each Section)

I_{ad} max.	1.0	mA

CHARACTERISTICS

V_a	100	250	V
V_g	−1.0	−3.0	V
I_a	0.8	1.0	mA
g_m	1.3	1.2	mA/V
μ	70	70	
r_a	54	58	kΩ



B7G

DIMENSIONS

Max. Overall Length	54.5	mm
Max. Seated Height	47.5	mm
Max. Diameter	19	mm

OPERATING CONDITIONS

V_b	90	180	V
R_a	220	470	kΩ
R_k	8.1	9.2	kΩ
*R_g	1.0	2.2	MΩ
$\frac{V_{out}}{V_{in}}$	37	47	

*Grid resistor of following valve.

REPLACEMENT FOR: 12AT6—Direct.

HBC91

DOUBLE DIODE TRIODE

HEATER

I_h	150	mA
V_h	12.6	V

LIMITING VALUES

Triode Section

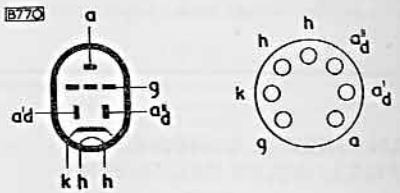
V_a max.	300	V
V_{h-k} max.	90	V

Diode Sections (Each Section)

I_{ad} max.	1.0	mA

CHARACTERISTICS

V_a	100	250	V
V_g	−1.0	−2.0	V
I_a	0.5	1.2	mA
g_m	1.25	1.6	mA/V
μ	100	100	
r_a	80	62.5	kΩ



B7G

DIMENSIONS

Max. Overall Length	54.5	mm
Max. Seated Height	47.5	mm
Max. Diameter	19	mm

OPERATING CONDITIONS

V_b	90	180	V
R_a	220	470	kΩ
R_k	7.6	7.4	kΩ
*R_g	1.0	2.2	MΩ
$\frac{V_{out}}{V_{in}}$	48	68	

* Grid resistor of following valve.

REPLACEMENT FOR: 12AV6—Direct.

Mullard

VARIABLE-MU R.F. PENTODE

HF93

HEATER

I_h	150	mA
V_h	12.6	V

DIMENSIONS

Max. Overall Length	54.5	mm
Max. Seated Height	47.5	mm
Max. Diameter	19	mm

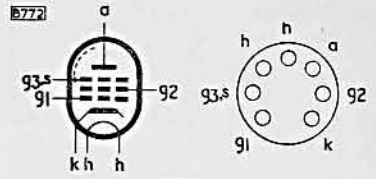
CAPACITANCES

(with no external shield)

c_{in}	5.5	pF
c_{out}	5.0	pF
c_{a-g1}	<0.0035	pF

LIMITING VALUES

V_a max.	300	V
V_{g2} max.	125	V
p_a max.	3.0	W
p_{g2} max.	600	mW
I_k max.	18	mA
V_{h-k} max.	90	V



B7G

CHARACTERISTICS

V_a	100	250	V
V_{g3}	0	0	V
R_{g2}	0	33	kΩ
V_{g2}	100	100	V
R_k	68	68	Ω
r_a	0.25	1.5	MΩ
g_m	4.3	4.4	mA/V
I_a	10.8	11	mA
I_{g2}	4.4	4.2	mA
*V_{g1}	−20	−20	V

*For 100 : 1 reduction in g_m.

REPLACEMENT FOR: 12BA6—Direct.
14H7—Change base. Check screen-grid voltage is less than 125V. Bias will require adjustment.

HEPTODE FREQUENCY CHANGER

HK90

HEATER

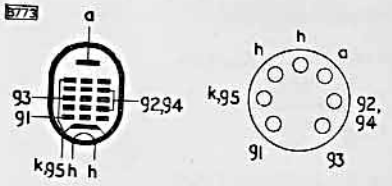
I_h	150	mA
V_h	12.6	V

DIMENSIONS

Max. Overall Length	54.5	mm
Max. Seated Height	47.5	mm
Max. Diameter	19	mm

CAPACITANCES

c_{g1-all}	5.5	pF
c_{g3-all}	7.2	pF
c_{a-all}	8.6	pF
c_{a-g3}	<0.3	pF
c_{g1-g3}	<0.15	pF
c_{a-g1}	<0.05	pF
c_{g1-k}	2.8	pF



B7G

LIMITING VALUES

V_a max.	300	V
V_{g2+g4} max.	100	V
p_a max.	1.0	W
p_{g2+g4} max.	1.0	W
I_k max.	14	mA
V_{h-k} max.	90	V

Mullard

HK90 (Cont.) HEPTODE FREQUENCY CHANGER

OPERATING CONDITIONS

(with separate excitation)*

V_a	100	250	V
V_{g2+g4}	100	100	V
V_{g3}	−1.5	−1.5	V
R_{g1-k}	20	20	kΩ
r_a	0.5	1.0	MΩ
g_c	455	475	μA/V
I_a	2.8	3.0	mA
I_{g2+g4}	7.3	7.1	mA
I_{g1}	500	500	μA
I_k	10.6	10.6	mA
†V_{g3}	−30	−30	V

†For 100 : 1 reduction in g_c.

CHARACTERISTICS

Oscillator Section

V_a	100	V
V_{g2+g4}	100	V
V_{g3}	0	V
V_{g1}	0	V
I_a	25	mA
$g_{m(g1-g2+g4+a)}$	7.25	mA/V
$\mu_{(g1-g2+g4+a)}$	20	

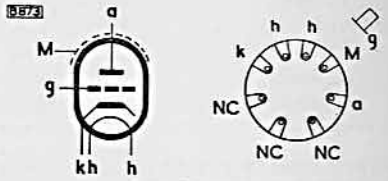
*The operating conditions shown with separate excitation correspond very closely with those obtained in a self-excited oscillator circuit operating with zero bias.

REPLACEMENT FOR: 12BE6—Direct.

HL13 MEDIUM IMPEDANCE TRIODE

DIMENSIONS

Max. Overall Length	101	mm
Max. Diameter	44	mm



Side Contact

For heater rating, operating conditions and limiting values see type HL13C. Except for dimensions and base connections, the HL13 and HL13C are identical.

REPLACEMENT FOR: CC2, HL13s—Direct.

HL13C MEDIUM IMPEDANCE TRIODE

HEATER

I_h	200	mA
V_h	13	V

DIMENSIONS

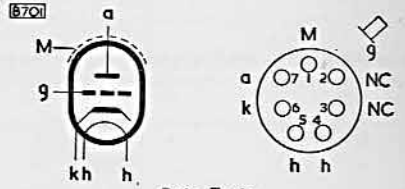
Max. Overall Length	120	mm
Max. Diameter	43	mm

LIMITING VALUES

V_a max.	200	V
p_a max.	2.0	W
I_k max.	10	mA
V_{h-k} max.	125	V

CHARACTERISTICS

V_a	200	V
I_a	5.0	mA
V_g	−3.7	V
g_m	3.3	mA/V
μ	40	
r_a	12	kΩ



Brit. 7-pin

OPERATING CONDITIONS

V_b	200	V
V_g	−2.6	V
I_a	650	μA
R_k	4.0	kΩ
R_a	160	kΩ
$\frac{V_{out}}{V_{in}}$	30	
V_{out}	36	V
D_{tot}	5	%

REPLACEMENT FOR:
C30B, HL13 (Tungsram), HL1320—Direct.
HL13 (Hivac)—Shunt heater with 120Ω 2W resistor.
HL133—Change base.
DA—Bias may require adjustment.
4D1—Earth pin 1.

Mullard

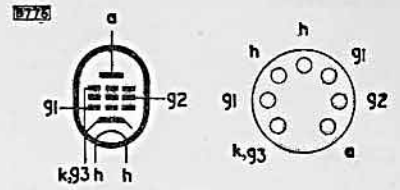
HL92 OUTPUT PENTODE

HEATER

I_h	150	mA
V_h	50	V

DIMENSIONS

Max. Overall Length	67.5	mm
Max. Seated Height	60.5	mm
Max. Diameter	19	mm



B7G

LIMITING VALUES

V_a max.	135	V
V_{g2} max.	117	V
p_a max.	5.5	W
p_{g2} max.	1.25	W
V_{h-k} max.	180	V

CHARACTERISTICS

V_a	110	V
V_{g2}	110	V
V_{g1}	−7.5	V
I_a	49	mA
I_{g2}	4.0	mA
g_m	7.5	mA/V
r_a	10	kΩ

OPERATING CONDITIONS

(As single valve class "A" amplifier)

V_a	110	V
V_{g2}	110	V
V_{g1}	−7.5	V
$I_{a(o)}$	49	mA
I_a (max. sig.)	50	mA
$I_{g2(o)}$	4.0	mA
I_{g2} (max. sig.)	8.5	mA
R_a	2.5	kΩ
P_{out}	1.9	W
$V_{in(r.m.s.)}$	5.3	V
D_{tot}	9.0	%

REPLACEMENT FOR: 50C5—Direct.

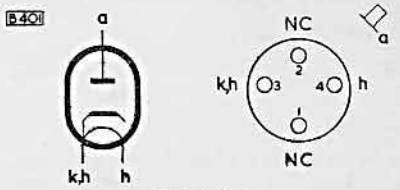
DIRECTLY HEATED HIGH VOLTAGE RECTIFIER (OBSOLETE) HVR1

FILAMENT

V_f	2.0	V
I_f	290	mA

DIMENSIONS

Max. Overall Length	132	mm
Max. Diameter	46	mm



Brit. 4-pin

This valve is directly heated. Pins 3 and 4 are connected to the filament.

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	6.0	kV
I_{out} max.	5.0	mA
P.I.V. max.	15	kV

REPLACED BY: HVR2—Increase heater voltage to 4.0V.

Mullard

HVR2

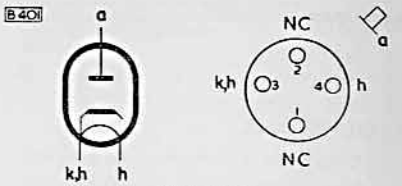
HIGH VOLTAGE RECTIFIER

HEATER

V_h	4.0	V
I_h	650	mA

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	6.0	kV
I_{out} max.	3.0	mA
P.I.V. max.	20	kV



Brit. 4-pin

DIMENSIONS

Max. Overall Length	131	mm
Max. Diameter	46	mm

REPLACEMENT FOR:
1877—Direct.
HVR1, HVR2A—increase heater voltage to 4.0V.

HVR2A

HIGH VOLTAGE RECTIFIER (OBSOLETE)

HEATER

V_h	2.0	V
I_h	1.5	A

DIMENSIONS

Max. Overall Length	135	mm
Max. Diameter	51	mm

LIMITING VALUES

For basing and limiting values see Type HVR2. Except for heater ratings and dimensions the HVR2 and HVR2A are identical.

REPLACED BY: HVR2—See above.

HY90

HALF-WAVE RECTIFIER

HEATER

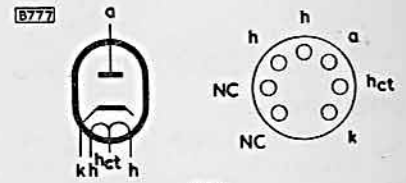
I_h	150	mA
V_h	35	V

DIMENSIONS

Max. Overall Length	67.5	mm
Max. Seated Height	60.5	mm
Max. Diameter	19	mm

LIMITING VALUES

P.I.V. max.	700	V
$i_{a(pk)}$ max.	600	mA
V_{h-k} max.	350	V



B7G

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ max.	117	240	V
R_{11m} min.	15	120	Ω
I_{out} max.	100	100	mA
C max.	40	40	μF

REPLACEMENT FOR: 35W4—Direct.

Mullard

IW2

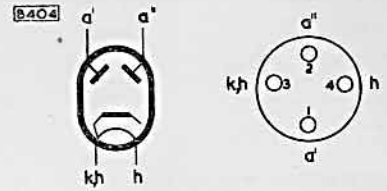
INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.2	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×250	V
I_{out} max.	60	mA



Brit. 4-pin

REPLACED BY: IW4-350 (I_h=2.0A).

IW2A

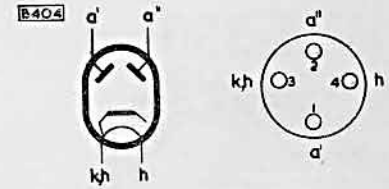
INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

V_h	4.0	V
I_h	2.4	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×250	V
I_{out} max.	60	mA



Brit. 4-pin

REPLACED BY: IW4-350—Direct.

IW3

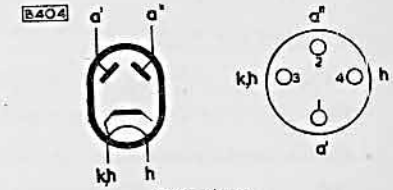
INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

V_h	4.0	V
I_h	2.4	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×350	V
I_{out} max.	120	mA
C max.	12	μF



Brit. 4-pin

DIMENSIONS

Max. Overall Length	133	mm
Max. Diameter	54	mm

REPLACED BY: IW4-350—Direct.

Mullard

IW4

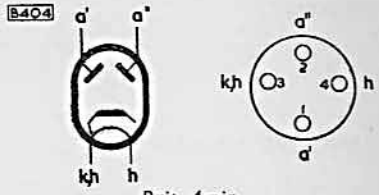
INDIRECTLY HEATED FULL-WAVE RECTIFIER (OBSOLETE)

HEATER

V_h	4.0	V
I_h	2.4	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×500	V
I_{out} max.	120	mA
C max.	12	μF



Brit. 4-pin

DIMENSIONS

Max. Overall Length	133	mm
Max. Diameter	54	mm

REPLACED BY: IW4-500—Direct.

IW4-350

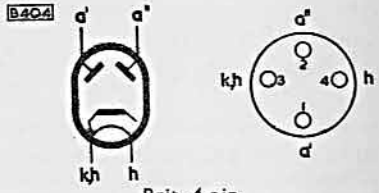
INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

V_h	4.0	V
I_h	2.0	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×350	V
I_{out} max.	120	mA
C max.	12	μF



Brit. 4-pin

DIMENSIONS

Max. Overall Length	130	mm
Max. Seated Height	114.5	mm
Max. Diameter	46	mm

REPLACEMENT FOR:

A11B, A11D, APV4, BVA211, BVA214, BVA215, BVA216, IW2A, IW3, MU12, R2, R42, UU3, UU4, UU60-250, UU120-350, UU120-350A, 1867—Direct.

AZ3, UU6—Change base.

IW2, 1881—IW4-350 requires more heater current.

Mullard

INDIRECTLY HEATED FULL-WAVE RECTIFIER

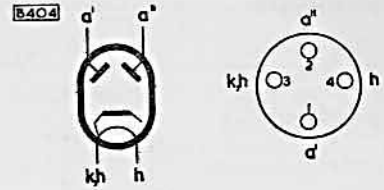
IW4-500

HEATER

V_h	4.0	V
I_h	2.5	A

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	2×500	V
I_{out} max.	120	mA
C max.	16	μF
R_{11m} min (per anode)	150	Ω



Brit. 4-pin

DIMENSIONS

Max. Overall Length	120	mm
Max. Diameter	47	mm

REPLACEMENT FOR:

A11C, G4120N, IW4, MU12/14, MU14, R3, UU5, UU120-500 (Hivac), 44IU, 1861—Direct.

43IU—Providing load current does not exceed 120mA.

DOUBLE DIODE TRIODE

KBC32

FILAMENT

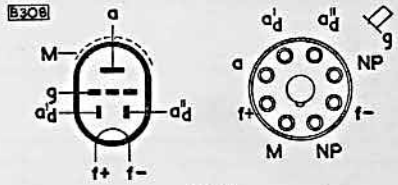
V_f	2.0	V
I_f	50	mA

LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
I_a	2.4	mA
g_m	1.2	mA/V
μ	25	
r_a	21	kΩ



Octal

DIMENSIONS

Max. Overall Length	110	mm
Max. Seated Height	96	mm
Max. Diameter	33	mm

OPERATING CONDITIONS

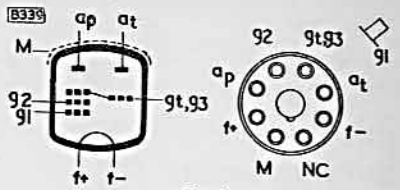
As Resistance Coupled Amplifier			
V_b	100	100	V
R_a	50	100	kΩ
V_g	−1.0	−1.2	V
I_a	500	300	μA
$\frac{V_{out}}{V_{in}}$	14	16.5	

REPLACEMENT FOR: HL23DD, 1H6G, 2102—Change base.

Mullard

KCF30

TRIODE PENTODE FREQUENCY CHANGER (OBSOLETE)



Octal

FILAMENT

V_f	2.0	V
I_f	200	mA

DIMENSIONS

Max. Overall Length	105	mm
Max. Diameter	32	mm

CAPACITANCES

Pentode Section

c_{a-g1}	0.01	pF
c_{in}	6.5	pF
c_{out}	8.0	pF

Triode Section

c_{a-g}	2.0	pF
c_{in}	9.0	pF
c_{out}	3.75	pF

LIMITING VALUES

Pentode Section

V_a max.	150	V
V_{g2} max.	150	V

Triode Section

V_a max.	150	V

OPERATING CONDITIONS

V_a	120	V
V_{g2}	60	V
V_{g1}	–1.5	V
I_a	580	μA
I_{g2}	920	μA
$V_{osc(r.m.s.)}$	5.7	V
g_c	260	μA/V
R_{gt-f+}	47	kΩ
*V_{g1}	–14	V

*For 26 : 1 reduction in g_c.

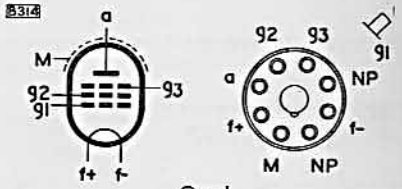
CHARACTERISTICS

Triode Section

V_a	100	V
V_g	0	V
g_m	1.7	mA/V
μ	18	

KF35

VARIABLE-MU R.F. PENTODE



Octal

FILAMENT

V_f	2.0	V
I_f	50	mA

DIMENSIONS

Max. Overall Length	110	mm
Max. Seated Height	96	mm
Max. Diameter	33	mm

CAPACITANCES

c_{a-g1}	<0.01	pF
c_{in}	8.0	pF
c_{out}	10.0	pF

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	150	V

CHARACTERISTICS

V_a	120	V
V_{g2}	60	V
V_{g1}	–1.5	V
g_m	1.08	mA/V
I_a	1.45	mA
I_{g2}	500	μA
*V_{g1}	–9.5	V

*For 100 : 1 reduction in g_m.

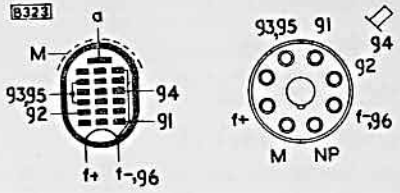
REPLACEMENT FOR:

VP22, VP23, VP210, 1A4E, 1A4P, 15—Change base.
1E5G—Earth pins 1 and 5.
K50M, VP2—Change base and top cap connector. Reduce screen voltage to 60V.

Mullard

KK32

OCTODE FREQUENCY CHANGER



Octal

FILAMENT

V_f	2.0	V
I_f	130	mA

CAPACITANCES

c_{g1-all}	6.3	pF
c_{g2-all}	8.5	pF
c_{g4-all}	9.0	pF
c_{out}	11	pF
c_{g2-g4}	<0.4	pF
c_{a-g4}	<0.07	pF
c_{g1-g4}	<0.2	pF

LIMITING VALUES

V_a max.	150	V
p_a max.	500	mW
V_{g2} max.	150	V
p_{g2} max.	600	mW
V_{g3+g5} max.	100	V
p_{g3+g5} max.	400	mW
I_k max.	11	mA

OPERATING CONDITIONS

(Short-Wave Working)

V_a	135	V
V_{g2}	135	V
V_{g3+g5}	60	V
V_{g4}	–1.5	V
$V_{osc(r.m.s.)}$	6.0	V
I_a	1.0	mA
I_{g2}	2.3	mA
I_{g3+g5}	1.0	mA
g_c	67	μA/V
r_a	1.7	MΩ

OPERATING CONDITIONS

(Medium and Long-Wave Working)

V_a	90	135	V
V_{g2}	90	135	V
V_{g3+g5}	45	45	V
V_{g4}	–0.5	–0.5	V
$V_{osc(r.m.s.)}$ (approx.)	8.5	8.5	V
I_a	700	700	μA
I_{g2}	1.3	2.1	mA
I_{g3+g5}	600	700	μA
g_c	270	270	μA/V
r_a	2.0	2.5	MΩ
*V_{g4}	–12	–12	V

*For 100 : 1 reduction in g_c.

REPLACEMENT FOR:

1C6—Change base.

1C7G, 1D7G—Earth pin 1.

Mullard

KL35

OUTPUT PENTODE

FILAMENT

V_f	2.0	V
I_f	150	mA

DIMENSIONS

Max. Overall Length	90	mm
Max. Diameter	41	mm

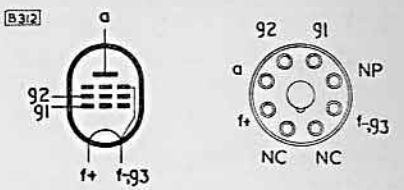
LIMITING VALUES

V_a max.	150	V
p_a max.	1.0	W
V_{g_2} max.	150	V
I_k max.	10	mA

CHARACTERISTICS

V_a	135	V
V_{g_2}	135	V
V_{g_1}	–4.5	V
I_a	5.6	mA
g_m	2.2	mA/V
r_a	150	kΩ

B312



Octal

OPERATING CONDITIONS

(As single valve class "A" amplifier)

	Fixed Bias	Self Bias	
V_a	135	135	V
V_{g_2}	135	135	V
V_{g_1}	–4.5	–4.8	V
I_a	5.6	5.0	mA
R_a	19	20	kΩ
$V_{in(r.m.s.)}$	3.0	2.9	V
P_{out}	340	310	mW
D_{tot}	10	10	%

REPLACEMENT FOR:

K30G, L2 (Ferranti), LP2 (Marconi-Osram), LP220, P220 (Ediswan-Mazda or Hivac), PB1, PM2, PM2A, PM252, 220PA—These valves are triodes. Output stage must therefore be redesigned and base changed.
PEN24—Change base. Change bias to –4.5V.
PEN25, 2101—Change base.
1F4, 1F5G—Change base. Bias may require adjustment.

KLL32

DOUBLE OUTPUT PENTODE

FILAMENT

V_f	2.0	V
I_f	300	mA

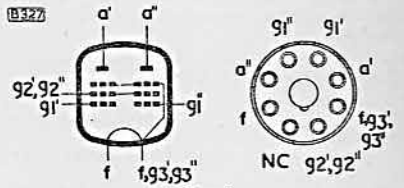
DIMENSIONS

Max. Overall Length	101	mm
Max. Diameter	41	mm

CHARACTERISTICS

V_a	100	V
V_{g_2}	100	V
V_{g_1}	0	V
g_m	2.6	mA/V

B327



Octal

OPERATING CONDITIONS

V_a	90	120	135	V
V_{g_2}	90	120	135	V
$I_{a(o)}$	2.8	3.3	3.8	mA
I_a (max. sig.)	9.8	14.4	16.9	mA
V_{g_1}	–7.4	–10.2	–11.3	V
I_{g_2} (max. sig.)	2.8	4.6	5.7	mA
$V_{in(g_1-g_1)}$ r.m.s.	5.2	7.3	8.4	V
P_{out}	0.45	0.94	1.2	W
D_{tot}	1.8	2.5	2.8	%
R_{a-a}	16	16	16	kΩ

Mullard

DOUBLE OUTPUT PENTODE

KLL32 (Cont.)

REPLACEMENT FOR: HP2, K33A, PD220, PM2B, PM2BA, 220B.

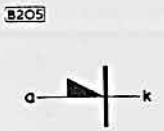
These valves are double triodes and the output stage must therefore be redesigned. It will also be necessary to change the base.

OA60

GERMANIUM DIODE

Germanium diode primarily intended for use as a video signal detector at frequencies up to 100 Mc/s.

B205



CAPACITANCE

	1.0	pF

LIMITING VALUES

Max. reverse working voltage		
Peak	30	V
Average	25	V
Max. average current	5.0	mA
Ambient temperature limits	–50	°C
	+60	°C

DIMENSIONS

Max. Overall Length	100	mm
Max. Diameter	6.0	mm

COLOUR CODING

Blue
Black

OPERATING CONDITIONS

f	20	30	30	50 Mc/s
T_{amb}	20	20	60	20 °C
R_{load}	3.9	3.9	3.9	3.9 kΩ
R_d	3.6	3.0	2.8	2.5 kΩ
η	54	60	58	66 %

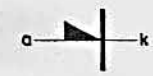
REPLACEMENT FOR: 1N87—Direct.

OA61

GERMANIUM DIODE

Germanium diode primarily intended for use as a d.c. restorer or synchronising pulse clipper.

B208



CAPACITANCE

	1.0	pF

LIMITING VALUES

Max. reverse working voltage		
Peak	100	V
Average	80	V
Max. average current	5.0	mA
Ambient temperature limits	–50	°C
	+60	°C

DIMENSIONS

Max. Overall Length	100	mm
Max. Diameter	6.0	mm

Mullard

OA61 (Cont).

GERMANIUM DIODE

COLOUR CODING

Blue
Brown

CHARACTERISTICS (measured at 20°C)

Min. forward current at +1 V	2.5	mA
Max. reverse current at –50 V	100	μA

REPLACEMENT FOR: 1N88—Direct.

OA70

GERMANIUM DIODE

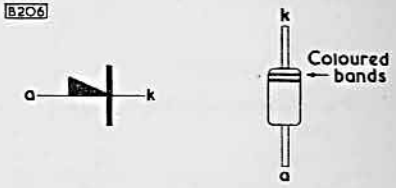
Germanium diode of all glass construction intended for use as a video signal detector at frequencies up to 100 Mc/s.

CAPACITANCE 1.0 pF

LIMITING VALUES

Max. inverse voltage		
Peak	22.5	V
Average over any 50 m.sec period) or d.c. component	15	V
Max. forward current		
Peak	150	mA
Average (over any 50m.sec period) or d.c. component	50	mA
Surge (occasional overload, max. duration 1.0 sec)	400	mA
Ambient temperature limits –50		°C
Ambient temperature limits +75		°C

B206



DIMENSIONS

Max. Overall Length	102.5	mm
Max. Diameter	5.0	mm

COLOUR CODING

Violet
Black

CHARACTERISTICS

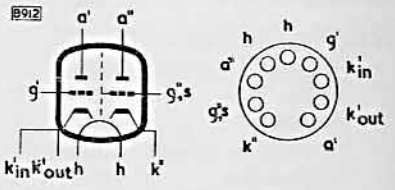
f	10	30	60	Mc/s
$v_{in(pk)}$	5.0	5.0	5.0	V
R_{load}	3.9	3.9	3.9	kΩ
C	10	10	10	pF
η	46	62	73	%
R_d	5.5	3.0	2.5	kΩ

PCC84

DOUBLE TRIODE

Double triode primarily intended for use as a cascode r.f. amplifier at frequencies up to 220 Mc/s in television receivers with series-connected heaters.

B9I2



B9A

HEATER

I_h	300	mA
V_h	7.0	V

Mullard

DOUBLE TRIODE

PCC84 (Cont.)

DIMENSIONS

Max. Overall Length	56	mm
Max. Seated Height	49	mm
Max. Diameter	22.2	mm

CAPACITANCES (measured without external shield)

$c_{a'-g'}$	1.1	pF
c_{in}'	2.3	pF
c_{out}'	0.45	pF
$c_{g'-h}$	<0.25	pF
$c_{a''-g''}$	2.3	pF
$c_{a-g''+h}$	2.5	pF
$c_{a''-k''}$	0.16	pF
$c_{k''-g''+h}$	4.7	pF
$c_{h-k''}$	2.7	pF
$c_{g'-a''}$	<0.006	pF
$c_{a'-a''}$	<0.035	pF
$c_{a'-k'+h+g''}$	1.2	pF

LIMITING VALUES (each section)

V_a max.	180	V
p_a max.	2.0	W
I_k max.	18	mA
*$v_{h-k''(pk)}$ max. (heater negative)	250	V
$V_{h-k''}$ max. (heater positive)	90	V
$V_{h-k'}$ max.	90	V

* Max. d.c. component=180 V.

CHARACTERISTICS (each section)

V_a	90	V
I_a	12	mA
V_g	–1.5	V
g_m	6.0	mA/V
μ	24	
*R_{in} (cathode connections, pins 7 and 8 strapped)	2.0	kΩ

* At 200 Mc/s.

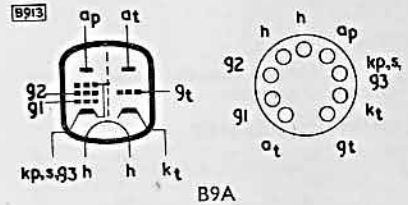
REPLACEMENT FOR: B319, 7AN7, 30L1—Direct.

PCF80

TRIODE PENTODE

Combined triode and high slope r.f. pentode with separate cathodes. Primarily designed for use as a frequency changer at frequencies up to 220 Mc/s in television receivers with series-connected heaters.

B9I3



B9A

HEATER

I_h	300	mA
V_h	9.0	V

DIMENSIONS

Max. Overall Length	56	mm
Max. Seated Height	49	mm
Max. Diameter	22.2	mm

CAPACITANCES (measured without external shield)

c_{ap-at}	<0.06	pF
c_{ap-gt}	<0.02	pF
c_{gp-at}	<0.16	pF
Pentode Section		
c_{in}	5.5	pF
c_{out}	3.8	pF
c_{a-g1}	<0.025	pF
Triode Section		
c_{g-k+h}	2.3	pF
c_{a-k+h}	0.3	pF
c_{a-g}	1.5	pF

CHARACTERISTICS

Pentode Section		
V_a	170	V
V_{g2}	170	V
I_a	10	mA
V_{g1}	–2.0	V
I_{g2}	2.8	mA
g_m	6.2	mA/V
μ_{g1-g2}	47	
r_a	400	kΩ
R_{in} (at 50Mc/s)	10	kΩ
R_{eq}	1.5	kΩ
Triode Section		
V_a	100	V
I_a	14	mA
V_g	–2.0	V
g_m	5.0	mA/V
μ (approx.)	20	

Mullard

PCF80 (Cont.)

TRIODE PENTODE

LIMITING VALUES

Pentode Section

V_a max.	250	V
p_a max.	1.7	W
V_{g_2} max. (I_k=14 mA)	175	V
V_{g_2} max. (I_k=10 mA)	200	V
p_{g_2} max.	500	mW
I_k max.	14	mA
V_{h-k} max. (heater positive)	90	V
V_{h-k} max. (heater negative)	150	V

Triode Section

V_a max.	250	V
p_a max.	1.5	W
I_k max.	14	mA
V_{h-k} max.	90	V

OPERATING CONDITIONS

As a frequency changer

V_a	170	170	V
V_{g_2}	170	170	V
R_{g_1-k}	100	100	kΩ
R_k	820	0	Ω
I_a	5.2	6.3	mA
I_{g_2}	1.5	2.5	mA
$V_{osc(r.m.s.)}$	3.5	4.0	V
I_{g_1}	0	53	μA
g_c	2.1	2.05	mA/V
r_a	870	720	kΩ

REPLACEMENT FOR: LZ319, 8A8, 30C1—Direct.

PEN4DD

DOUBLE DIODE OUTPUT PENTODE

HEATER

V_h	4.0	V
I_h	2.25	A

DIMENSIONS

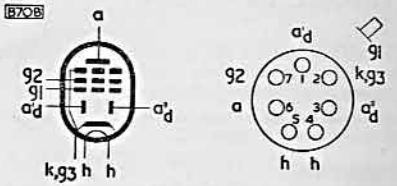
Max. Overall Length	152	mm
Max. Diameter	52	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V
p_{g_2} max.	1.5	W
I_k max.	55	mA
V_{h-k} max.	50	V

CHARACTERISTICS

V_a	250	V
V_{g_2}	250	V
V_{g_1}	–6.0	V
I_a	36	mA
I_{g_2}	5.0	mA
g_m	9.5	mA/V
r_a	50	kΩ



Brit. 7-pin

OPERATING CONDITIONS

(As single valve class "A" amplifier)

V_a	250	V
V_{g_2}	250	V
V_{g_1}	–6.0	V
I_a	36	mA
I_{g_2}	5.0	mA
R_a	7.0	kΩ
$V_{in(r.m.s.)}$	3.6	V
P_{out}	4.3	W
D_{tot}	10	%

REPLACEMENT FOR:

A27D, DDPP4M, DO42, DP495—Direct.
ABL1, DDPP4Bs—Change base.
AC/ZDD, AC2PENDD, DDPP4B, PT4D, 42OT/DD—Rewire base.
DN41—Rewire base. Raise screen voltage to anode voltage. Increase cathode bias resistor to 140Ω.

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OUTPUT PENTODE (OBSOLETE)

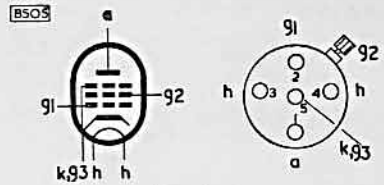
PEN4V

HEATER

V_h	4.0	V
I_h	1.0	A

LIMITING VALUES

V_a max.	250	V
V_{g_2} max.	250	V



Brit. 5-pin

OPERATING CONDITIONS

(As single valve class "A" amplifier)

V_a	250	V
V_{g_2}	200	V
V_{g_1}	–10	V
I_a	35	mA
R_a	8.0	kΩ

CHARACTERISTICS

V_a	250	V
V_{g_2}	100	V
V_{g_1}	0	V
g_m	3.0	mA/V

REPLACED BY: PEN4VA (5-pin)—Change grid bias to –22V. No change with automatic bias.

OUTPUT PENTODE

PEN4VA

HEATER

V_h	4.0	V
I_h	1.35	A

DIMENSIONS

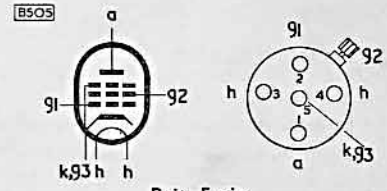
Max. Overall Length	137	mm
Max. Diameter	50	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V
p_{g_2} max.	1.5	W
I_k max.	50	mA
V_{h-k} max.	50	V

CHARACTERISTICS

V_a	250	V
V_{g_2}	250	V
V_{g_1}	–20	V
I_a	36	mA
I_{g_2}	3.0	mA
g_m	2.8	mA/V
r_a	40	kΩ



Brit. 5-pin

Base connections of 7-pin version as for PEN4VB.

OPERATING CONDITIONS

(As single valve class "A" amplifier)

V_a	250	V
V_{g_2}	250	V
V_{g_1}	–20	V
I_a	36	mA
I_{g_2}	3.0	mA
R_k	500	Ω
R_a	6.0	kΩ
P_{out}	3.8	W
D_{tot}	10	%

REPLACEMENT FOR:

A70B, AC/PEN, APP4A, KT42, MKT4, MP/PEN, MPT4, P440N, P441N, 7A2—Direct.
APP4As—Change base.
PEN4V (5-pin)—Change grid bias to –22V. (No change with automatic bias.)
AC/Y, N40 (5-pin)—Bias may require adjustment.

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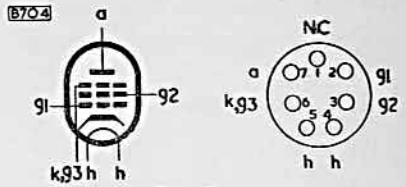
PEN4VB

OUTPUT PENTODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.95	A

Except for the longer heating time the PEN4VB is identical to the PENA4.



Brit. 7-pin

REPLACED BY: PENA4—Direct.

PEN13C

OUTPUT PENTODE (OBSOLETE)

HEATER

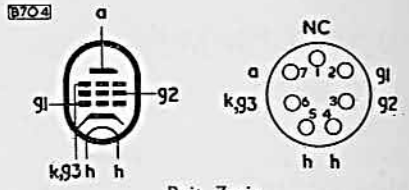
V_h	13	V
I_h	500	mA

LIMITING VALUES

V_a max.	250	V
p_a max.	8.0	W
V_{g2} max.	250	V
p_{g2} max.	2.0	W
V_{h-k} max.	75	V
I_k max.	50	mA

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
V_{g1}	–12	V
I_a	32	mA
I_{g2}	7.0	mA
g_m	6.0	mA/V



Brit. 7-pin

DIMENSIONS

Max. Overall Length	138	mm
Max. Diameter	51	mm

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	V
V_{g2}	250	V
I_a	32	mA
I_{g2}	7.0	mA
R_k	250	Ω
R_a	6.4	kΩ
$V_{in(r.m.s.)}$	5.6	V
P_{out}	3.2	W
D_{tot}	<10	%

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PEN26

OUTPUT PENTODE (OBSOLETE)

HEATER

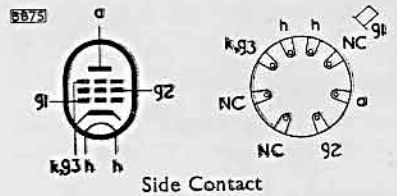
I_h	200	mA
V_h	24	V

LIMITING VALUES

V_a max.	200	V
p_a max.	8.0	W
V_{g2} max.	100	V
p_{g2} max.	1.0	W
I_k max.	70	mA
V_{h-k} max.	175	V

CHARACTERISTICS

V_a	200	V
V_{g2}	100	V
V_{g1}	–19	V
I_a	40	mA
I_{g2}	5.0	mA
g_m	3.1	mA/V



Side Contact

DIMENSIONS

Max. Overall Length	123	mm
Max. Diameter	46	mm

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	200	V
V_{g2}	100	V
I_a	40	mA
I_{g2}	5.0	mA
R_k	420	Ω
R_a	5.0	kΩ
P_{out}	3.0	W
$V_{in(r.m.s.)}$	8.8	V
D_{tot}	10	%

REPLACED BY: CL4—Change bias resistor to 170Ω. Adjust screen voltage to 200V.

PEN36C

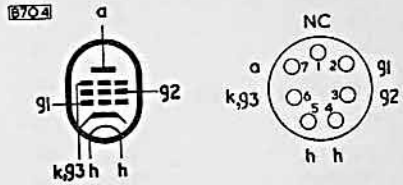
OUTPUT PENTODE (OBSOLETE)

HEATER

I_h	200	mA
V_h	33	V

DIMENSIONS

Max. Overall Length	132	mm
Max. Diameter	51	mm



Brit. 7-pin

For characteristics, operating data and limiting values see type CL33.

Except for base and dimensions, the PEN36C is identical to the CL33.

REPLACED BY: CL33—Change base.

Mullard

PEN40DD

DOUBLE DIODE OUTPUT PENTODE (OBSOLETE)

HEATER

I_h	200	mA
V_h	44	V

DIMENSIONS

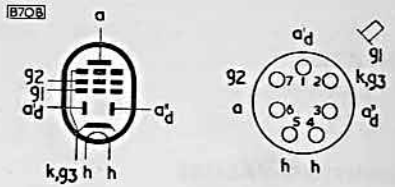
Max. Overall Length	146	mm
Max. Diameter	50	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V
p_{g_2} max.	2.0	W
I_k max.	70	mA
V_{h-k} max.	175	V

CHARACTERISTICS

V_a	200	V
V_{g_2}	200	V
V_{g_1}	−8.5	V
I_a	45	mA
I_{g_2}	6.0	mA
g_m	8.0	mA/V
r_a	35	kΩ



Brit. 7-pin

The metallising is connected to Pin 2.

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	200	V
V_{g_2}	200	V
I_a	45	mA
I_{g_2}	6.0	mA
R_k	170	Ω
R_a	4.5	kΩ
$V_{in(r.m.s.)}$	5.0	V
P_{out}	4.0	W
D_{tot}	10	%

REPLACED BY: CBL31—Change base.

PEN428

OUTPUT PENTODE

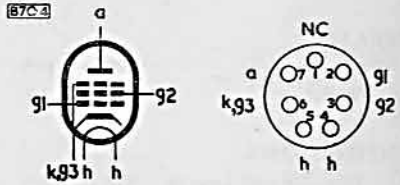
HEATER

V_h	4.0	V
I_h	2.1	A

LIMITING VALUES

*V_a max.	375	V
p_a max.	18	W
*V_{g_2} max.	275	V
p_{g_2} max.	3.0	W
V_{h-k} max.	50	V

*These ratings apply only to operation in Class "AB" push-pull. For single valve operation the maximum values of V_a and V_{g_2} are 250V.



Brit. 7-pin

DIMENSIONS

Max. Overall Length	132	mm
Max. Diameter	50	mm

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OUTPUT PENTODE

PEN428 (Cont.)

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	V
V_{g_2}	250	V
R_k	150	Ω
I_a	72	mA
R_a	3.2	kΩ
P_{out}	8.0	W
D_{tot}	10	%

(Two valves in class "AB" push-pull.)

V_a	250	375	V
V_{g_2}	275	275	V
$I_{a(o)}$	2×52	2×48	mA
I_a (max. sig.)	2×66	2×62	mA
$I_{g_2(o)}$	2×4	2×5	mA
I_{g_2} (max. sig.)	—	2×9	mA
*R_k	120	165	Ω
R_{a-a}	4.5	6.5	kΩ
P_{out}	19	28	W
D_{tot}	6.0	3.0	%

*Common cathode bias resistor.

OUTPUT PENTODE (OBSOLETE)

PEN650

This valve has been recoded EL50, and data will be found under this type number.

OUTPUT PENTODE

PENA4

HEATER

V_h	4.0	V
I_h	1.95	A

DIMENSIONS

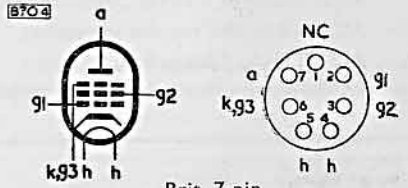
Max. Overall Length	132	mm
Max. Seated Height	50	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V

CHARACTERISTICS

V_a	250	V
V_{g_2}	250	V
V_{g_1}	−5.8	V
I_a	36	mA
I_{g_2}	5.0	mA
g_m	9.5	mA/V
r_a	50	kΩ



Brit. 7-pin

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	V
V_{g_2}	250	V
I_a	36	mA
I_{g_2}	5.0	mA
R_a	8.0	kΩ
R_k	145	Ω
P_{out}	3.8	W

REPLACEMENT FOR:

A70C, A70D, AC/Z, AC2PEN, APP4B, N41, OP42, P495, PEN4VB, PT4 (Ferranti), 7A3, 42MP/PEN, 42OT—Direct.

AL4, APP4Bs—Change base.

KT41—Bias may require adjustment.

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PENB4

OUTPUT PENTODE

HEATER

V_h	4.0	V
I_h	2.1	A

DIMENSIONS

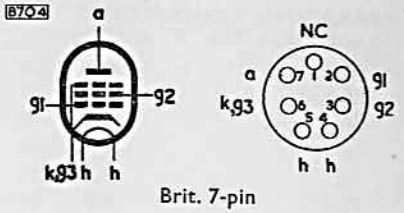
Max. Overall Length	138	mm
Max. Diameter	51	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	18	W
V_{g_2} max.	275	V
p_{g_2} max.	3.0	W
I_k max.	90	mA
V_{h-k} max.	50	V

CHARACTERISTICS

V_a	250	V
V_{g_2}	275	V
V_{g_1}	−13.8	V
I_a	72	mA
I_{g_2}	7.0	mA
g_m	8.5	mA/V
r_a	22	kΩ



Brit. 7-pin

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	V
V_{g_2}	275	V
I_a	72	mA
I_{g_2}	7.0	mA
R_k	175	Ω
R_a	3.5	kΩ
P_{out}	8.8	W
$V_{in(r.m.s.)}$	8.2	V
D_{tot}	10	%

REPLACEMENT FOR:

A70E, AC4PEN, APP4E, OP41—Direct.

AC/Q—Bias may require adjustment.

AL5, PEN44—Change base.

AL60—Rewire base. Adjust bias resistor to 180Ω.

PL33

OUTPUT PENTODE

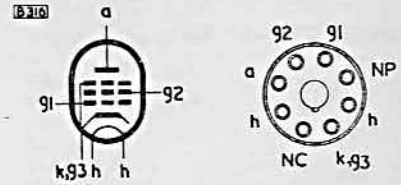
High sensitivity output pentode with maximum anode dissipation of 9 watts, suitable for use in frame time base or audio output stage of television receivers with series-connected heaters.

HEATER

I_h	300	mA
V_h	19	V

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	275	V
p_{g_2} max. (zero sig.)	1.2	W
p_{g_2} max. (max. sig.)	2.5	W
I_k max.	55	mA
V_{h-k} max.	300	V



Octal

DIMENSIONS

Max. Overall Length	126	mm
Max. Seated Height	112	mm
Max. Diameter	46	mm

Mullard

OUTPUT PENTODE

PL33 (Cont.)

CHARACTERISTICS

V_a	200	225	V
V_{g_2}	200	225	V
V_{g_1}	−4.65	−5.3	V
I_a	28	32	mA
I_{g_2}	3.0	3.4	mA
g_m	8.6	9.0	mA/V
r_a	55	50	kΩ
$\mu_{g_1-g_2}$	23	23	

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	200	225	V
V_{g_2}	200	225	V
R_k	150	150	Ω
V_{g_1}	−4.65	−5.3	V
I_a	28	32	mA
I_{g_2}	3.0	3.4	mA
R_a	7.0	7.0	kΩ
$V_{in(r.m.s.)}$	3.1	3.4	V
P_{out}	2.55	3.3	W
D_{tot}	10	10	%

OUTPUT PENTODE

PL38

Output pentode primarily intended for use as line time base output valve in television receivers with series connected heaters.

HEATER

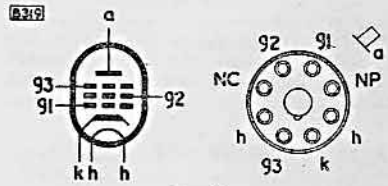
I_h	300	mA
V_h	30	V

DIMENSIONS

Max. Overall Length	141	mm
Max. Seated Height	127	mm
Max. Diameter	45.4	mm

LIMITING VALUES

V_a max.	800	V
$v_{a\ (pk)}$ max.	8.0	kV
V_{g_2} max.	400	V
p_a max.	25	W
p_{g_2} max.	8.0	W
I_k max.	200	mA
V_{h-k} max.	200	V



Octal

CHARACTERISTICS

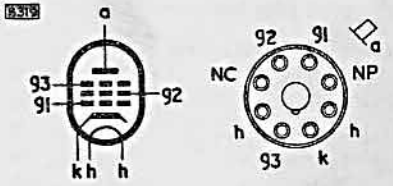
V_a	200	V
V_{g_2}	200	V
V_{g_1}	−5.5	V
I_a	75	mA
I_{g_2}	9.0	mA
g_m	13.5	mA/V
r_a	20	kΩ
$\mu_{g_1-g_2}$	16.5	

OUTPUT PENTODE

PL38M

For data, see PL38 above. Except for the fact that the PL38M is metallised, these two valves are identical.

The metallising is connected to Pin 3.



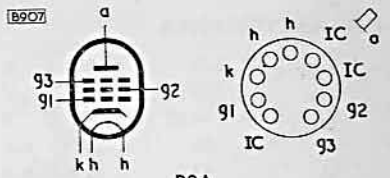
Octal

Mullard

PL81

LINE OUTPUT PENTODE

Output pentode primarily intended for use in the line timebase of television receivers with series connected heaters.



B9A

HEATER

I_h	300	mA
V_h	21.5	V

LIMITING VALUES

V_a max.	250	V
*$V_{a\ (pk)}$ max.	7.0	kV
p_a max.	8.0	W
V_{g_2} max.	250	V
**p_{g_2} max.	4.5	W
p_{a+g_2} max.	10	W
I_k max.	180	mA
V_{h-k} max.	200	V

*Max. pulse duration 18% of one cycle, with maximum of 18 μsec.

**Max. average p_{g_2} is 6W during the period between the commencement of I_{g_2} and the instant when I_a attains one half of its normal operating value.

DIMENSIONS

Max. Overall Length	83	mm
Max. Seated Height	76	mm
Max. Diameter	22.2	mm

CHARACTERISTICS

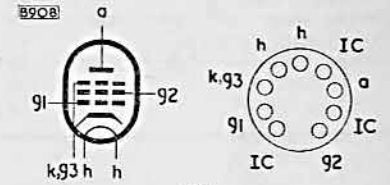
V_a	170	200	V
V_{g_2}	170	200	V
V_{g_3}	0	0	V
V_{g_1}	–22	–28	V
I_a	45	40	mA
I_{g_2}	3.0	2.8	mA
g_m	6.2	6.0	mA/V
$\mu_{g_1-g_2}$	5.5	5.5	
r_a	10	11	kΩ

REPLACEMENT FOR: N152, 21A6, 21A6/PL81—Direct.

PL82

OUTPUT PENTODE

Output pentode with a maximum anode dissipation of 9W suitable for use in frame timebase or audio output valve.



B9A

HEATER

I_h	300	mA
V_h	16.5	V

DIMENSIONS

Max. Overall Length	78.5	mm
Max. Seated Height	71.5	mm
Max. Diameter	22.2	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V
p_{g_2} max.	2.5	W
I_k max.	75	mA
V_{h-k} max.	200	V

CHARACTERISTICS

V_a	170	200	V
V_{g_2}	170	200	V
I_a	53	45	mA
I_{g_2}	10	8.5	mA
V_{g_1}	–10.4	–14.2	V
g_m	9.0	7.6	mA/V
r_a	20	24	kΩ
$\mu_{g_1-g_2}$	10	10	

Mullard

OUTPUT PENTODE

PL82 (Cont.)

OPERATING CONDITIONS (As single valve class "A" amplifier)

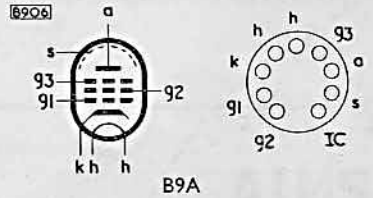
V_a	170	200	V
V_{g_2}	170	200	V
V_{g_1}	–10.4	–13.9	V
R_a	3.0	4.0	kΩ
I_a	53	45	mA
I_{g_2}	10	8.5	mA
$V_{in(r.m.s.)}$	6.0	7.0	V
P_{out}	4.0	4.2	W
D_{tot}	10	10	%

REPLACEMENT FOR:
N154, N329, 16A5—Direct.
N37—Change base. Change bias resistor to 170Ω. Heater voltage differs.

VIDEO OUTPUT PENTODE

PL83

Video output pentode for use in television receivers with series connected heaters. It is particularly suitable for use in projection television receivers or with high definition television systems.



B9A

HEATER

I_h	300	mA
V_h	15	V

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V
p_{g_2} max.	2.0	W
I_k max.	70	mA
V_{h-k} max.	150	V

CHARACTERISTICS

V_a	170	200	V
V_{g_2}	170	200	V
V_{g_3}	0	0	V
V_{g_1}	–2.3	–3.5	V
I_a	36	36	mA
I_{g_2}	5.0	5.0	mA
g_m	10	10	mA/V
r_a	100	100	kΩ
$\mu_{g_1-g_2}$	24	24	

DIMENSIONS

Max. Overall Length	78.5	mm
Max. Seated Height	71.5	mm
Max. Diameter	22.2	mm

OPERATING CONDITIONS
Driving a Cathode Ray Tube with Cathode Injection

V_b	170	V
V_{g_2}	170	V
V_{g_3}	0	V
V_{g_1}	–6.7	V
I_a	4.0	mA
I_{g_2}	250	μA
R_a	2.2	kΩ
$V_{out\ (pk)}$	>70	V

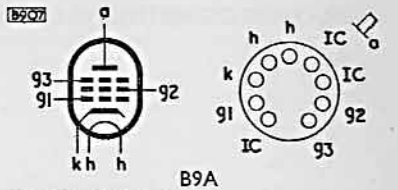
REPLACEMENT FOR: N153, N309, 15A6—Direct.

Mullard

PL820

OUTPUT PENTODE

Output pentode suitable for use in the e.h.t. units of projection television receivers.



B9A

HEATER

I_h	300	mA
V_h	21.5	V

LIMITING VALUES

V_a max.	250	V
*$V_{a\ (pk)}$ max.	7.0	kV
p_a max.	8.0	W
V_{g_2} max.	250	V
**p_{g_2} max.	4.5	W
$p_a+p_{g_2}$ max.	10	W
I_k max.	180	mA
V_{h-k} max.	200	V

*Max. pulse duration 18% of one cycle, with maximum of 18μ sec.

**Max. average p_{g_2} is 6W during the period between the commencement of I_{g_2} and the instant when I_a attains one half of its normal operating value.

DIMENSIONS

Max. Overall Length	83	mm
Max. Seated Height	76	mm
Max. Diameter	22.2	mm

CHARACTERISTICS

V_a	170	200	V
V_{g_2}	170	200	V
V_{g_3}	0	0	V
V_{g_1}	–22	–28	V
I_a	45	40	mA
I_{g_2}	3.0	2.8	mA
g_m	6.2	6.0	mA/V
$\mu_{g_1-g_2}$	5.5	5.5	
r_a	10	11	kΩ

PM1A

BATTERY TRIODE (OBSOLETE)

FILAMENT

V_f	2.0	V
I_f	100	mA

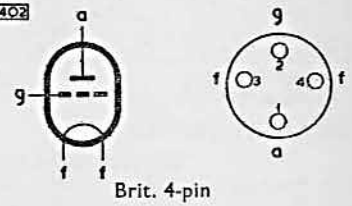
LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
I_a	1.05	mA
r_a	41.6	kΩ
μ	50	
g_m	1.2	mA/V

REPLACED BY: PM2HL—Direct.



Brit. 4-pin

DIMENSIONS

Max. Overall Length	110	mm
Max. Diameter	42	mm

Mullard

BATTERY TRIODE (OBSOLETE)

PM1HF

FILAMENT

V_f	2.0	V
I_f	100	mA

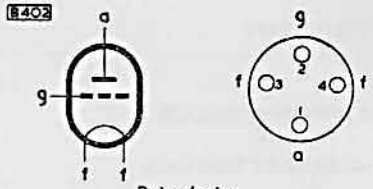
LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
I_a	2.3	mA
g_m	800	μA/V
μ	18	
r_a	22.5	kΩ

REPLACED BY: PM2HL—Direct.



Brit. 4-pin

DIMENSIONS

Max. Overall Length	100	mm
Max. Diameter	42	mm

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

PM1HL

FILAMENT

V_f	2.0	V
I_f	100	mA

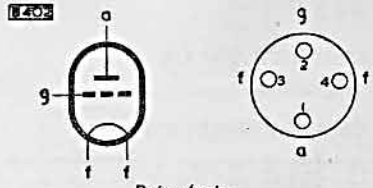
LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	135	V
V_g	–1.5	V
I_a	2.3	mA
g_m	1.2	mA/V
μ	28	
r_a	23.4	kΩ

REPLACED BY: PM2HL—Direct.



Brit. 4-pin

DIMENSIONS:

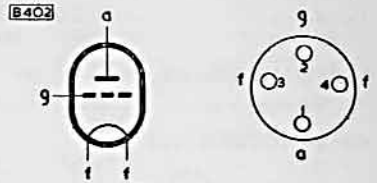
Max. Overall Length	98	mm
Max. Diameter	42	mm

Mullard

PM1LF

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

FILAMENT		
V_f	2.0	V
I_f	100	mA
LIMITING VALUE		
V_a max.	150	V
CHARACTERISTICS		
V_a	100	V
V_g	0	V
I_a	5.8	mA
g_m	900	μA/V
μ	11	
r_a	12	kΩ



Brit. 4-pin

DIMENSIONS

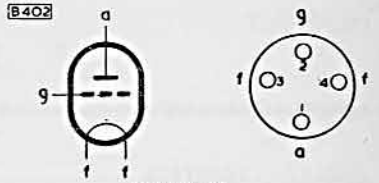
Max. Overall Length	100	mm
Max. Diameter	42	mm

REPLACED BY: PM2HL—Change bias to –1.5V.

PM2

OUTPUT TRIODE (OBSOLETE)

FILAMENT		
V_f	2.0	V
I_f	200	mA
LIMITING VALUE		
V_a max.	150	V
CHARACTERISTICS		
V_a	100	V
V_g	0	V
I_a	14.5	mA
g_m	1.7	mA/V
μ	7.5	
r_a	4.4	kΩ



Brit. 4-pin

DIMENSIONS

Max. Overall Length	112	mm
Max. Diameter	46	mm

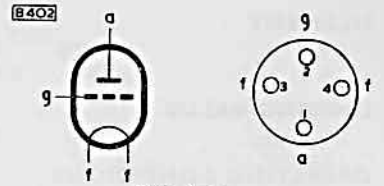
REPLACED BY: KL35—Change base, and redesign output stage (KL35 is an output pentode).

Mullard

OUTPUT TRIODE (OBSOLETE)

PM2A

FILAMENT		
V_f	2.0	V
I_f	200	mA
DIMENSIONS		
Max. Overall Length	104	mm
Max. Diameter	45	mm
LIMITING VALUE		
V_a max.	150	V
CHARACTERISTICS		
V_a	135	V
V_g	–6.0	V
I_a	5.0	mA
g_m	2.0	mA/V
μ	12	
r_a	6.0	kΩ



Brit. 4-pin

OPERATING CONDITIONS
(As single valve class "A" amplifier)

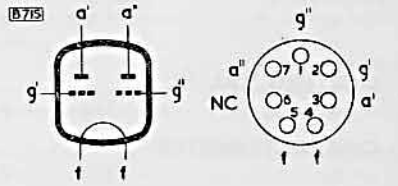
V_a	135	V
V_g	–6.0	V
I_a	5.0	mA
R_a	7.0	kΩ
P_{out}	150	mW
D_{tot}	5.0	%

REPLACED BY: KL35—Change base. Redesign output stage (KL35 is an output pentode).

CLASS "B" DOUBLE TRIODE (OBSOLETE)

PM2B

FILAMENT		
V_f	2.0	V
I_f	200	mA
LIMITING VALUE		
V_a max.	150	V
OPERATING CONDITIONS		
V_a	120	V
$I_{a(o)}$	3.0	mA
I_a (max. sig.)	20	mA
V_g	0	V
R_{a-a}	14	kΩ
$V_{in(g-g)r.m.s.}$	28	V
P_{out}	1.25	W



Brit. 7-pin

DIMENSIONS

Max. Overall Length	112	mm
Max. Diameter	46	mm

REPLACED BY: KLL32—Change base. Redesign output stage (KLL32 is q.p.p. output pentode).

Mullard

PM2BA

CLASS "B" DOUBLE TRIODE (OBSOLETE)

FILAMENT

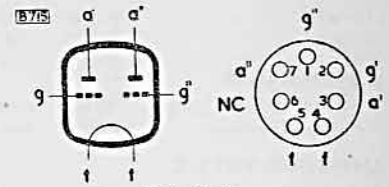
V_f	2.0	V
I_f	200	mA

LIMITING VALUE

V_a max.	150	V

OPERATING CONDITIONS

V_a	120	V
V_g	–4.5	V
$I_{a(o)}$	3.0	mA
I_a (max. sig.)	20	mA
R_{a-a}	14	kΩ
$V_{in(g-g)r.m.s.}$	28	V
P_{out}	1.45	W
D_{tot}	5.0	%



Brit. 7-pin

DIMENSIONS

Max. Overall Length	112	mm
Max. Diameter	46	mm

REPLACED BY: KLL32—Change base. Redesign output stage (KLL32 is q.p.p. output pentode).

PM2DL

CLASS "B" DRIVER (OBSOLETE)

FILAMENT

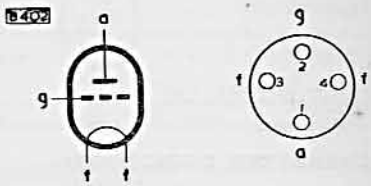
V_f	2.0	V
I_f	100	mA

LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	120	V
V_g	–4.5	V
I_a	1.5	mA
g_m	1.5	mA/V
μ	18	
r_a	12	kΩ



Brit. 4-pin

DIMENSIONS

Max. Overall Length	112	mm
Max. Diameter	46	mm

REPLACED BY: PM2HL—Direct.

Mullard

PM2DX

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

FILAMENT

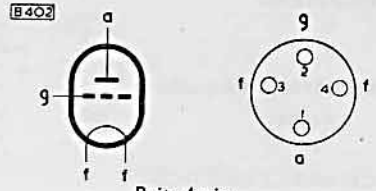
V_f	2.0	V
I_f	100	mA

LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	135	V
V_g	–4.5	V
I_a	2.0	mA
g_m	1.0	mA/V
μ	18	
r_a	18	kΩ



Brit. 4-pin

DIMENSIONS

Max. Overall Length	98	mm
Max. Diameter	42	mm

REPLACED BY: PM2HL—Direct.

PM2HL

MEDIUM IMPEDANCE TRIODE

FILAMENT

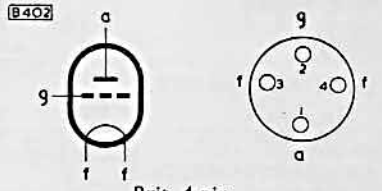
V_f	2.0	V
I_f	100	mA

LIMITING VALUES

V_a max.	150	V
p_a max.	750	mW
I_k max.	5.0	mA

CHARACTERISTICS

V_a	90	135	V
V_g	–1.5	–1.5	V
I_a	0.5	2.2	mA
g_m	0.8	1.4	mA/V
μ	30	30	
r_a	37.5	21.5	kΩ



Brit. 4-pin

The metallised version has the metallising connected to pin 3.

DIMENSIONS

Max. Overall Length	102	mm
Max. Diameter	36	mm

REPLACEMENT FOR:

B228, H2, H210, HL2, HL2K, HL210, HR210, K30A, K30C, K30D, K30K, L2 (Ediswan-Mazda) L2/B, L21, L210, LL2, PM1A, PM1HF, PM1HL, PM2DL, PM2DX, SD2, 210HF, 210HL—Direct.

K30B, PM1LF—Change grid bias to –1.5V.

HL22, HL23, LL2s—Change base.

HLB1, LD210, 210LF—Bias may require adjustment.

Mullard

PM12

R.F. TETRODE (OBSOLETE)

FILAMENT

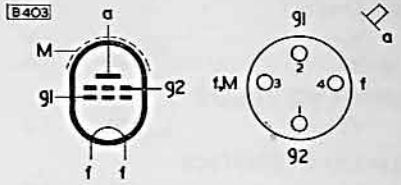
V_f	2.0	V
I_f	150	mA

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	80	V

CHARACTERISTICS

V_a	150	V
V_{g2}	75	V
V_{g1}	0	V
I_a	4.3	mA
g_m	1.1	mA/V
r_a	180	kΩ



Brit. 4-pin

DIMENSIONS

Max. Overall Length	125	mm
Max. Diameter	45	mm

REPLACED BY: PM12M—Raise screen-grid voltage to 90V.

PM12A

R.F. TETRODE (OBSOLETE)

FILAMENT

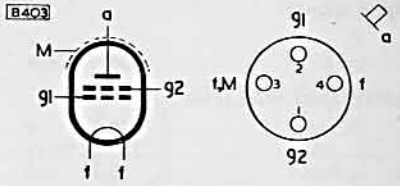
V_f	2.0	V
I_f	180	mA

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	90	V

CHARACTERISTICS

V_a	125	V
V_{g2}	75	V
V_{g1}	0	V
I_a	2.0	mA
g_m	1.5	mA/V
r_a	330	kΩ



Brit. 4-pin

DIMENSIONS

Max. Overall Length	125	mm
Max. Diameter	45	mm

REPLACED BY: PM12M—Raise screen-grid voltage to 90V.

Mullard

R.F. TETRODE

PM12M

FILAMENT

V_f	2.0	V
I_f	180	mA

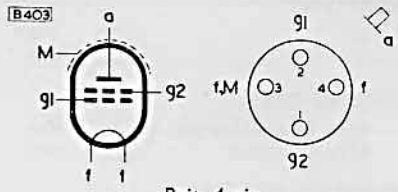
LIMITING VALUES

V_a max.	150	V
V_{g2} max.	90	V

CHARACTERISTICS

V_a	150	V
V_{g2}	90	V
V_{g1}	0	V
I_a	2.5	mA
I_{g2}	500	μA
g_m	1.4	mA/V
*V_{g1}	−7.0	V

*For 100 : 1 reduction in g_m.



Brit. 4-pin

DIMENSIONS

Max. Overall Length	133	mm
Max. Diameter	46	mm

REPLACEMENT FOR:

K40N, S213, S215VM, SE211C, SG215, SG215A, VS2, VS24, VS24K, VS210, VS215, 215SG, 220VS, 220VSG—Direct.

K40B, PM12, PM12A, S21, S22, S23, S24, S215, S215A, S215B, SS210, 220SG—Raise screen-grid voltage to 90V.

OUTPUT PENTODE (OBSOLETE)

PM22

FILAMENT

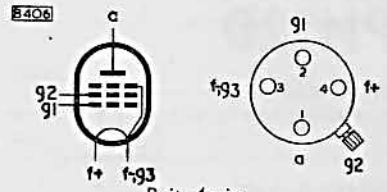
V_f	2.0	V
I_f	300	mA

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	150	V

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	0	V
I_a	16.5	mA
g_m	1.3	mA/V
μ	82	
r_a	62.5	kΩ



Brit. 4-pin

Base connections for 5-pin version as for PM22D.

DIMENSIONS

Max. Overall Length	107	mm
Max. Diameter	46	mm

OPERATING CONDITIONS

V_a	100	125	V
V_{g2}	100	125	V
V_{g1}	−6.5	−9.0	V
I_a	8.0	10	mA

REPLACED BY: PM22A—Reduce bias voltage to −4.5V at anode and screen-grid voltages of 135V. Load resistance=19kΩ.

Mullard

PM22A

OUTPUT PENTODE

FILAMENT

V_f	2.0	V
I_f	150	mA

DIMENSIONS

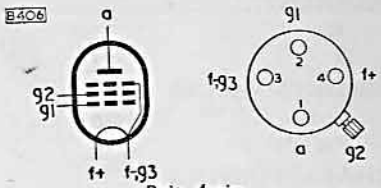
Max. Overall Length	117	mm
Max. Diameter	41	mm

LIMITING VALUES

V_a max.	150	V
V_{g_2} max.	150	V
p_a max.	1.0	W
I_k max.	10	mA

CHARACTERISTICS

V_a	135	V
V_{g_2}	135	V
V_{g_1}	–4.5	V
I_a	5.6	mA
g_m	2.2	mA/V
r_a	150	kΩ



Brit. 4-pin

Base connections for 5-pin version as PM22D below.

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	135	V
V_{g_2}	135	V
V_{g_1}	–4.5	V
I_a	5.6	mA
R_a	19	kΩ
$V_{in\ (r.m.s.)}$	3.0	V
P_{out}	340	mW
D_{tot}	10	%

REPLACEMENT FOR:
K70B, KT2, KT24, P225 (5-pin), PEN220, PENB1, PP2, PT2, 220HPT, 220OT—Direct.
KL4, PP2s—Change base.
PEN230, PM22, PT240, 220PT, 230PT—Adjust bias to –4.5V at anode and screen voltages of 135V. Load resistance=19kΩ.
Y220—Bias may require adjustment.

PM22D

OUTPUT PENTODE

FILAMENT

V_f	2.0	V
I_f	300	mA

DIMENSIONS

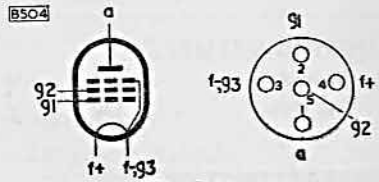
Max. Overall Length	120	mm
Max. Diameter	47	mm

LIMITING VALUES

V_a max.	150	V
V_{g_2} max.	150	V

CHARACTERISTICS

V_a	135	V
V_{g_2}	135	V
V_{g_1}	–2.4	V
I_a	5.0	mA
I_{g_2}	800	μA
g_m	3.0	mA/V



Brit. 5-pin

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	135	V
V_{g_2}	135	V
V_{g_1}	–2.4	V
I_a	5.0	mA
I_{g_2}	800	μA
R_a	24	kΩ
$V_{in\ (r.m.s.)}$	1.75	V
P_{out}	300	mW
D_{tot}	10	%

REPLACEMENT FOR: K70D, PEN231—Direct.

Mullard

PM24

OUTPUT PENTODE (OBSOLETE)

FILAMENT

V_f	4.0	V
I_f	150	mA

DIMENSIONS

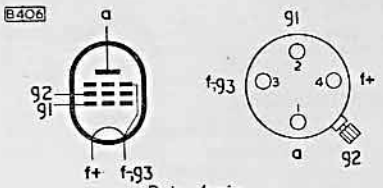
Max. Overall Length	107	mm
Max. Diameter	46	mm

LIMITING VALUES

V_a max.	150	V
p_a max.	3.0	W
V_{g_2} max.	150	V

CHARACTERISTICS

V_a	100	V
V_{g_2}	100	V
V_{g_1}	0	V
I_a	24	mA
g_m	1.75	mA/V



Brit. 4-pin

Base connections for 5-pin version as PM24A below.

OPERATING CONDITIONS

V_a	150	V
V_{g_2}	150	V
V_{g_1}	–11	V
I_a	20	mA
R_a	8.0	kΩ

REPLACED BY: PM24A—Change base if necessary.

PM24A

OUTPUT PENTODE

FILAMENT

V_f	4.0	V
I_f	275	mA

DIMENSIONS

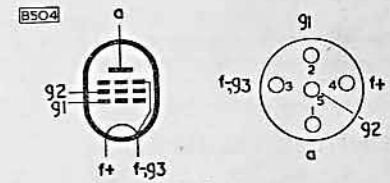
Max. Overall Length	107	mm
Max. Diameter	51	mm

LIMITING VALUES

V_a max.	300	V
V_{g_2} max.	200	V

CHARACTERISTICS

V_a	100	V
V_{g_2}	100	V
V_{g_1}	0	V
I_a	22	mA
g_m	2.0	mA/V



Brit. 5-pin

OPERATING CONDITIONS

V_a	300	V
V_{g_2}	200	V
V_{g_1}	–22.5	V
I_a	20	mA
I_{g_2}	3.5	mA
R_a	10	kΩ

REPLACEMENT FOR: PM24 (see above).

Mullard

PM24B

OUTPUT PENTODE (OBSOLETE)

FILAMENT

V_f	4.0	V
I_f	1.0	A

DIMENSIONS

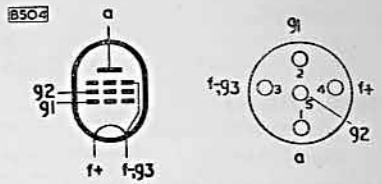
Max. Overall Length	126	mm
Max. Diameter	56	mm

LIMITING VALUES

V_a max.	400	V
V_{g2} max.	300	V
p_a max.	12	W

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	0	V
g_m	2.1	mA/V



Brit. 5-pin

OPERATING CONDITIONS

V_a	300	V
V_{g2}	300	V
I_a	40	mA
I_{g2}	7.0	mA
V_{g1}	–35	V
R_a	8.0	kΩ

REPLACED BY: PM24M—Redesign circuit. Maximum anode and screen-grid voltage for PM24M is 250V.

PM24C

OUTPUT PENTODE (OBSOLETE)

FILAMENT

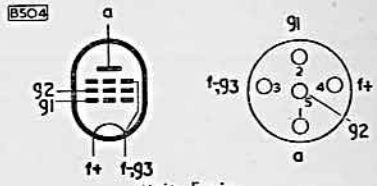
V_f	4.0	V
I_f	1.0	A

LIMITING VALUES

V_a max.	400	V
V_{g2} max.	200	V
p_a max.	12	W

CHARACTERISTICS

V_a	400	V
V_{g2}	200	V
V_{g1}	–20	V
g_m	3.0	mA/V



Brit. 5-pin

DIMENSIONS

Max. Overall Length	140	mm
Max. Diameter	60	mm

OPERATING CONDITIONS

V_a	400	V
V_{g2}	200	V
V_{g1}	–28	V
I_a	30	mA
I_{g2}	4.5	mA
R_a	12	kΩ

REPLACED BY: PM24M—Redesign circuit. Maximum anode and screen-grid voltage for PM24M is 250V.

Mullard

PM24M

OUTPUT PENTODE

FILAMENT

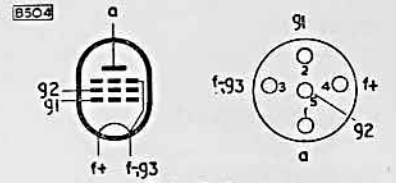
V_f	4.0	V
I_f	1.1	A

LIMITING VALUES

V_a max.	250	V
p_a max.	7.5	W
V_{g2} max.	250	V
p_{g2} max.	2.0	W
I_k max.	50	mA

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
V_{g1}	–17	V
I_a	30	mA
I_{g2}	5.6	mA
g_m	3.0	mA/V
r_a	43	kΩ



Brit. 5-pin

DIMENSIONS

Max. Overall Length	135	mm
Max. Diameter	50	mm

OPERATING CONDITIONS

V_a	250	V
V_{g2}	250	V
I_a	30	mA
I_{g2}	5.6	mA
V_{g1}	–17	V
R_a	7.0	kΩ
$V_{in(r.m.s.)}$	9.0	V
P_{out}	2.8	W

REPLACEMENT FOR:

FY, P435, PENA1, PP4, PT4 (Marconi Osram), PT41—Direct.

PM24B, PM24C—Redesign circuit. Maximum anode and screen-grid voltage of PM24M is 250V.

PP4s—Change base.

PM202

OUTPUT TRIODE

FILAMENT

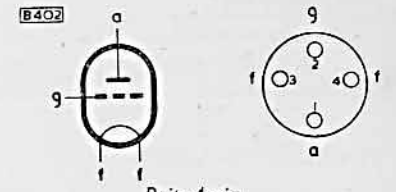
V_f	2.0	V
I_f	200	mA

LIMITING VALUE

V_a max.	150	V
p_a max.	3.0	W

CHARACTERISTICS

V_a	100	V
V_g	0	V
g_m	3.5	mA/V
μ	7.0	
r_a	2.0	kΩ



Brit. 4-pin

DIMENSIONS

Max. Overall Length	112	mm
Max. Diameter	40	mm

REPLACEMENT FOR:

E235, LP2 (Ferranti), P2, P220A, P240, PP220, PX230, SP220, UD2—Direct.

P220 (Tungsram), 230XP—Bias may require adjustment.

Mullard

PM252

OUTPUT TRIODE (OBSOLETE)

FILAMENT

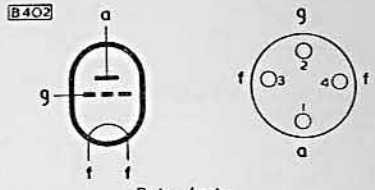
V_f	2.0	V
I_f	400	mA

LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
I_a	32	mA
g_m	3.7	mA/V
μ	7.0	
r_a	1.9	kΩ



Brit. 4-pin

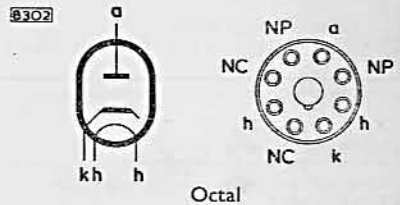
DIMENSIONS

Max. Overall Length	112	mm
Max. Diameter	46	mm

REPLACED BY: KL35—Change base.

PY31

INDIRECTLY HEATED HALF-WAVE RECTIFIER



Octal

HEATER

I_h	300	mA
V_h	17	V

DIMENSIONS

Max. Overall Length	112	mm
Max. Seated Height	98	mm
Max. Diameter	44	mm

LIMITING VALUES

P.I.V. max.	1.0	kV
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	125	mA
C max.	60	μF
V_{h-k} max.	300	V

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ (V)	C (μF)	R_{lim} min. (Ω)
250	60	175
250	32	125
250	16	75
250	8	0
170	60	100
170	32	75
170	16	30
127	60	0

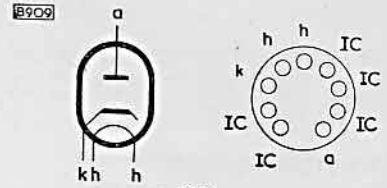
REPLACEMENT FOR: 12Z3—Change base. Check that heater current is 300mA.

Mullard

PY80

BOOSTER DIODE

Booster diode with high peak inverse voltage primarily intended for use in energy recovery circuits in television receivers with series connected heaters.



B9A

HEATER

I_h	300	mA
V_h	19	V

LIMITING VALUES

*P.I.V. max.	4.0	kV
†$i_{a(pk)}$ max.	400	mA
$I_{a(av)}$ max.	180	mA
‡$v_{h-k(pk)}$ max.	650	V

* Max. pulse duration 18% of one cycle, with a maximum of 18 μsec.
† Including switching surges.
‡ Max. 160V a.c. r.m.s. or d.c. (heater positive with respect to cathode) + Max. 500V d.c. (heater negative with respect to cathode).

DIMENSIONS

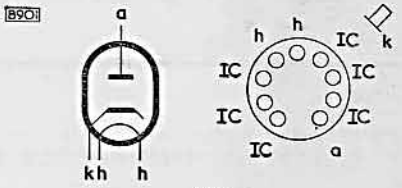
Max. Overall Length	78.5	mm
Max. Seated Height	71.5	mm
Max. Diameter	22.2	mm

REPLACEMENT FOR: U152, 19X3—Direct.

PY81

BOOSTER DIODE

Booster diode with high peak inverse voltage and high heater-to-cathode insulation, intended for use in energy recovery circuits in television receivers with series connected heaters.



B9A

HEATER

I_h	300	mA
V_h	17	V

LIMITING VALUES

*P.I.V. max.	4.5	kV
$i_{a(pk)}$ max.	450	mA
$I_{a(av)}$ max.	150	mA
C max.	4.0	μF
*†$v_{h-k\ (pk)}$ max. (heater negative)	4.5	kV
*$v_{a-h\ (pk)}$ max. (heater positive)	3.0	kV

* Max. pulse duration 18% of one cycle with a maximum of 18 μsecs.

† The voltage between heater and cathode during the forward stroke of the scan must not exceed a peak value of 800V. This voltage may be made up of an a.c. mains voltage of not more than $220V_{r.m.s.}$ and a d.c. component of not more than 600V.

DIMENSIONS

Max. Overall Length	83	mm
Max. Seated Height	76	mm
Max. Diameter	22.2	mm

REPLACEMENT FOR: U153, 17Z3—Direct.

Mullard

PY82 INDIRECTLY HEATED HALF-WAVE RECTIFIER

HEATER

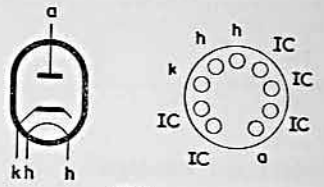
I_h	300	mA
V_h	19	V

LIMITING VALUES

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	180	mA
*$v_{h-k(pk)}$ max.	550	V
†C max.	60	μF

$V_{a(r.m.s.)}$ (V)	R_{11m} min. (C=60μF) (Ω)
250	100
240	80
230	60
220	40
210	30
200	30

B9D9



B9A

DIMENSIONS

Max. Overall Length	78.5	mm
Max. Seated Height	71.5	mm
Max. Diameter	22.2	mm

Notes

*Max. 220V a.c. $_{r.m.s.}$ +Max. 250V d.c. (heater negative with respect to cathode).

†This limit allows for normal capacitor tolerances up to +80%. When two PY82 are connected in parallel, C max.=100μF. In this case each anode must have the minimum sputter resistance (R_{11m}) specified.

REPLACEMENT FOR: U154, U319, 19Y3—Direct.

PZ30 INDIRECTLY HEATED MULTIPLE RECTIFIER

Indirectly heated rectifier with two separate half-wave sections, primarily intended for use as half-wave or voltage-doubling rectifier in d.c./a.c. television equipment.

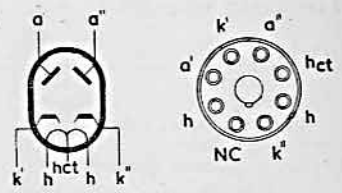
HEATER

I_h	300	mA
V_h	52	V

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	240	V
I_a max. (per anode)	200	mA
$v_{h-k\ (pk)}$ max.	650	V
C max.	50	μF

B3C9



Octal

DIMENSIONS

Max. Overall Length	125	mm
Max. Seated Height	111	mm
Max. Diameter	46	mm

Mullard

INDIRECTLY HEATED MULTIPLE RECTIFIER

PZ30 (Cont.)

OPERATING CONDITIONS

In Half-wave Circuit			
$V_{a(r.m.s.)}$	240	240	V
C	50	32	μF
R_{11m} min. (each anode)	50	30	Ω

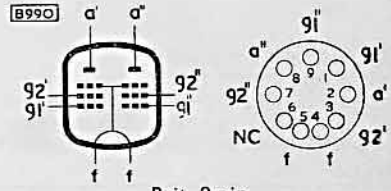
In Voltage Doubler Circuit			
$V_{a(r.m.s.)}$	220	240	V
I_{out}	200	200	mA
V_{out}	425	480	V
R_{11m} min. (each anode)	30	30	Ω
C	2×32	2×32	μF

REPLACEMENT FOR:

R14—Direct.
35RE—Change base. Heater voltage differs.

QP22A DOUBLE OUTPUT PENTODE (OBSOLETE)

B9O0



Brit. 9-pin

FILAMENT

V_f	2.0	V
I_f	450	mA

DIMENSIONS

Max. Overall Length	115	mm
Max. Diameter	41	mm

LIMITING VALUES

V_a max.	150	V
V_{g_2} max.	150	V

OPERATING CONDITIONS

V_a	135	V
V_{g_2}	As graded*	
V_{g1}	–10.5	V
$I_{a(o)}$	2.5 to 3.0	mA
R_{a-a}	16	kΩ
g_m	4.0	mA/V
$V_{in(g1-g1)\ r.m.s.}$	28	V
P_{out}	1.4	W
D_{tot}	5.0	%

*To ensure that both pentode sections are accurately matched these valves are graded into five grades, P, Q, R, S & T. To identify the two sections, the letters A and B are printed on the base in line with pins 2 and 7 respectively. Immediately above these letters appear the grading letters.

Matching is effected by operating the pentodes at screen grid voltages in accordance with the following table:

Grade	V_{g_2}	
P	103.5	V
Q	111	V
R	118.5	V
S	126	V
T	133.5	V

REPLACED BY: QP22B—Change base. Use common screen grid supply.

Mullard

QP22B

DOUBLE OUTPUT PENTODE

FILAMENT

V_f	2.0	V
I_f	300	mA

DIMENSIONS

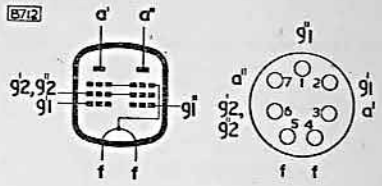
Max. Overall Length	117	mm
Max. Diameter	41	mm

LIMITING VALUES

V_a max.	135	V
V_{g2} max.	135	V

CHARACTERISTICS

V_a	100	V
V_{g2}	100	V
V_{g1}	0	V
g_m	3.1	mA/V



Brit. 7-pin

OPERATING CONDITIONS

V_a	120	135	V
V_{g2}	120	135	V
V_{g1}	–10.7	–11.7	V
$I_{a(o)}$	3.3	3.8	mA
I_{g2}	450	500	μA
$V_{in(g1-g1)}$ r.m.s.	22	24	V
R_{a-a}	15.5	14.7	kΩ
P_{out}	1.0	1.33	W

REPLACEMENT FOR:
K77B, QP230, 240QP—Direct.
QP21, QP240 (Hivac), QPT2—Bias may require adjustment.
QP25—Change base. Bias may require adjustment.
QP22A, QP240 (Ediswan/Mazda)—Change base. Use common screen supply.

RL7

V.H.F. PENTODE

This valve has been recoded EF54, and data will be found under this type number.

RL16

U.H.F. OSCILLATOR TRIODE

This type has been recoded EC52, and data will be found under this type number.

RL18

U.H.F. OSCILLATOR TRIODE

This valve has been recoded EC53, and data will be found under this type number.

RL37

GROUNDED-GRID TRIODE

This valve has been recoded EC54, and data will be found under this type number.

Mullard

R.F. TETRODE (OBSOLETE)

S4V

HEATER

V_h	4.0	V
I_h	1.0	A

DIMENSIONS

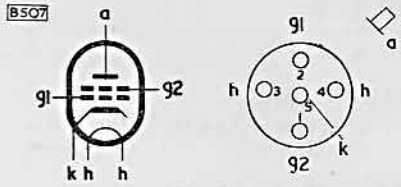
Max. Overall Length	130	mm
Max. Diameter	45	mm

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	80	V

CHARACTERISTICS

V_a	100	V
V_{g2}	75	V
V_{g1}	0	V
g_m	1.1	mA/V
r_a	909	kΩ



Brit. 5-pin

OPERATING CONDITIONS

V_a	200	V
V_{g2}	75	V
V_{g1}	–1.0	V
I_a	1.5	mA

REPLACED BY: SP4—Direct.

R.F. TETRODE (OBSOLETE)

S4VA

HEATER

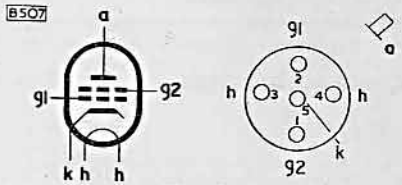
V_h	4.0	V
I_h	1.0	A

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	110	V

CHARACTERISTICS

V_a	200	200	V
V_{g2}	110	110	V
V_{g1}	0	–1.5	V
I_a	6.5	2.5	mA
g_m	3.0	2.0	mA/V



Brit. 5-pin

DIMENSIONS

Max. Overall Length	145	mm
Max. Diameter	48	mm

REPLACED BY: SP4 (5-pin)—Direct.

Mullard

S4VB

R.F. TETRODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.0	A

DIMENSIONS

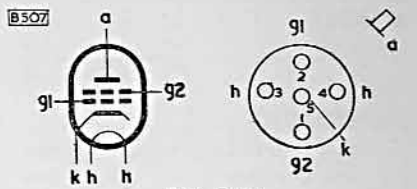
Max. Overall Length	146	mm
Max. Diameter	48.5	mm

CAPACITANCES

c_{in}	12.4	pF
c_{out}	7.3	pF
c_{a-g1}	0.003	pF

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	110	V
I_k max.	10	mA
V_{h-k} max.	50	V



Brit. 5-pin

CHARACTERISTICS

V_a	200	V
V_{g2}	110	V
V_{g1}	−1.5	V
R_k	250	Ω
I_a	4.6	mA
I_{g2}	1.05	mA
g_m	2.5	mA/V
r_a	300	kΩ

REPLACED BY: SP4 (5-pin)—Direct.

SD4

SINGLE DIODE TETRODE (OBSOLETE)

HEATER

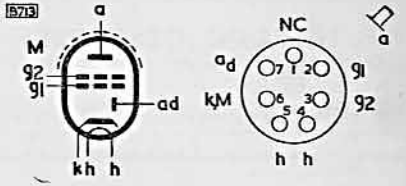
V_h	4.0	V
I_h	1.0	A

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V

CHARACTERISTICS

V_a	200	V
V_{g2}	100	V
V_{g1}	0	V
g_m	3.0	mA/V



Brit. 7-pin

REPLACED BY: TDD4.

Change connections as below:—

Connections for SD4 Pin No.		*Connections for TDD4*
1	... ...	Not used
2	Disconnect and take lead to	Top Cap
3	Disconnect and insulate end of lead	—
4	As at present	4
5	As at present	5
6	As at present and join to Pin 1	1 & 6
7	Disconnect and take lead to	3
Top Cap	Disconnect and take lead to	7

In some cases the lead to the top cap may have to be screened.

SP2

R.F. PENTODE

FILAMENT

V_f	2.0	V
I_f	180	mA

DIMENSIONS

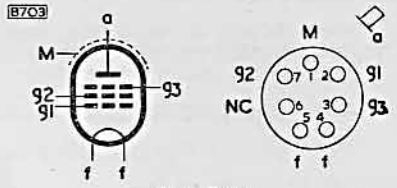
Max. Overall Length	135	mm
Max. Diameter	46	mm

CAPACITANCES

c_{in}	11.0	pF
c_{out}	6.0	pF
c_{a-g1}	<0.01	pF

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	150	V
p_a max.	800	mW
p_{g2} max.	300	mW
I_k max.	7.0	mA



Brit. 7-pin

CHARACTERISTICS

V_a	135	V
V_{g2}	135	V
V_{g1}	0	V
I_a	3.0	mA
I_{g2}	1.0	mA
g_m	1.8	mA/V
r_a	700	kΩ

REPLACEMENT FOR:

HP210nc (7-pin), S218, SP210, Z22—Direct.
HP210nc (4-pin), SP22, SPT2, Z21 (4-pin)—Change base.
HP215 (Hivac), 210SPT—Raise screen-grid voltage to anode voltage.
SP215—Bias may require adjustment.
Z21 (7-pin)—Earth pin 3.

SP4

R.F. PENTODE

HEATER

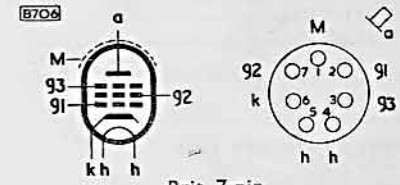
V_h	4.0	V
I_h	1.0	A

DIMENSIONS

Max. Overall Length	140	mm
Max. Diameter	51	mm

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V
p_a max.	1.0	W
p_{g2} max.	300	mW
I_k max.	10	mA
V_{h-k} max.	50	V



Brit. 7-pin

Base connections for 5-pin version as VP4

OPERATING CONDITIONS

V_a	200	V
V_{g2}	100	V
I_a	3.0	mA
V_{g1}	−2.0	V
g_m	2.3	mA/V
r_a	2.2	MΩ

SP4 (Cont.)

R.F. PENTODE

REPLACEMENT FOR:

A50A, AC/HP, AC/SL, AC/S2, AS4120, E446, HP4101C, MS4B, MS4C, MSG/HA, MSG/LA, MSP4, MS/PEN, MS/PENA, S4V, S4VA, S4VB (5-pin), S435N, SPT4A (7-pin), 8A1, 41MSG—Direct.

AC/SH (5-pin), AC/S2PEN (7-pin)—Bias may require adjustment.

AC/SG—Raise screen-grid voltage to 100V for r.f. amplifier.

AF7, SP4s—Change base.

SP4 (Tungsram)—Rewire base.

SP4B

R.F. PENTODE

HEATER

V_h	4.0	V
I_h	650	mA

DIMENSIONS

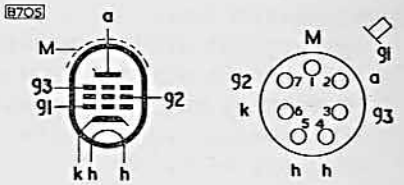
Max. Overall Length	125	mm
Max. Diameter	43	mm

CAPACITANCES

c_{in}	6.9	pF
c_{out}	8.1	pF
c_{a-g1}	<0.003	pF

LIMITING VALUES

V_a max.	250	V
V_{g2} max.	250	V
p_a max.	1.5	W
p_{g2} max.	500	mW
I_k max.	8.0	mA
V_{h-k} max.	50	V



Brit. 7-pin

CHARACTERISTICS

V_a	250	V
V_{g2}	250	V
V_{g1}	−2.4	V
I_a	4.0	mA
I_{g2}	1.5	mA
g_m	3.4	mA/V
r_a	2.0	MΩ

REPLACEMENT FOR:

A50B—Direct.

MS/PENB—Raise screen-grid voltage to anode voltage.

SP4C—Change base.

Mullard

R.F. PENTODE (OBSOLETE)

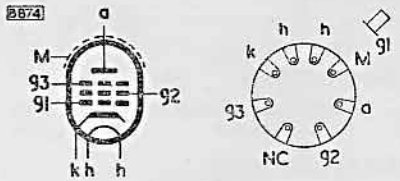
SP4C

HEATER

V_h	4.0	V
I_h	650	mA

DIMENSIONS

Max. Overall Length	105	mm
Max. Diameter	43	mm



Side Contact

No metallising on pin 1

For further data see Type SP4B. Except for basing and dimensions, the SP4B and SP4C are identical.

REPLACED BY: SP4B—Change base.

R.F. PENTODE

SP13

HEATER

I_h	200	mA
V_h	13	V

DIMENSIONS

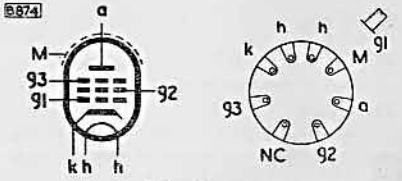
Max. Overall Length	109	mm
Max. Diameter	42	mm

CAPACITANCES

c_{in}	7.1	pF
c_{out}	7.7	pF
c_{a-g1}	<0.003	pF

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V
p_a max.	1.0	W
I_k max.	6.0	mA
V_{h-k} max.	125	V



Side Contact

CHARACTERISTICS

V_a	200	V
V_{g2}	100	V
I_a	3.3	mA
I_{g2}	1.2	mA
V_{g1}	−2.0	V
R_k	400	Ω
r_a	1.3	MΩ
g_m	2.2	mA/V

REPLACEMENT FOR:

CF1, CF7, S1328, SP13s—Direct.

SP13 (Tungsram)—Change base.

Mullard

SP13C

R.F. PENTODE

HEATER

I_h	200	mA
V_h	13	V

DIMENSIONS

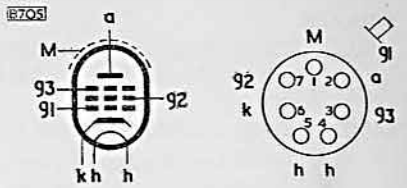
Max. Overall Length	125	mm
Max. Diameter	43	mm

CAPACITANCES

c_{in}	6.9	pF
c_{out}	8.1	pF
c_{a-g1}	<0.003	pF

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	200	V
p_a max.	1.0	W
p_{g2} max.	300	mW
I_k max.	6.0	mA
V_{h-k} max.	125	V



Brit. 7-pin

CHARACTERISTICS

V_a	200	V
V_{g2}	200	V
V_{g1}	−2.2	V
I_a	2.5	mA
I_{g2}	900	μA
g_m	2.8	mA/V
r_a	2.5	MΩ

REPLACEMENT FOR: C50B, SP13B, SP1320—Direct.

S1324, 8D2, 13SPA—Raise screen-grid voltage to anode voltage.

T4D

SINGLE DIODE (OBSOLETE)

HEATER

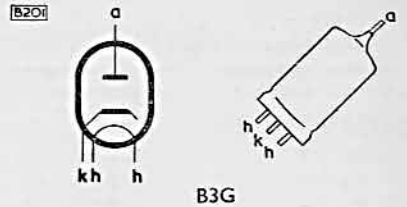
V_h	4.0	V
I_h	200	mA

CAPACITANCE

c_{a-k}	2.1	pF

LIMITING VALUES

V_a max.	50	V
I_a max.	5.0	mA
V_{h-k} max.	50	V



B3G

DIMENSIONS

Max. Overall Length	69	mm
Max. Diameter	12	mm

REPLACED BY: EA50—Raise heater voltage to 6.3V.

T6D

SINGLE DIODE

This valve has been recoded EA50, and data will be found under this type number.

Mullard

DOUBLE DIODE TRIODE (OBSOLETE)

TDD2

FILAMENT

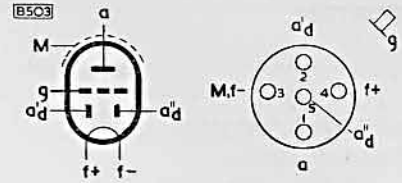
V_f	2.0	V
I_f	100	mA

LIMITING VALUE

V_a max.	150	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
g_m	1.4	mA/V
μ	16.5	
r_a	12	kΩ



Brit. 5-pin

DIMENSIONS

Max. Overall Length	125	mm
Max. Diameter	44	mm

REPLACED BY: TDD2A—Change grid bias to −1.5V. Not suitable as Class "B" driver.

DOUBLE DIODE TRIODE

TDD2A

FILAMENT

V_f	2.0	V
I_f	120	mA

DIMENSIONS

Max. Overall Length	125	mm
Max. Diameter	46	mm

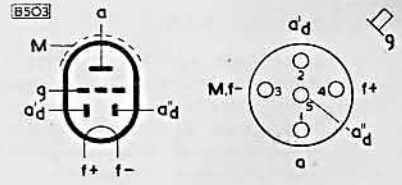
LIMITING VALUES

Triode Section

V_a max.	150	V
p_a max.	600	mW
I_k max.	5.0	mA

Diode Sections (Each Section)

V_{ad} max.	125	V
I_{ad} max.	200	μA



Brit. 5-pin

CHARACTERISTICS

V_a	90	135	V
V_g	−1.5	−1.5	V
I_a	0.65	1.95	mA
g_m	0.7	1.2	mA/V
μ	30	30	
r_a	43	25	kΩ

REPLACEMENT FOR:

DDT2, DDT220, H2D, HD22, HD23, HD24, HL21DD, K23B, L21DD, 210DDT—Direct.

K23A, L2DD, TDD2—Change grid bias to −1.5V. Not suitable as Class "B" driver.

DDT215—Bias may require adjustment.

2D2—See page 242.

Mullard

TDD4

DOUBLE DIODE TRIODE

HEATER

V_h	4.0	V
I_h	650	mA

LIMITING VALUES

Triode Section

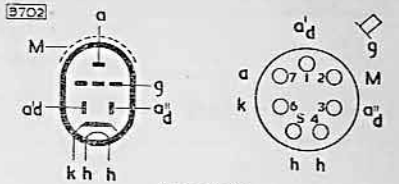
V_a max.	250	V
p_a max.	1.5	W
I_k max.	10	mA
V_{h-k} max.	50	V

Diode Sections (Each Section)

$v_{ad\ (pk)}$ max.	200	V
I_{ad} max.	800	μA

CHARACTERISTICS

V_a	250	V
I_a	4.0	mA
V_g	−7.0	V
g_m	2.0	mA/V
r_a	13.5	kΩ
μ	27	



Brit. 7-pin

DIMENSIONS

Max. Overall Length	128	mm
Max. Diameter	45	mm

OPERATING CONDITIONS

As resistance coupled amplifier

V_b	250	V
R_a	68	kΩ
V_g	−4.0	V
I_a	2.0	mA
R_k	2.0	kΩ
$\frac{V_{out}}{V_{in}}$	25	
$V_{out\ (r.m.s.)}$	50	V
D_{tot}	5.0	%

REPLACEMENT FOR:

A23A, AC/DDT, AC/HL/DD, DDT4, DH42, DT41, DT436—Direct.
ABC1, DDT4s, HL41DD—Change base.
DDT, H4D, MHD4—Bias may require adjustment.
11A2—Earth pin 2. Bias may require adjustment.
154V—Change base. Connect diodes to cathode.
SD4—See page 202.

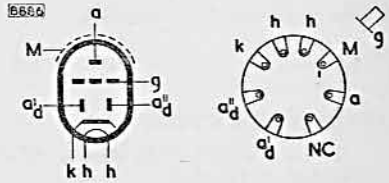
TDD13

DOUBLE DIODE TRIODE (OBSOLETE)

DIMENSIONS

Max. Overall Length	105	mm
Max. Diameter	36	mm

For characteristics and operating data see Type TDD13C. Except for basing and dimensions the TDD13 and TDD13C are identical.



Side Contact

REPLACED BY: EBC33—Change base. EBC33 has 6.3V heater.

Mullard

TDD13C

DOUBLE DIODE TRIODE (OBSOLETE)

HEATER

I_h	200	mA
V_h	13	V

LIMITING VALUES

Triode Section

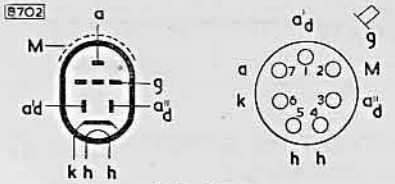
V_a max.	200	V
p_a max.	1.5	W
I_k max.	10	mA
V_{h-k} max.	125	V

Diode Sections (Each Section)

$v_{ad\ (pk)}$ max.	200	V
I_{ad} max.	800	μA

CHARACTERISTICS

V_a	200	V
V_g	−5.0	V
I_a	4.0	mA
g_m	2.0	mA/V
μ	27	
r_a	13.5	kΩ



Brit. 7-pin

DIMENSIONS

Max. Overall Length	128	mm
Max. Diameter	45	mm

OPERATING CONDITIONS

V_b	200	V
R_a	160	kΩ
V_g	−3.6	V
I_a	650	μA
R_k	5.5	kΩ
$\frac{V_{out}}{V_{in}}$	19.5	
$V_{out\ (r.m.s.)}$	37	V
D_{tot}	5.0	%

REPLACED BY: EBC33—Change base. EBC33 has 6.3V heater.

TH2

TRIODE HEXODE (OBSOLETE)

FILAMENT

V_f	2.0	V
I_f	230	mA

DIMENSIONS

Max. Overall Length	134	mm
Max. Diameter	47	mm

CAPACITANCES

c_{at-ap}	0.6	pF
c_{g1-at}	<0.01	pF

Triode Section

c_{a-g}	7.7	pF
c_{in}	21.0	pF
c_{out}	1.4	pF

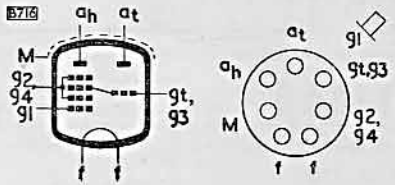
Hexode Section

c_{a-g1}	<0.002	pF
c_{g1-g3}	0.19	pF
c_{in}	8.5	pF
c_{out}	15.0	pF

LIMITING VALUES

Triode Section

V_a max.	100	V
I_a max.	4.0	mA



Brit. 7-pin

OPERATING CONDITIONS

Hexode Section

V_a	135	V
V_{g2+g4}	60	V
V_{osc}	5.0	V
V_{g1}	−1.5	V
I_a	950	μA
I_{g2+g4}	1.6	mA
g_c	430	μA/V
r_a	600	kΩ
R_{g3-f}	47	kΩ

Triode Section

V_a	100	V
I_a	4.0	mA

REPLACED BY: FC2—Redesign Circuit.

Mullard

o

TH4

TRIODE HEXODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.0	A

OPERATING CONDITIONS

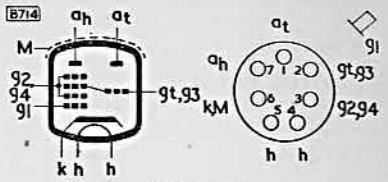
Hexode Section

V_a	250	V
V_{g2+g4}	70	V
V_{g1}	−1.5	V
I_a	4.0	mA
I_{g2+g4}	6.0	mA
†R_k	100	Ω
g_c	1.0	mA/V
r_a	1.5	MΩ
$V_{osc(r.m.s.)}$ (1 Mc/s)	20	V
$V_{osc(r.m.s.)}$ (20 Mc/s)	25	V

†R_k=350Ω for short wave operation.

Triode Section

V_a	130	V
I_a	6.0	mA
g_m	1.2	mA/V



Brit. 7-pin

DIMENSIONS

Max. Overall Length	148	mm
Max. Diameter	50	mm

CAPACITANCES

Hexode Section

c_{in}	7.4	pF
c_{out}	14.3	pF
c_{g1-g3}	0.1	pF

Triode Section

c_{a-k}	2.8	pF
c_{a-g}	1.8	pF

REPLACED BY: TH4B—Change cathode bias resistor to 150Ω. Grid leak to be increased to 47kΩ between grid and cathode.

TH4A

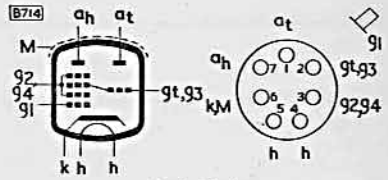
TRIODE HEXODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.5	A

DIMENSIONS

Max. Overall Length	148	mm
Max. Diameter	51	mm



Brit. 7-pin

TRIODE HEXODE (OBSOLETE)

TH4A (Cont.)

CAPACITANCES

c_{at-g1}	0.04	pF
c_{at-ah}	0.8	pF
c_{gt-g1}	0.15	pF

Hexode Section

c_{in}	8.0	pF
c_{out}	13	pF

Triode Section

c_{in}	16.5	pF
c_{out}	3.1	pF
c_{a-g}	3.25	pF

LIMITING VALUES

Hexode Section

V_a max.	300	V
p_a max.	1.0	W
V_{g2+g4} max.	125	V
p_{g2+g4} max.	600	mW
I_k max.	21	mA
V_{h-k} max.	50	V

Triode Section

V_a max.	125	V
p_a max.	1.0	W

REPLACED BY: TH4B—Direct.

OPERATING CONDITIONS

Hexode Section

V_a	275	V
V_{g2+g4}	100	V
V_{g1}	−2.5	V
I_a	3.25	mA
I_{g2+g4}	7.0	mA
g_c	750	μA/V
r_a	1.5	MΩ
I_{g1}	220	μA
R_{g3-k}	47	kΩ
*V_{g1}	−25	V

*For 100 : 1 reduction in g_c.

CHARACTERISTICS

Triode Section

V_a	100	V
I_a	22	mA
g_m	6.0	mA/V
μ	20	

TH4B

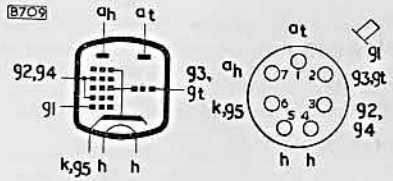
TRIODE HEPTODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.45	A

DIMENSIONS

Max. Overall Length	155	mm
Max. Diameter	37	mm



Brit. 7-pin

CAPACITANCES

Heptode Section

c_{in}	8.4	pF
c_{out}	13.8	pF
c_{g1-g3}	0.16	pF

Triode Section

c_{g-k}	13.6	pF
c_{a-k}	3.5	pF

LIMITING VALUES

Heptode Section

V_a max.	300	V
p_a max.	1.0	W
V_{g2+g4} max.	150	V
p_{g2+g4} max.	600	mW
I_k max.	25	mA
V_{h-k} max.	50	V

Triode Section

V_a max.	125	V
p_a max.	1.0	W

TH4B (Cont.)

TRIODE HEPTODE (OBSOLETE)

OPERATING CONDITIONS

Heptode Section

V_a	250	V
V_{g2+g4}	100	V
V_{g1}	−2.5	V
$V_{osc\ (r.m.s.)}$	8.0	V
I_a	3.25	mA
I_{g2+g4}	6.0	mA
g_c	750	μA/V
r_a	1.5	MΩ
R_k	140	Ω
R_{g3-k}	47	kΩ

CHARACTERISTICS

Triode Section

V_a	100	V
I_a	9.5	mA
g_m	5.5	mA/V
μ	17.5	

REPLACEMENT FOR:

A36B, A36C, AC/TH1, TH4A, TX41, 20A1—Direct.

A36A, TH4, TX4—Change bias resistor to 140Ω. Oscillator grid leak to be increased to 47kΩ between grid and cathode.

AC/TH1A, TH41—Change base. Receiver may need realigning.

41STH—Bias may require adjustment.

4THA—Receiver may need realigning.

TH13C

TRIODE HEXODE (OBSOLETE)

HEATER

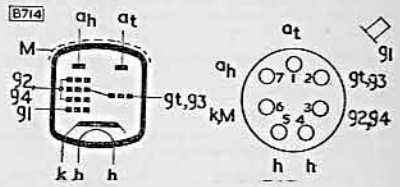
V_h	13	V
I_h	310	mA

DIMENSIONS

Max. Overall Length	148	mm
Max. Diameter	50	mm

LIMITING VALUE

V_{h-k} max.	75	V



Brit. 7-pin

For characteristics, operating data and limiting values see type TH4. Except for heater ratings, the TH13C and TH4 are identical.

REPLACED BY: ECH81—Change base. Connect 22Ω 3W resistor in series with heater. Join pins 7 and 9. May be necessary to realign receiver.

Mullard

TRIODE HEXODE

TH21C

HEATER

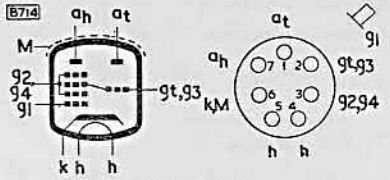
I_h	200	mA
V_h	21	V

DIMENSIONS

Max. Overall Length	148	mm
Max. Diameter	50	mm

LIMITING VALUE

V_{h-k} max.	125	V



Brit. 7-pin

For characteristics, operating conditions and limiting values see type TH4. Except for heater ratings, the TH21C and TH4 are identical.

REPLACEMENT FOR: C36A, TX21, 202STH—Direct.

TRIODE HEXODE (OBSOLETE)

TH22C

HEATER

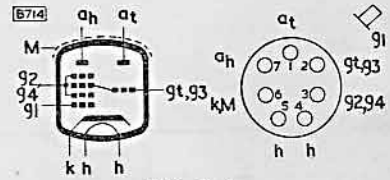
I_h	200	mA
V_h	29	V

DIMENSIONS

Max. Overall Length	148	mm
Max. Diameter	51	mm

LIMITING VALUE

V_{h-k} max.	125	V



Brit. 7-pin

For characteristics, operating conditions and limiting values see type TH4A. Except for heater ratings, the TH22C and TH4A are identical.

REPLACED BY: CCH35—Change base. Feed screen-grid from h.t.+ via potentiometer of 22kΩ and 33kΩ. CCH35 has 7.0V heater.

TRIODE HEPTODE (OBSOLETE)

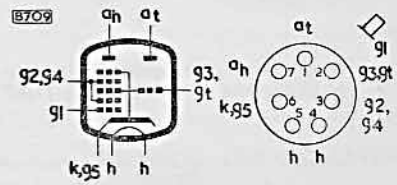
TH30C

HEATER

I_h	200	mA
V_h	29	V

DIMENSIONS

Max. Overall Length	155	mm
Max. Diameter	37	mm



Brit. 7-pin

TH30C (Cont.)

TRIODE HEPTODE (OBSOLETE)

CAPACITANCES

Heptode Section

c_{in}	8.4	pF
c_{out}	13.8	pF
c_{g1-g3}	0.16	pF

Triode Section

c_{g-k}	13.6	pF
c_{a-k}	3.5	pF

LIMITING VALUES

Heptode Section

V_a max.	300	V
p_a max.	1.0	W
V_{g2+g4} max.	150	V
p_{g2+g4} max.	600	mW
I_k max.	25	mA
V_{h-k} max.	100	V

Triode Section

V_a max.	125	V
p_a max.	1.0	W

OPERATING CONDITIONS

Heptode Section

V_a	250	V
V_{g2+g4}	100	V
V_{g1}	–2.5	V
$V_{osc(r.m.s.)}$	8.0	V
I_a	3.25	mA
I_{g2+g4}	6.0	mA
g_c	750	μA/V
r_a	1.5	MΩ
R_k	140	Ω
R_{g3-k}	47	kΩ

Triode Section

V_a	100	V
I_a	9.5	mA
g_m	5.5	mA/V
μ	17.5	

TH62

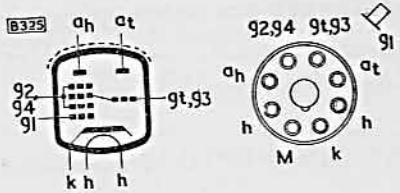
TRIODE HEXODE (OBSOLETE)

HEATER

V_h	6.3	V
I_h	200	mA

DIMENSIONS

Max. Overall Length	108	mm
Max. Diameter	36	mm



Octal

For characteristics, operating conditions and limiting values see type ECH3. Except for basing and dimensions, the TH62 and ECH3 are identical.

REPLACED BY: ECH35 in a.c. receivers.
CCH35 in a.c./d.c. receivers.

TSE4

SECONDARY EMISSION VALVE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.1	A

DIMENSIONS

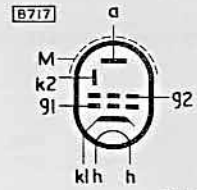
Max. Overall Length	140	mm
Max. Diameter	45	mm

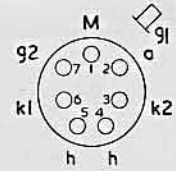
CAPACITANCES

c_{in}	10	pF
c_{out}	9.3	pF
c_{a-g1}	0.004	pF

LIMITING VALUES

V_a max.	250	V
p_a max.	2.0	W
V_{g2} max.	150	V
p_{g2} max.	110	mW
V_{k2} max.	150	V
p_{k2} max.	1.1	W
I_k max.	4.0	mA
V_{h-k1} max.	50	V





Brit. 7-pin

OPERATING CONDITIONS

V_a	250	V
V_{g2}	150	V
V_{k2}	150	V
V_{g1}	–2.5	V
I_a	8.0	mA
I_{g2}	700	μA
I_{k2}	–6.0	mA
g_m	14.5	mA/V
r_a	100	kΩ

TSP4

R.F. PENTODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.3	A

CAPACITANCES

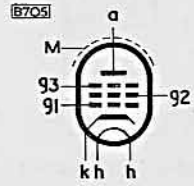
c_{in}	9.6	pF
c_{out}	7.5	pF
c_{a-g1}	<0.01	pF

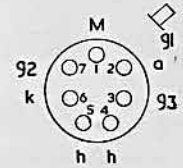
LIMITING VALUES

V_a max.	250	V
V_{g2} max.	250	V
I_k max.	20	mA

OPERATING CONDITIONS
As Video Output Valve

V_a	250	V
V_{g2}	250	V
V_{g1}	–3.0	V
I_a	10.5	mA
I_{g2}	2.0	mA
r_a	750	kΩ
R_k	250	Ω
R_a	10	kΩ
$\frac{V_{out}}{V_{in}}$	54.5	
$V_{out(r.m.s.)}$	30	V
D_2	3.4	%
D_3	0.5	%





Brit. 7-pin

DIMENSIONS

Max. Overall Length	138	mm
Max. Diameter	45.2	mm

OPERATING CONDITIONS
As R.F. or I.F. Amplifier

V_a	200	V
V_{g2}	200	V
V_{g1}	–2.5	V
I_a	8.0	mA
I_{g2}	1.5	mA
g_m	4.73	mA/V
R_k	260	Ω

REPLACED BY: EF80—Change base. Raise heater voltage to 6.3V. Adjust bias.

TT4

LOW IMPEDANCE TRIODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.0	A

DIMENSIONS

Max. Overall Length	128	mm
Max. Diameter	48	mm

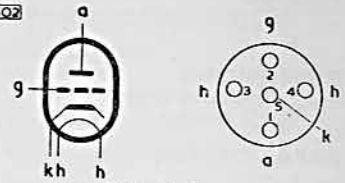
LIMITING VALUES

V_a max.	250	V
p_a max.	5.0	W
I_k max.	30	mA
V_{h-k} max.	50	V

CHARACTERISTICS

V_a	250	V
V_g	−16	V
I_a	20	mA
g_m	3.2	mA/V
μ	10.5	
r_a	3.3	kΩ

B5O2



Brit. 5-pin

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	V
V_g	−16	V
I_a	20	mA
R_k	800	Ω
R_a	10	kΩ
$V_{inr.m.s.}$	9.1	V
P_{out}	500	mW
D_2	5.0	%

OPERATING CONDITIONS AS RESISTANCE COUPLED AMPLIFIER

V_b	550	450	350	250	V
R_a	150	120	100	86	kΩ
I_a	2.5	2.3	2.0	1.6	mA
R_k	9.0	9.0	9.0	9.0	kΩ
$\frac{V_{out}}{V_{in}}$	7.4	7.0	6.5	7.2	
$V_{out(r.m.s.)}$	96	80	58	42	V
D_2	5.0	5.0	5.0	5.0	%

REPLACED BY: EC31—Change base. Raise heater voltage to 6.3V.

TT4A

LOW IMPEDANCE TRIODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.0	A

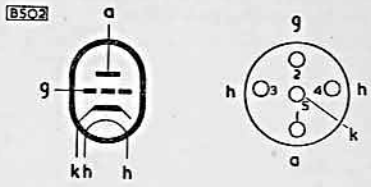
DIMENSIONS

Max. Overall Length	125	mm
Max. Diameter	47	mm

LIMITING VALUES

V_a max.	250	V
p_a max.	5.0	W
I_k max.	30	mA
V_{h-k} max.	50	V

B5O2



Brit. 5-pin

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LOW IMPEDANCE TRIODE (OBSOLETE) TT4A (Cont.)

CHARACTERISTICS

V_a	250	V
V_g	−9.0	V
I_a	20	mA
g_m	4.1	mA/V
μ	18	
r_a	4.4	kΩ

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	V
I_a	20	mA
V_g	−9.0	V
R_a	5.0	kΩ
R_k	450	Ω
$V_{in(r.m.s.)}$	5.0	V
P_{out}	400	mW
D_2	5.0	%

REPLACED BY: EC31—Change base. Raise heater voltage to 6.3V. Change bias resistor and load.

TV4

TUNING INDICATOR (OBSOLETE)

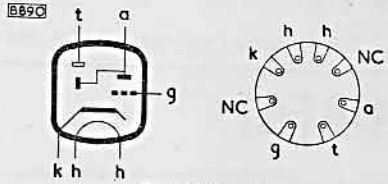
HEATER

V_h	4.0	V
I_h	300	mA

DIMENSIONS

Max. Overall Length	76	mm
Max. Diameter	28	mm

B8O



Side Contact

LIMITING VALUES

V_a max.	250	V
V_t max.	250	V
V_{h-k} max.	50	V

OPERATING CONDITIONS

V_b	250	250	V
R_a	2.0	2.0	MΩ
V_g	0	−5.0	V
ø	10	90	°
I_a	95	—	μA
I_t	130	—	μA

REPLACED BY: EM34—Change base. Raise heater voltage to 6.3V. Change anode load to 1MΩ, and supply h.t. to pin 6 through a 1MΩ resistor.

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TV4A

TUNING INDICATOR (OBSOLETE)

HEATER

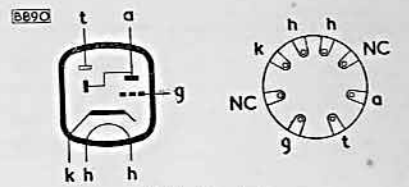
V_h	4.0	V
I_h	300	mA

DIMENSIONS

Max. Overall Length	76	mm
Max. Diameter	28	mm

LIMITING VALUES

V_a max.	250	V
V_t max.	250	V
V_{h-k} max.	50	V



Side Contact

OPERATING CONDITIONS

V_b		200		250	V
R_a		1.0		1.0	MΩ
V_g	0	−18	0	−21	V
I_a	175	—	220	—	μA
I_t	250	—	300	—	μA
ø	10	90	10	90	°

REPLACED BY: EM34—Change base. Raise heater voltage to 6.3V. Supply h.t. to pin 6 through a 1MΩ resistor.

TV6

TUNING INDICATOR (OBSOLETE)

This valve has been recoded EM1, and data will be found under this type number.

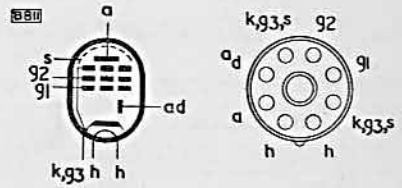
UAF41

SINGLE DIODE R.F. PENTODE (OBSOLETE)

HEATER

I_h	100	mA
V_h	12.6	V

Except for base connections, the UAF41 is identical to the UAF42.



B8A

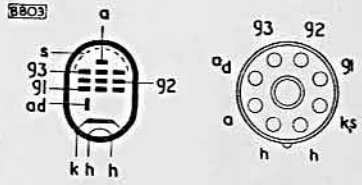
REPLACED BY: UAF42—Connect pins 4 and 7 together.

UAF42

SINGLE DIODE R.F. PENTODE

HEATER

I_h	100	mA
V_h	12.6	V



B8A

SINGLE DIODE R.F. PENTODE

UAF42 (Cont.)

CAPACITANCES

c_{ad-g1}	<0.0015	pF
c_{ad-ap}	<0.15	pF
Pentode Section		
c_{a-g1}	<0.002	pF
c_{out}	5.1	pF
c_{in}	4.5	pF
c_{g1-h}	<0.05	pF
Diode Section		
c_{ad-k}	3.8	pF
c_{ad-h}	<0.02	pF

LIMITING VALUES

Pentode Section

V_a max.	250	V
p_a max.	2.0	W
V_{g2} max. (I_a<2.5mA)	250	V
V_{g2} max. (I_a=5.0mA)	125	V
p_{g2} max.	300	mW
I_k max.	10	mA
V_{h-k} max.	150	V

Diode Section

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	800	μA

REPLACEMENT FOR:
WD142—Direct.
UAF41—Connect pins 4 and 7 together.

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

OPERATING CONDITIONS

$V_a=V_b$	100	170	200	V
R_{g2}	56	56	76	kΩ
V_{g2}	50	85	85	V
R_k	310	310	310	Ω
V_{g1}	−1.2	−2.0	−2.0	V
I_a	2.8	5.0	5.0	mA
I_{g2}	0.9	1.5	1.5	mA
g_m	1.7	2.0	2.0	mA/V
r_a	0.85	0.9	1.0	MΩ
μ_{g1-g2}	18	18	18	
*V_{g1}	−16	−28	−34	V
R_{eq}	5.8	7.5	7.5	kΩ

*For 100 : 1 reduction in g_m.

DOUBLE DIODE (Separate Cathodes)

UB41

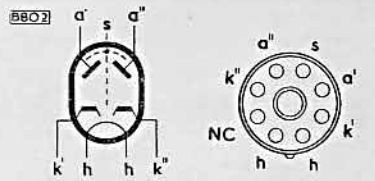
HEATER

I_h	100	mA
V_h	19	V

CAPACITANCES

$c_{a'-a''}$	<0.03	pF
$c_{k'-k''}$	<0.01	pF
$c_{a'-k''}$	<0.01	pF
$c_{a''-k''}$	<0.01	pF
$c_{a'-k'+h+s}$	4.0	pF
$c_{a''-k''+h+s}$	3.5	pF
*$c_{k'-all}$	4.5	pF
*$c_{a'-all}$	4.0	pF

*External skirt connected to all.



B8A

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

LIMITING VALUES (each section)

$V_{a(r.m.s.)}$ max.	150	V
I_a max.	9.0	mA
$i_{a(pk)}$ max.	54	mA
V_{h-k} max.	300	V

UBC41

DOUBLE DIODE TRIODE

HEATER

I_h	100	mA
V_h	14	V

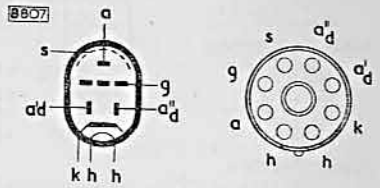
LIMITING VALUES

Triode Section

V_a max.	250	V
p_a max.	1.0	W
I_k max.	5.0	mA
V_{h-k} max.	150	V

Diode Sections

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	800	μA



B8A

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

CHARACTERISTICS

V_a	100	170	V
V_g	–1.0	–1.6	V
I_a	0.8	1.5	mA
g_m	1.4	1.65	mA/V
μ	70	70	
r_a	50	42	kΩ

OPERATING CONDITIONS AS RESISTANCE COUPLED AMPLIFIER

(With cathode bias)

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) (D_{tot}=5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=10%)	R_{g1}† (kΩ)
350	100	1.18	2.2	43	30.5	54	330
300	100	1.0	2.2	42.5	25.5	46	330
250	100	0.85	2.2	42	21	38	330
200	100	0.7	2.2	41	16	28.5	330
150	100	0.5	2.2	40	12	19.5	330
100	100	0.28	3.3	33.5	6.0	10.5	330
350	220	0.67	3.9	47.5	34.5	64	680
300	220	0.56	3.9	47	27	54	680
250	220	0.48	3.9	46.5	24.5	44.5	680
200	220	0.4	3.9	46	19	34	680
150	220	0.32	3.9	44	16.5	24	680
100	220	0.18	5.6	38	8.0	13.5	680

†R_{g1}=Grid resistor of following valve.

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DOUBLE DIODE TRIODE

UBC41 (Cont.)

OPERATING CONDITIONS AS RESISTANCE COUPLED AMPLIFIER*

(With grid current bias)

V_b (V)	R_a (kΩ)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$) (D_{tot}=2.5%)	V_{out} ($V_{r.m.s.}$) (D_{tot}=5%)	R_{g1}† (kΩ)
350	100	2.0	55	27	43	330
300	100	1.95	53.5	22	35	330
250	100	1.3	51	17	27	330
200	100	0.95	48.5	12	19	330
150	100	0.6	44	7.0	11	330
100	100	0.3	35.5	3.0	5.0	330
350	220	1.1	61.5	29	47	680
300	220	0.9	59.5	23	38	680
250	220	0.7	57	17	29.5	680
200	220	0.5	54	12.5	21	680
150	220	0.33	49	8.0	14	680
100	220	0.18	40	4.0	7.0	680

*Measured with grid resistor of 20MΩ and signal source impedance Z_s=0. The distortion figures quoted hold good for values of Z_s not exceeding 200kΩ. At this value of Z_s the gain will be reduced by 10%.

†R_{g1}=Grid resistor of following valve.

REPLACEMENT FOR:

DH142, 10LD3, 141DDT—Direct.

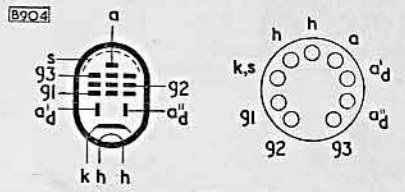
DH101—Change base. Bias may require adjustment. UBC41 has 14V heater.

DH107—Change base. UBC41 has 14V heater.

DOUBLE DIODE PENTODE

UBF80

Double diode variable-mu pentode. The pentode section is suitable for use as an r.f., i.f., or a.f. amplifier.



B9A

HEATER

I_h	100	mA
V_h	17	V

CAPACITANCES

$c_{a'd-g1}$	<0.0008	pF
$c_{a'd-a}$	<0.2	pF
$c_{a"d-g1}$	<0.001	pF
$c_{a"d-a}$	<0.05	pF

Pentode Section

c_{a-g1}	<0.0025	pF
c_{out}	4.9	pF
c_{in}	4.2	pF
c_{g1-h}	<0.07	pF

Diode Sections

$c_{a'd-k}$	2.15	pF
$c_{a"d-k}$	2.35	pF
$c_{a'd-a"d}$	<0.35	pF
$c_{a'd-h}$	<0.02	pF
$c_{a"d-h}$	<0.005	pF

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UBF80 (Cont.)

DOUBLE DIODE PENTODE

LIMITING VALUES

Pentode Section

V_a max.	250	V
p_a max.	1.5	W
V_{g_2} max. (I_a<2 mA)	250	V
V_{g_2} max. (I_a=5 mA)	125	V
p_{g_2} max.	300	mW
I_k max.	10	mA
V_{h-k} max.	150	V

Diode Sections (Each section)

$v_{ad(pk)}$ max.	200	V
I_{ad} max.	800	μA

DIMENSIONS

Max. Overall Length	67.5	mm
Max. Seated Height	60.5	mm
Max. Diameter	22.2	mm

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a=V_b$	100	170	200	V
R_{g_2}	47	47	68	kΩ
V_{g_2}	50	85	85	V
V_{g_3}	0	0	0	V
R_k	300	300	300	Ω
I_a	2.8	5.0	5.0	mA
I_{g_2}	1.0	1.75	1.75	mA
V_{g_1}	–1.2	–2.0	–2.0	V
g_m	1.9	2.2	2.2	mA/V
r_a	0.9	0.9	1.0	MΩ
$\mu_{g_1-g_2}$	18	18	18	
R_{eq}	4.6	6.2	6.2	kΩ
*V_{g_1}	–15.5	–26.5	–31.5	V

*For 100 : 1 reduction in g_m.

OPERATING CONDITIONS AS RESISTANCE COUPLED AMPLIFIER

Pentode Connection

V_b (V)	R_a (kΩ)	I_a (mA)	R_{g_2} (kΩ)	I_{g_2} (μA)	R_k (kΩ)	R_{g_1} (MΩ)	$\frac{V_{out}}{V_{in}}$	D_{tot}* (%)	R_{g_1}** (kΩ)
100	220	0.32	680	120	2.7	1.0	82	1.9	680
100	100	0.73	270	290	1.0	1.0	67	1.8	330
100	220	0.32	820	110	0	10	100	3.0	680
100	100	0.66	330	250	0	10	70	3.2	330
170	220	0.56	680	200	2.7	1.0	85	1.5	680
170	100	1.25	270	500	1.0	1.0	70	1.6	330
170	220	0.56	820	190	0	10	140	1.0	680
170	100	0.16	330	460	0	10	100	1.4	330

Triode Connection
(g_2 connected to a, g_3 connected to k)

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	R_{g_1} (MΩ)	$\frac{V_{out}}{V_{in}}$	D_{tot}* (%)	R_{g_1}** (kΩ)
100	100	0.74	1.8	1.0	11	4.9	330
100	47	1.4	1.0	1.0	11	4.8	150
100	100	0.8	0	10	12	4.7	330
100	47	1.5	0	10	12	4.8	150
170	100	1.25	1.8	1.0	11	3.5	330
170	47	2.4	1.0	1.0	11	3.1	150
170	100	1.4	0	10	14	3.8	330
170	47	2.8	0	10	14	3.4	150

*V_{out}=5.0$V_{r.m.s.}$

**R_{g_1}=Grid resistor of following valve.

REPLACEMENT FOR: 171DDP—Direct.

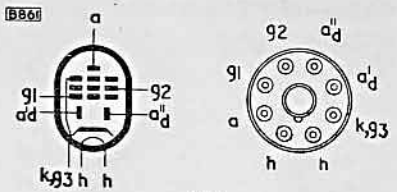
Mullard

DOUBLE DIODE OUTPUT PENTODE

UBL21

HEATER

I_h	100	mA
V_h	55	V



B8G

LIMITING VALUES

Pentode Section

V_a max.	250	V
p_a max.	11	W
V_{g_2} max.	250	V
p_{g_2} max. (max. sig.)	3.5	W
p_{g_2} max. (zero sig.)	1.9	W
I_k max.	75	mA
V_{h-k} max.	150	V

Diode Sections (Each Section)

V_{ad} max.	200	V
I_{ad} max.	800	μA

DIMENSIONS

Max. Overall Length	96	mm
Max. Diameter	32	mm

OPERATING CONDITIONS (As single valve class "A" amplifier)

V_a	100	180	200	V
V_{g_2}	100	180	200	V
R_k	140	140	200	Ω
V_{g_1}	–5.3	–10	–13	V
I_a	32.5	61	55	mA
I_{g_2}	5.5	10	9.5	mA
g_m	7.5	9.0	8.0	mA/V
r_a	25	22	25*	kΩ
$\mu_{g_1-g_2}$	9.0	9.0	9.0	
R_a	3.0	3.0	3.5	kΩ
P_{out}	1.35	4.8	4.8	W
$V_{in(r.m.s.)}$	3.8	6.2	6.2	V
D_{tot}	10	10	10	%

TRIODE HEPTODE

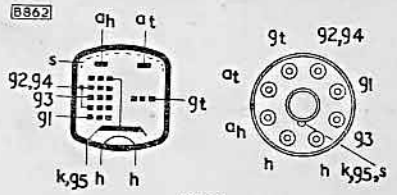
UCH21

HEATER

I_h	100	mA
V_h	20	V

CAPACITANCES

C_{gt-g_1}	<0.1	pF
C_{gt+g_3-k}	12.8	pF
$C_{gt+g_3-g_1}$	<0.35	pF
C_{gt+g_3-ah}	<0.1	pF



B8G

DIMENSIONS

Max. Overall Length	96	mm
Max. Seated Height	80	mm
Max. Diameter	32	mm

Mullard

UCH21 (Cont.)

CAPACITANCES (cont.)

Heptode Section

c_{in}	6.8	pF
c_{out}	9.5	pF
c_{a-g1}	<0.002	pF
c_{g1-g3}	<0.3	pF
c_{g3-all}	8.0	pF

Triode Section

c_{in}	4.5	pF
c_{out}	3.5	pF
c_{g-k}	3.2	pF
c_{a-k}	2.0	pF
c_{a-g}	1.1	pF

LIMITING VALUES

Heptode Section

V_a max.	250	V
p_a max.	1.5	W
V_{g2+g4} max. (I_a=3 mA)	100	V
V_{g2+g4} max. (I_a<1 mA)	250	V
p_{g2+g4} max.	1.0	W
I_k max.	15	mA
V_{h-k} max.	150	V

Triode Section

V_a max.	175	V
p_a max.	500	mW

TRIODE HEPTODE

CHARACTERISTICS

Triode Section

V_a	100	V
V_g	0	V
I_a	12	mA
g_m	3.2	mA/V
μ	19	

OPERATING CONDITIONS

Heptode Section as Mixer

$V_a=V_b$	100	200	V
R_{g2+g4}	15	15	kΩ
R_k	150	150	Ω
R_{g3+gt}	47	47	kΩ
I_{g3+gt}	95	190	μA
V_{g1}	–1.0	–2.0	V
V_{g2+g4}	53	100	V
I_a	1.5	3.5	mA
I_{g2+g4}	3.0	6.5	mA
g_c	580	750	μA/V
r_a	1.0	1.0	MΩ
R_{eq}	40	55	kΩ

OPERATING CONDITIONS

Triode Section as R.F. Oscillator

V_b	100	200	V
R_a	22	22	kΩ
R_{g3+gt}	47	47	kΩ
I_{g3+gt}	95	190	μA
I_a	1.9	4.1	mA
g_m (effective)	440	450	μA/V

UCH21 (Cont.)

OPERATING CONDITIONS OF HEPTODE SECTION AS I.F. AMPLIFIER

$V_a=V_b$	100	200	V
V_{g3}	0	0	V
R_{g2+g4}	33	33	kΩ
V_{g1}	–1.0	–2.0	V
V_{g2+g4}	50	94	V
I_a	2.6	5.2	mA
I_{g2+g4}	1.9	3.5	mA
g_m	2.0	2.2	mA/V
r_a	700	700	MΩ
μ_{g1-g2}	19	19	
R_{eq}	4.9	9.0	kΩ
*V_{g1}	–15	–28	V

*For 100 : 1 reduction in g_m.

OPERATING CONDITIONS OF TRIODE SECTION AS RESISTANCE COUPLED A.F. AMPLIFIER

V_b (V)	R_a (kΩ)	V_g (V)	I_a (mA)	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)	$\frac{V_{out}}{V_{in}}$
200	220	–2.0	0.8	7.5	2.8	10
100	220	–1.0	0.37	7.5	6.0	10
200	100	–2.0	1.5	7.5	2.8	10.5
100	100	–1.0	0.68	7.5	5.8	10.5
200	47	–2.0	2.8	7.5	2.2	11
100	47	–1.0	1.3	7.5	5.4	11

Note.—This valve may also be used as a phase splitter in audio amplifiers.

REPLACEMENT FOR:

UCH4—Change base. Receiver may require realigning.
X101—Rewire base. Screen-grid resistor may need adjustment, and receiver realigning.

TRIODE HEXODE (OBSOLETE) UCH41

HEATER

I_h	100	mA
V_h	14	V

CAPACITANCES

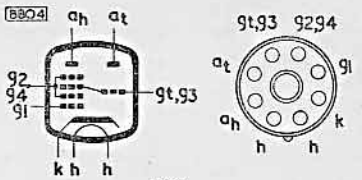
c_{gt-g1}	<0.35	pF
c_{gt-ah}	<0.2	pF

Hexode Section

c_{in}	3.4	pF
c_{out}	6.0	pF
c_{a-g1}	<0.1	pF

Triode Section

c_{in}	4.9	pF
c_{out}	1.5	pF
c_{a-g}	1.2	pF



B8A

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

UCH41 (Cont.)

TRIODE HEXODE (OBSOLETE)

LIMITING VALUES

Hexode Section

V_a max.	250	V
p_a max.	800	mW
V_{g2+g4} max.	125	V
p_{g2+g4} max.	300	mW
I_k max.	7.0	mA
V_{h-k} max.	150	V

Triode Section

V_a max.	175	V
p_a max.	750	mW
I_k max.	5.5	mA

CHARACTERISTICS

Triode Section

V_a	100	V
V_g	0	V
I_a	8.5	mA
g_m	1.9	mA/V
μ	19	

OPERATING CONDITIONS AS FREQUENCY CHANGER

(With screen grid fed from junction of R_1 and R_2, which form a potentiometer across the h.t. supply.)

Hexode Section

$V_a=V_b$	100	170	200	V
R_1	22	22	22	kΩ
R_2	47	47	47	kΩ
R_k	200	200	225	Ω
R_{g3+gt}	22	22	22	kΩ
I_{g3+gt}	200	320	360	μA
V_{g1}	−1.0	−1.8	−2.2	V
V_{g2+g4}	53	87	105	V
I_a	1.0	2.2	3.0	mA
I_{g2+g4}	1.0	1.9	2.1	mA
g_c	320	450	500	μA/V
r_a	1.4	1.2	1.0	MΩ
$*V_{g1}$	−14	−22	−27	V

*For 100 : 1 reduction in g_c.

Triode Section

V_b	100	170	200	V
R_a	10	10	22	kΩ
I_a	2.8	4.9	4.6	mA
R_{g3+gt}	22	22	22	kΩ
I_{g3+gt}	200	320	360	μA
$V_{osc(r.m.s.)}$	4.0	7.0	8.0	V
g_m (approx.)	560	600	500	μA/V

REPLACED BY: UCH42—Screen-grid resistors may require alteration.

TRIODE HEXODE FREQUENCY CHANGER

UCH42

HEATER

I_h	100	mA
V_h	14	V

CAPACITANCES

c_{gt-g1}	<0.35	pF
c_{gt-ah}	<0.2	pF

Hexode Section

$c_{g1-h+k+g2+g4+skirt}$	3.8	pF
$c_{a-h+k+g2+g4+skirt}$	9.2	pF
c_{a-g1}	<0.1	pF
c_{g1-h}	<0.15	pF

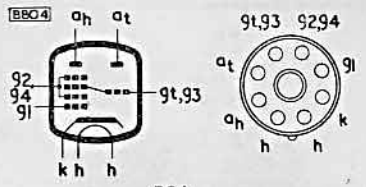
Triode Section

$c_{gt-h+k+g2+g4+skirt}$	5.5	pF
$c_{at-h+k+g2+g4+skirt}$	2.3	pF
c_{at-gt}	1.2	pF

CHARACTERISTICS

Triode Section

V_a	100	V
V_g	0	V
I_a	10	mA
g_m	2.8	mA/V
μ	22	



B8A

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

LIMITING VALUES

Hexode Section

V_a max.	250	V
p_a max.	1.5	W
V_{g2+g4} max. (I_a=3 mA)	125	V
V_{g2+g4} max. (I_a<1 mA)	250	V
p_{g2+g4} max.	300	mW
I_k max.	7.0	mA
V_{h-k} max.	150	V

Triode Section

V_a max.	175	V
p_a max.	800	mW
I_k max.	6.0	mA

OPERATING CONDITIONS AS FREQUENCY CHANGER

With screen grid fed from junction of R_1 and R_2, which form a potentiometer across the h.t. supply.

Hexode Section

$V_a=V_b$	100	170	200	V
R_1	18	18	18	kΩ
R_2	27	27	27	kΩ
R_k	180	180	180	Ω
R_{g3+gt}	47	47	47	kΩ
I_{g3+gt}	100	200	200	μA
V_{g1}	−1.0	−1.85	−2.0	V
V_{g2+g4}	43	70	85	V
I_a	1.2	2.1	3.0	mA
I_{g2+g4}	1.5	2.6	3.0	mA
g_c	530	670	750	μA/V
r_a	>1.0	>1.0	>1.0	MΩ
R_{eq}	60	65	75	kΩ
$*V_{g1}$	−13.5	−25	−27.5	V

*For 100 : 1 reduction in g_c.

UCH42 (Cont.)

TRIODE HEXODE FREQUENCY CHANGER

Triode Section

V_b	100	170	200	V
R_a	10	10	22	kΩ
$R_{g_1+g_3}$	47	47	47	kΩ
$I_{g_1+g_3}$	100	200	200	μA
I_a	3.1	5.7	5.2	mA
g_m (approx.)	600	650	550	μA/V

REPLACEMENT FOR:

X142, 141TH—Direct.

UCH41—Screen-grid resistors may require alteration.

UF41

VARIABLE-MU R.F. PENTODE

HEATER

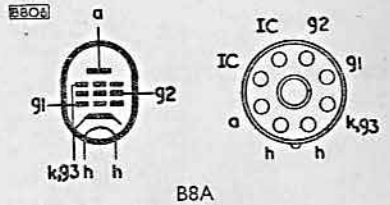
I_h	100	mA
V_h	12.6	V

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

CAPACITANCES

c_{a-g_1}	0.002	pF
c_{out}	7.0	pF
c_{in}	5.0	pF
c_{g_1-h}	0.05	pF



B8A

LIMITING VALUES

V_a max.	250	V
p_a max.	2.0	W
V_{g_2} max. (I_a<4 mA)	250	V
V_{g_2} max. (I_a=7.2 mA)	150	V
p_{g_2} max.	300	mW
I_k max.	10	mA
V_{h-k} max.	150	V

OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

$V_a=V_b$	100	170	200	V
R_{g_2}	39	39	39	kΩ
R_k	330	330	330	Ω
I_a	3.3	6.0	7.2	mA
I_{g_2}	1.0	1.75	2.1	mA
V_{g_1}	−1.4	−2.5	−3.0	V
g_m	1.9	2.2	2.3	mA/V
r_a	0.8	1.0	1.0	MΩ
$\mu_{g_1-g_2}$	18	18	18	
R_{eq}	5.5	6.5	7.0	kΩ
*V_{g_1}	−17	−28	−34	V

*For 100 : 1 reduction in g_m.

REPLACEMENT FOR:

W142, 121VP—Direct.

W101—Change base. UF41 has 12.6V heater.

Mullard

UF42

HIGH SLOPE R.F. PENTODE

HEATER

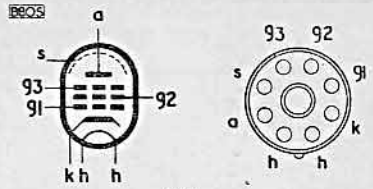
I_h	100	mA
V_h	21	V

CAPACITANCES

c_{a-g_1}	0.005	pF
c_{in}	9.5	pF
c_{out}	4.5	pF

LIMITING VALUES

V_a max.	300	V
p_a max.	2.5	W
V_{g_2} max.	300	V
p_{g_2} max.	700	mW
I_k max.	13	mA
V_{h-k} max.	150	V



B8A

DIMENSIONS

Max. Overall Length	60	mm
Max. Seated Height	53	mm
Max. Diameter	22	mm

CHARACTERISTICS

V_a	170	V
V_{g_2}	170	V
V_{g_1}	−2.0	V
I_a	10	mA
I_{g_2}	2.8	mA
r_a	200	kΩ
g_m	8.5	mA/V
V_{g_2} (I_a=10 μA)	−48	V

REPLACEMENT FOR:

Z142—Direct.

Z145, 10F1—Rewire base.

10F3—Bias will require adjustment.

UL41

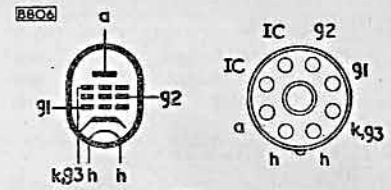
OUTPUT PENTODE

HEATER

I_h	100	mA
V_h	45	V

LIMITING VALUES

V_a max.	250	V
p_a max.	9.0	W
V_{g_2} max.	250	V
p_{g_2} max. (zero signal)	1.75	W
p_{g_2} max. (max. signal)	4.0	W
I_k max.	75	mA
V_{h-k} max.	150	V



B8A

DIMENSIONS

Max. Overall Length	76	mm
Max. Seated Height	69	mm
Max. Diameter	22	mm

Mullard

UL41 (Cont.)

OUTPUT PENTODE

OPERATING CONDITIONS (As single valve class "A" amplifier)

V_a	100	170	200	V
V_{g2}	100	170	200	V
V_{g1}	−5.7	−10.4	−14.2	V
I_a	29	53	45	mA
I_{g2}	5.5	10	8.5	mA
g_m	8.0	9.5	8.2	mA/V
r_a	18	20	24	kΩ
R_a	3.0	3.0	4.3	kΩ
P_{out}	1.35	4.2	4.2	W
$V_{in(r.m.s.)}$	3.75	6.0	6.3	V
D_{tot}	10	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

V_a	100	170	200	V
V_{g2}	100	170	200	V
$I_{a(o)}$	2×24	2×44	2×45	mA
I_a (max. sig.)	2×27	2×49	2×53	mA
$I_{g2(o)}$	2×4.6	2×8.8	2×9.0	mA
I_{g2} (max. sig.)	2×6.8	2×16.5	2×19	mA
†R_k	100	100	130	Ω
R_{a-a}	4 0	4.0	4 0	kΩ
P_{out}	2.2	9.0	12.5	W
$V_{in(g1-g1)r.m.s.}$	9.2	18 6	24 5	V
D_{tot}	3.5	4.0	4.0	%

†Common cathode bias resistor.

REPLACEMENT FOR:

N142, 451PT—Direct.

10P14—Change base. Bias may require adjustment. 10P14 p_a max.=10W.

UL44

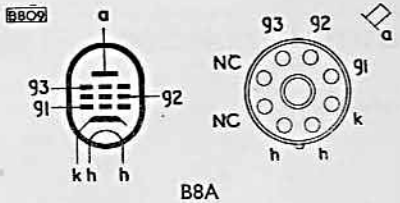
LINE TIMEBASE OUTPUT PENTODE

HEATER

I_h	100	mA
V_h	45	V

DIMENSIONS

Max. Overall Length	65	mm
Max. Seated Height	58	mm
Max. Diameter	22	mm



B8A

LIMITING VALUES

V_a max.	350	V
$v_{a\ (pk)}$ max.	3.5	kV
p_a max.	5.0	W
V_{g2} max.	250	V
p_{g2} max.	3.0	W
I_k max.	75	mA

CHARACTERISTICS

V_a	175	V
V_{g2}	175	V
V_{g1}	−13.5	V
I_a	30	mA
I_{g2}	4.7	mA
g_m	7.1	mA/V
μ_{g1-g2}	10	

Mullard

OUTPUT PENTODE

UL46

Output pentode designed for use in video output and frame timebase circuits. For ratings, characteristics, base connections and dimensions, see type UL41.

TUNING INDICATOR

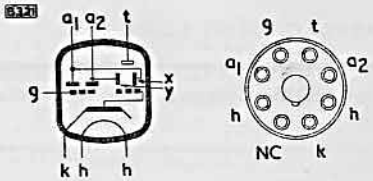
UM34

Electron beam tube for use as tuning indicator in d.c./a.c. radio receivers or as null indicator in test equipment.

HEATER

I_h	100	mA
V_h	12.6	V

For operating conditions and limiting values see type EM34. Except for heater rating, the EM34 and UM34 are identical.



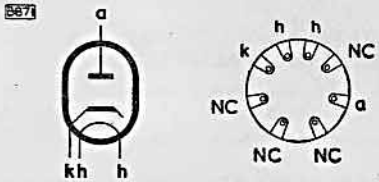
Octal

INDIRECTLY HEATED HALF-WAVE RECTIFIER (OBSOLETE)

URI

HEATER

I_h	200	mA
V_h	20	V



Side Contact

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} (max.)	75	mA

REPLACED BY: CY1—Direct.

DIMENSIONS

Max Overall Length	100	mm
Max Diameter	43	mm

INDIRECTLY HEATED HALF-WAVE RECTIFIER

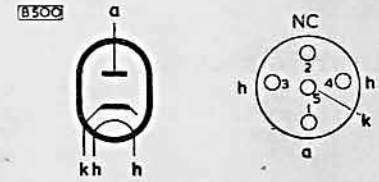
URIC

HEATER

I_h	200	mA
V_h	20	V

DIMENSIONS

Max. Overall Length	118	mm
Max. Diameter	43	mm



Brit. 5-pin

UR1C (Cont.)

INDIRECTLY HEATED MULTIPLE HALF-WAVE RECTIFIER

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	120	mA
V_{h-k} max.	350	V
C max. (R_{11m}=0Ω)	8	μF
C max. (R_{11m}=75Ω)	16	μF
C max. (R_{11m}=125Ω)	32	μF

REPLACEMENT FOR:
C10B, CY1C, G2080 (5-pin), RZ, V20—Direct.
U4020, V30, 1D5—Check heater current=200mA (heater voltage differs).
40SUA—Change base. Check heater current=200mA (heater voltage differs).

UR2

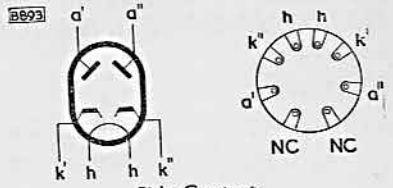
INDIRECTLY HEATED MULTIPLE RECTIFIER (OBSOLETE)

HEATER

I_h	200	mA
V_h	30	V

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	120	mA
V_{h-k} max.	350	V



Side Contact

REPLACED BY: Redesign circuit for 2×UY41 with heaters in parallel. UY41 I_{out} max.=100 mA.

UR3

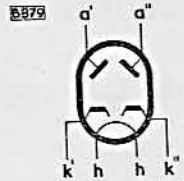
INDIRECTLY HEATED MULTIPLE RECTIFIER (OBSOLETE)

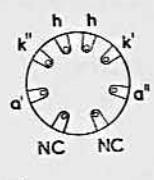
HEATER

I_h	200	mA
V_h	30	V

LIMITING VALUES

$V_{a\ (r.m.s.)}$ max.	250	V
I_{out} max.	120	mA
V_{h-k} max.	350	V





Side Contact

REPLACED BY: Redesign circuit for 2×UY41 with heaters in parallel. UY41 I_{out} max.=100 mA.

UR3C

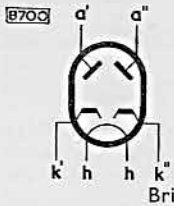
INDIRECTLY HEATED MULTIPLE RECTIFIER (OBSOLETE)

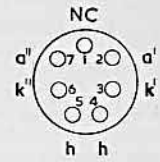
HEATER

I_h	200	mA
V_h	30	V

LIMITING VALUES

$V_{a\ (r.m.s.)}$ max.	250	V
I_{out} max.	120	mA
V_{h-k} max.	350	V
C max. (R_{11m}=50Ω)	8	μF
C max. (R_{11m}=75Ω)	16	μF
C max. (R_{11m}=125Ω)	32	μF





Brit. 7-pin

DIMENSIONS

Max. Overall Length	118	mm
Max. Diameter	43	mm

REPLACED BY: Redesign circuit for 2×UY41 with heaters in parallel. UY41 I_{out} max =100mA.

UY1N

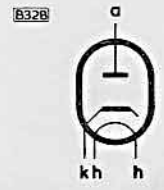
INDIRECTLY HEATED HALF-WAVE RECTIFIER

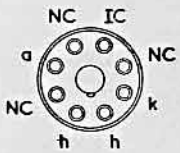
HEATER

I_h	100	mA
V_h	50	V

LIMITING VALUES

$V_{a\ (r.m.s.)}$ max.	250	V
I_{out} max.	140	mA
V_{h-k} max.	550	V
C max.	60	μF





Octal

DIMENSIONS

Max. Overall Length	100	mm
Max. Seated Height	85	mm
Max. Diameter	32	mm

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ (V)	C (μF)	R_{11m} (min.) (Ω)
250	60	175
250	32	125
250	16	75
250	8	0
170	60	100
170	32	75
170	16	30
127	60	0

REPLACEMENT FOR:
U101, UY21—Change base.
UY31—Rewire base.

UY21

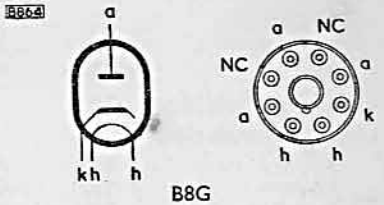
INDIRECTLY HEATED HALF-WAVE RECTIFIER (OBSOLETE)

DIMENSIONS

Max. Overall Length	93	mm
Max. Diameter	32	mm

For operating conditions and limiting values see type UY1N. Except for basing and dimensions, the UY21 and UY1N are identical.

B8G



REPLACED BY: UY1N—Change base.

UY31

INDIRECTLY HEATED HALF-WAVE RECTIFIER (OBSOLETE)

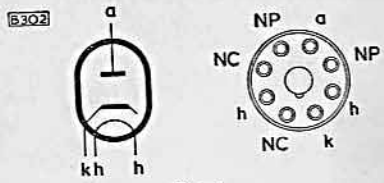
HEATER

I_h	100	mA
V_h	50	V

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	125	mA
V_{h-k} max.	500	V
C max.	60	μF

Octal



DIMENSIONS

Max. Overall Length	114	mm
Max. Diameter	43	mm

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ (V)	C (μF)	R_{11m} (min.) (Ω)
250	60	175
250	32	125
250	16	75
250	8	0
170	60	100
170	32	75
170	16	30
127	60	0

REPLACED BY: UY1N—Rewire base.

Mullard

HALF-WAVE RECTIFIER

UY41

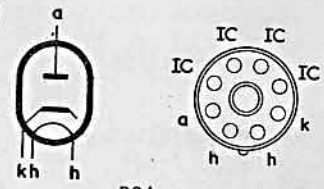
HEATER

I_h	100	mA
V_h	31	V

LIMITING VALUES

$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	100	mA
$v_{h-k\ (pk)}$ max.	550	V
C max.	50	μF

B8A



DIMENSIONS

Max. Overall Length	67	mm
Max. Seated Height	60	mm
Max. Diameter	22	mm

OPERATING CONDITIONS

$V_{a(r.m.s.)}$ (V)	C (μF)	R_{11m} min. (Ω)
250	50	210
220	50	160
127	50	0
250	32	140
220	32	125
127	32	0
250	16	100
220	16	90
127	16	0

REPLACEMENT FOR:

U142, 311SU—Direct.

U107—Change base. Check heater current=100mA (heater voltage differs).

U145, U404—Check that no connection is made to pin 3. Check heater current =100mA (heater voltage differs).

Two of these valves, with heaters wired in parallel and providing the load current does not exceed 100mA may be used to replace the following types:—CY2, CY32, PV29s, PV30, PV30s, UR2, UR3, UR3C.

Mullard

VM4V

VARIABLE-MU R.F. TETRODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.0	A

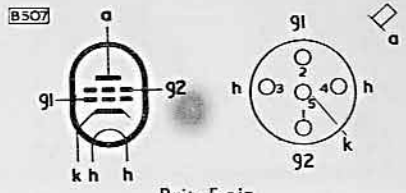
LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V

CHARACTERISTICS

V_a	200	V
V_{g2}	100	V
V_{g1}	–1.5	V
I_a	8.5	mA
g_m	1.2	mA/V
*V_{g1}	–40	V

*For 100 : 1 reduction in g_m.



Brit. 5-pin

VP2

VARIABLE-MU R.F. PENTODE (OBSOLETE)

FILAMENT

V_f	2.0	V
I_f	180	mA

DIMENSIONS

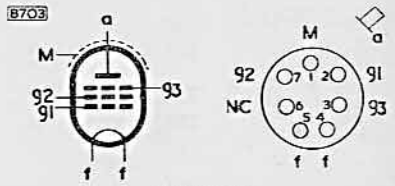
Max. Overall Length	139	mm
Max. Diameter	49	mm

CAPACITANCES

c_{in}	10.7	pF
c_{out}	6.3	pF
c_{a-g1}	0.007	pF

LIMITING VALUES

V_a max.	150	V
V_{g2} max.	150	V



Brit. 7-pin

OPERATING CONDITIONS

V_a	135	V
V_{g2}	135	V
V_{g1}	0	V
I_a	3.0	mA
I_{g2}	1.25	mA
g_m	1.5	mA/V
r_a	400	kΩ

REPLACED BY: KF35—Change base and top cap connector. Reduce screen-grid voltage to 60V.

VP2B

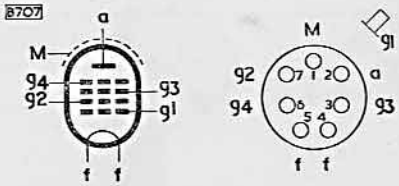
HEXODE

HEATER

V_f	2.0	V
I_f	135	mA

DIMENSIONS

Max. Overall Length	128	mm
Max. Diameter	44	mm



Brit. 7-pin

Mullard

HEXODE

VP2B (Cont.)

LIMITING VALUES

V_a max.	135	V
V_{g2} max.	60	V
V_{g4} max.	60	V

OPERATING CONDITIONS

As a mixer (g_2 and g_4 strapped)

V_a	90	135	V
V_{g2+g4}	40	60	V
V_{g1}	–1.0	–1.5	V
I_a	0.5	1.0	mA
I_{g2+g4}	0.6	1.1	mA
$V_{osc(r.m.s.)}$	7.0	10	V
g_c	300	450	mA/V
r_a	1.5	1.0	MΩ

REPLACEMENT FOR:

K50N, VX2—Direct.
VX2s—Change base.

OPERATING CONDITIONS

As a pentode (g_2 and g_3 strapped: g_4 earthed)

V_a	90	135	V
V_{g2+g3}	40	60	V
V_{g1}	–0.4	–1.5	V
I_a	1.9	2.0	mA
I_{g2+g3}	950	950	μA
g_m	1.25	1.4	mA/V
r_a	0.85	1.3	MΩ

As a tetrode (g_2 and g_4 strapped: g_3 earthed)

V_a	90	135	V
V_{g2+g4}	40	60	V
V_{g1}	–1.0	–1.5	V
I_a	1.95	2.1	mA
I_{g2+g4}	750	700	μA
g_m	1.3	1.5	mA/V
r_a	720	700	kΩ

VARIABLE-MU R.F. PENTODE (OBSOLETE)

VP4

HEATER

V_h	4.0	V
I_h	1.0	A

DIMENSIONS

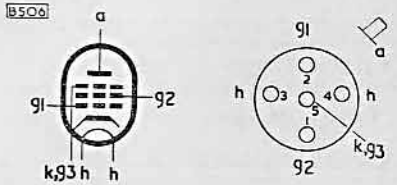
Max. Overall Length	150	mm
Max. Diameter	50	mm

CAPACITANCES

c_{a-g1}	<0.005	pF
c_{in}	12.4	pF
c_{out}	10	pF

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V
I_k max.	10	mA
V_{h-k} max.	80	V



Brit. 5-pin

This valve was also manufactured with a British 7-pin base. For connections refer to type VP4A.

OPERATING CONDITIONS

V_a	200	V
V_{g2}	100	V
V_{g1}	–2.0	V
I_a	4.5	mA
g_m	2.3	mA/V
r_a	1.0	MΩ
*V_{g1}	–22	V

*For 100 : 1 reduction in g_m.

Mullard

VP4A

VARIABLE-MU R.F. PENTODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	1.2	A

DIMENSIONS

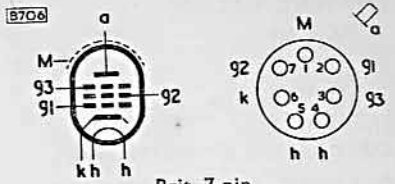
Max. Overall Length	140	mm
Max. Diameter	49.5	mm

CAPACITANCES

c_{in}	12.5	pF
c_{out}	10.2	pF
c_{a-g1}	<0.006	pF

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V
V_{h-k} max.	80	V



Brit. 7-pin

This valve was also manufactured with a British 5-pin base. For connections refer to type VP4.

OPERATING CONDITIONS

V_a	200	V
V_{g2}	100	V
V_{g1}	−2.0	V
I_a	4.25	mA
I_{g2}	1.8	mA
g_m	2.5	mA/V
r_a	1.4	MΩ

VP4B

VARIABLE-MU R.F. PENTODE

HEATER

V_h	4.0	V
I_h	650	mA

DIMENSIONS

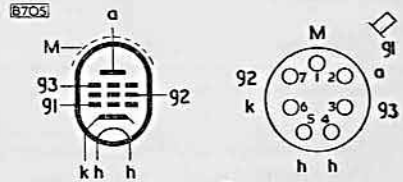
Max. Overall Length	124	mm
Max. Diameter	43	mm

CAPACITANCES

c_{in}	5.35	pF
c_{out}	8.0	pF
c_{a-g1}	0.002	pF

LIMITING VALUES

V_a max.	250	V
V_{g2} max.	250	V



Brit. 7-pin

OPERATING CONDITIONS

V_a	250	V
V_{g2}	250	V
V_{g1}	−3.0	V
R_k	160	Ω
I_a	11.5	mA
I_{g2}	4.25	mA
g_m	2.0	mA/V

REPLACEMENT FOR:

A50P, AC/VPB, AC/VP2, S420, VP41 (Ekco)—Direct.
AC/VP1, VP4C—Rewire base.
MVS/PENB—Raise screen-grid voltage to anode voltage.
VP41 (Ediswan-Mazda)—Change base.

Mullard

VARIABLE-MU R.F. PENTODE

VP13A

HEATER

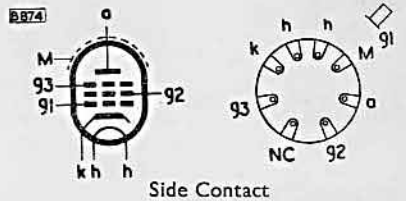
I_h	200	mA
V_h	13	V

DIMENSIONS

Max. Overall Length	109	mm
Max. Diameter	42	mm

LIMITING VALUES

V_a max.	200	V
V_{g2} max.	100	V
V_{h-k} max.	125	V



Side Contact

OPERATING CONDITIONS

V_a	200	V
V_{g2}	100	V
V_{g1}	−2.0	V
I_a	4.0	mA
I_{g2}	1.4	mA
g_m	2.2	mA/V

REPLACEMENT FOR:

CF2, HP13s—Direct.

HP13, VP13—Change base.

VARIABLE-MU R.F. PENTODE (OBSOLETE)

VP13C

HEATER

I_h	200	mA
V_h	13	V

DIMENSIONS

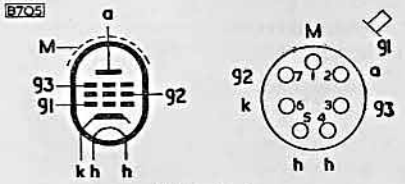
Max. Overall Length	126	mm
Max. Diameter	43	mm

CAPACITANCES

c_{in}	6.1	pF
c_{out}	8.0	pF
c_{a-g1}	0.0023	pF

LIMITING VALUES

V_a max.	200	V
p_a max.	2.5	W
V_{g2} max.	200	V
p_{g2} max.	700	mW
V_{h-k} max.	125	V



Brit. 7-pin

OPERATING CONDITIONS

V_a	200	V
V_{g2}	200	V
V_{g1}	−2.0	V
I_a	9.0	mA
I_{g2}	3.6	mA
g_m	2.2	mA/V

REPLACED BY: EF39—Change base. Feed screen grid from h.t.+ through 68kΩ resistor. Check heater current=200mA (heater voltage differs).

Mullard

054V

OUTPUT TRIODE (OBSOLETE)

HEATER

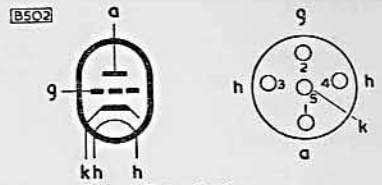
V_h	4.0	V
I_h	1.0	A

LIMITING VALUES

V_a max.	200	V
p_a max.	6.0	W

CHARACTERISTICS

V_a	100	V
V_g	0	V
g_m	4.0	mA/V
μ	5.0	
r_a	1.25	kΩ



Brit. 5-pin

REPLACED BY: ACO44—Change base. Redesign stage.

1A7G

HEPTODE FREQUENCY CHANGER

FILAMENT

V_f	1.4	V
I_f	50	mA

DIMENSIONS

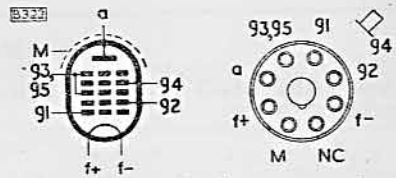
Max. Overall Length	100	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

CAPACITANCES

c_{a-g4}	<0.5	pF
c_{g2-g4}	<0.4	pF
c_{g1-g4}	<0.2	pF
c_{g1-g2}	0.9	pF
$c_{in(g4)}$	7.0	pF
$c_{in(g2)}$	4.4	pF
$c_{in(g1)}$	3.4	pF
c_{out}	10	pF

LIMITING VALUES

V_a max.	110	V
V_{g3+g5} max.	60	V
V_{g2} max.	110	V
I_k max.	4.0	mA



Octal
Pin 1—No connection

OPERATING CONDITIONS

V_a	90	V
V_{g3+g5}	45	V
V_{g2}	90	V
V_{g4}	0	V
R_{g1}	220	kΩ
r_a	600	kΩ
g_c	250	μA/V
I_a	600	μA
I_{g3+g5}	700	μA
I_{g2}	1.2	mA
I_{g1}	35	μA
I_k	2.5	mA
*V_{g4}	−3.0	V

*For 50: 1 reduction in g_c.

REPLACEMENT FOR:
X14—Direct.
FC141—Change base.

Mullard

OUTPUT PENTODE

1C5G
1C5GT

FILAMENT

V_f	1.4	V
I_f	100	mA

DIMENSIONS

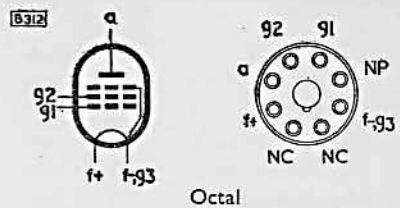
Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

LIMITING VALUES

V_a max.	110	V
V_{g2} max.	110	V
I_k max.	12	mA

CHARACTERISTICS

V_a	83	90	V
V_{g2}	83	90	V
V_{g1}	−7.0	−7.5	V
I_a	7.0	7.5	mA
I_{g2}	1.6	1.6	mA
g_m	1.5	1.55	mA/V
r_a	110	115	kΩ



Octal

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	83	90	V
V_{g2}	83	90	V
V_{g1}	−7.0	−7.5	V
$I_{a(o)}$	7.0	7.5	mA
I_a (max. sig.)	7.3	7.8	mA
$I_{g2(o)}$	1.6	1.6	mA
I_{g2} (max. sig.)	3.5	3.5	mA
R_a	9.0	8.0	kΩ
$V_{in(r.m.s.)}$	5.0	5.3	V
D_{tot}	10	10	%
P_{out}	200	240	mW

REPLACEMENT FOR:
N14, DL35—1C5G Direct.
DL2—1C5G Change base.

DIODE HIGH-μ TRIODE

1H5G

FILAMENT

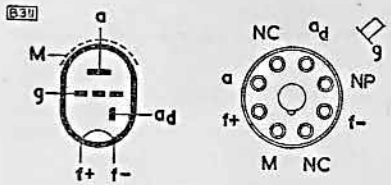
V_f	1.4	V
I_f	50	mA

LIMITING VALUE

V_a max.	110	V

CHARACTERISTICS

V_a	90	V
V_g	0	V
I_a	150	μA
g_m	275	μA/V
μ	65	
r_a	240	kΩ



Octal
Pin 1—No connection

The diode anode is located at the negative end of the filament.

DIMENSIONS

Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

REPLACEMENT FOR: DAC32 (Cl.), HD14—Direct.

Mullard

Q

IN5G

R.F. PENTODE

FILAMENT

V_f	1.4	V
I_f	50	mA

DIMENSIONS

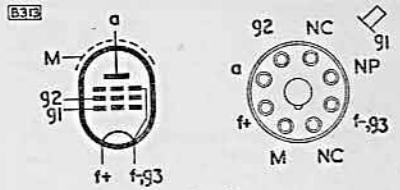
Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

CAPACITANCES

c_{in}	3.0	pF
c_{out}	10	pF
c_{a-g1}	<0.007	pF

LIMITING VALUES

V_a max.	110	V
V_{g2} max.	110	V



Octal
Pin 1—No connection

OPERATING CONDITIONS

V_a	90	V
V_{g2}	90	V
V_{g1}	0	V
I_a	1.2	mA
I_{g2}	300	μA
g_m	750	μA/V
r_a	1.5	MΩ
*V_{g1}	−4.0	V

*For 150 : 1 reduction in g_m.

REPLACEMENT FOR: Z14—Direct.

2D2

INDIRECTLY HEATED DOUBLE DIODE (OBSOLETE)

HEATER

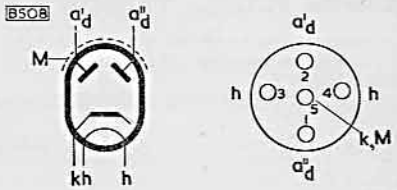
V_h	2.0	V
I_h	90	mA

DIMENSIONS

Max. Overall Length	84	mm
Max. Diameter	30	mm

LIMITING VALUES

$V_{a(pk)}$ max.	125	V
I_a max.	500	μA
V_{h-k} max.	75	V



Brit. 5-pin

REPLACED BY: TDD2A—Change connections as below:—

Connections for 2D2 Pin No.		*Connections for TDD2A* Pin No.
1	Disconnect and take lead to ...	5
2	As at present	2
3	As at present	3
4	As at present	4
5	Disconnect and insulate end of lead	—

Also connect the earthy end of the speech diode load to l.t.+, care being taken not to short out the grid bias supply. Under these conditions the receiver should operate as before, but with a reduction of volume due to the removal of the a.g.c. delay voltage.

Mullard

2D4

DOUBLE DIODE (OBSOLETE)

HEATER

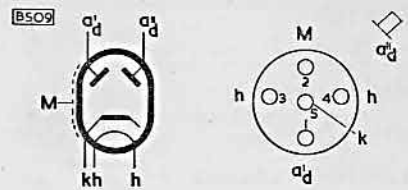
V_h	4.0	V
I_h	500	mA

DIMENSIONS

Max. Overall Length	109	mm
Max. Seated Height	91	mm
Max. Diameter	28	mm

LIMITING VALUES (each section)

V_a max.	200	V
I_a max.	800	μA
V_{h-k} max.	50	V



Brit. 5-pin

REPLACED BY: 2D4A—Rewire base and top cap.

2D4A

DOUBLE DIODE (OBSOLETE)

HEATER

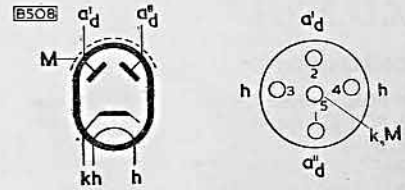
V_h	4.0	V
I_h	650	mA

DIMENSIONS

Max. Overall Length	93	mm
Max. Diameter	29	mm

LIMITING VALUES (each section)

V_a max.	200	V
$i_{a(pk)}$ max.	800	μA
V_{h-k} max.	50	V



Brit. 5-pin

REPLACEMENT FOR:
A20B, AC/DD (Hivac), D41, D400, DD4, DDA1, DDL4, V914—Direct.
AB1, AC/DD (Ediswan-Mazda), 2D4—Rewire base and top cap.
AB2, DD4s—Change base.
DD465—Rewire base.

2D4B

DOUBLE DIODE (OBSOLETE)

HEATER

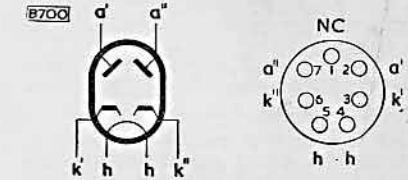
V_h	4.0	V
I_h	350	mA

DIMENSIONS

Max. Overall Length	95	mm
Max. Seated Height	78	mm
Max. Diameter	42	mm

LIMITING VALUES (each section)

V_a max.	200	V
I_a max.	800	μA
V_{h-k} max.	50	V



Brit. 7-pin
Pin 1—Metallising and shield

REPLACED BY: EB34—Change base. Raise heater voltage to 6.3V.

Mullard

2D13

DOUBLE DIODE (OBSOLETE)

HEATER

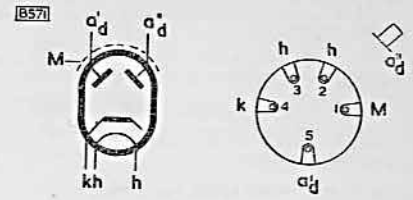
I_h	200	mA
V_h	13	V

DIMENSIONS

Max. Overall Length	83	mm
Max. Diameter	29	mm

LIMITING VALUES

V_a max.	200	V
I_a max.	800	μA
V_{h-k} max.	125	V



Side Contact

REPLACED BY: EB34—Change base. Connect pins 4 and 8 together. Check heater current=200mA. EB34 has 6.3V heater.

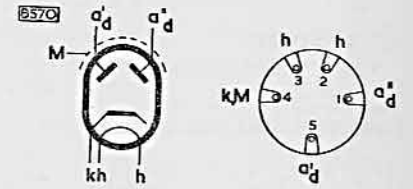
2D13A

DOUBLE DIODE (OBSOLETE)

DIMENSIONS

Max. Overall Length	85	mm
Max. Diameter	29	mm

For further data refer to type 2D13. Except for basing and dimensions, the 2D13 and 2D13A are identical.



Side Contact

REPLACED BY: EB34—Change base. Connect pins 4 and 8 together. Check heater current=200mA. EB34 has 6.3V heater.

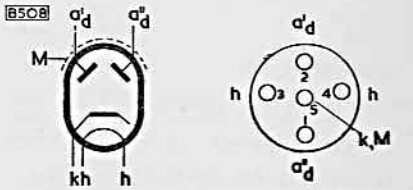
2D13C

DOUBLE DIODE (OBSOLETE)

DIMENSIONS

Max. Overall Length	93	mm
Max. Diameter	29	mm

For further data refer to type 2D13. Except for basing and dimensions, the 2D13 and 2D13C are identical.



Brit. 5-pin

REPLACED BY: EB34—Change base. Connect pins 4 and 8 together. Check heater current=200mA. EB34 has 6.3V heater.

Mullard

OUTPUT PENTODE

3Q5GT

FILAMENT

	Series	Parallel	
V_f	2.8	1.4	V
I_f	50	100	mA

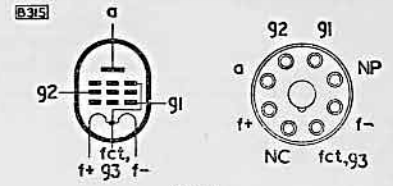
DIMENSIONS

Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

LIMITING VALUES

V_a max.	110	V
V_{g_2} max.	110	V
*I_k max.	6.0	mA

*For each 1.4 V filament section



Octal

CHARACTERISTICS

	Series	Parallel	
V_a	90	90	V
V_{g_2}	90	90	V
V_{g_1}	–4.5	–4.5	V
I_a	8.0	9.5	mA
I_{g_2}	1.0	1.3	mA
g_m	2.0	2.2	mA/V
r_a	80	90	kΩ

OPERATING CONDITIONS (As single valve class "A" amplifier)

	Series		Parallel			
V_a	90	110	85	90	110	V
V_{g_2}	90	110	85	90	110	V
V_{g_1}	–4.5	–6.6	–5.0	–4.5	–6.6	V
I_a	8.0	8.5	7.0	9.5	10	mA
I_{g_2}	1.0	1.1	0.8	1.3	1.4	mA
$V_{in(r.m.s.)}$	3.2	3.6	3.5	3.2	3.8	V
R_a	8.0	8.0	9.0	8.0	8.0	kΩ
P_{out}	230	330	250	270	400	mW
D_{tot}	8.5	8.5	5.5	6.0	6.0	%

REPLACEMENT FOR:

DL33, N16, 3Q5G—Direct.
N15—Increase bias.

DIRECTLY HEATED FULL-WAVE RECTIFIER

5U4G

FILAMENT

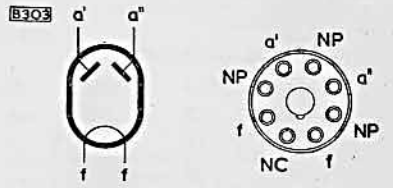
V_f	5.0	V
I_f	3.0	A

LIMITING VALUES

P.I.V. max.	1.5	kV
$i_{a(pk)}$ max.	675	mA

OPERATING CONDITIONS

$V_{a\ (r.m.s.)}$	2×450	2×550	V
C	10	10	μF
R_{l1m} (min.) (per anode)	170	230	Ω
I_{out} (max.)	225	156	mA
V_{out}	430	590	V



Octal

DIMENSIONS

Max. Overall Length	135	mm
Max. Seated Height	121	mm
Max. Diameter	53	mm

Mullard

5U4G (Cont.)

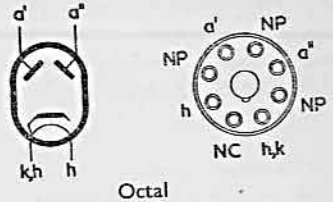
DIRECTLY HEATED
FULL-WAVE RECTIFIER

REPLACEMENT FOR:
U52—Direct.
5X4G—Rewire base.
5Z3—Change base.

5V4G

INDIRECTLY HEATED
FULL-WAVE RECTIFIER

B3OS



Octal

HEATER

V_h	5.0	V
I_h	2.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	525	mA
$V_{a(r.m.s.)}$ max.	2×375	V
I_{out} max.	175	mA
C max.	40	μF
R_{11m} min. (per anode)	100	Ω

DIMENSIONS

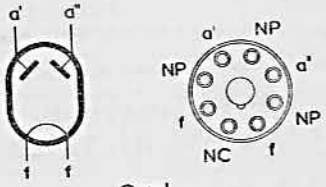
Max. Overall Length	117	mm
Max. Seated Height	103	mm
Max. Diameter	46	mm

REPLACEMENT FOR: 83V—Change base.

5Y3G
5Y3GT

DIRECTLY HEATED
FULL-WAVE RECTIFIER

B3O3



Octal

FILAMENT

V_f	5.0	V
I_f	2.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	400	mA

OPERATING CONDITIONS

$V_{a(r.m.s.)}$	2×350	2×500	V
I_{out} (max.)	125	84	mA
C	10	10	μF
R_{11m} min. (per anode)	50	140	Ω
V_{out}	350	560	V

DIMENSIONS

	5Y3G	5Y3GT	
Max. Overall Length	117	86	mm
Max. Seated Height	103	72	mm
Max. Diameter	46	33	mm

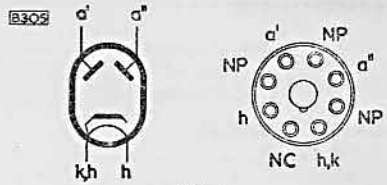
REPLACEMENT FOR:
U50—Direct.
5Y4G—Rewire base.

Mullard

INDIRECTLY HEATED
FULL-WAVE RECTIFIER

5Z4GT

B3OS



Octal

HEATER

V_h	5.0	V
I_h	2.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a\ (pk)}$ max.	375	mA
$V_{a(r.m.s.)}$ max.	2×350	V
I_{out} max.	125	mA
C max.	50	μF
R_{11m} min. (per anode)	380	Ω

DIMENSIONS

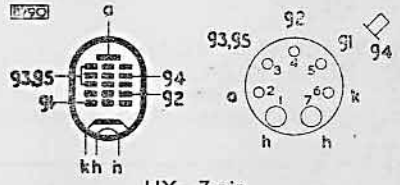
Max. Overall Length	86	mm
Max. Seated Height	72	mm
Max. Diameter	31	mm

REPLACEMENT FOR: GZ30, R52, 5Z4, 5Z4G—Direct.

HEPTODE FREQUENCY CHANGER

6A7

B7G



UX—7 pin

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

C_{a-g1}	0.3	pF
C_{g2-g1}	0.15	pF
C_{g1-g1}	0.15	pF
C_{g1-g2}	1.0	pF
$C_{in(g1)}$	8.5	pF
$C_{in(g2)}$	5.5	pF
$C_{in(g1)}$	7.0	pF
C_{out}	9.0	pF

DIMENSIONS

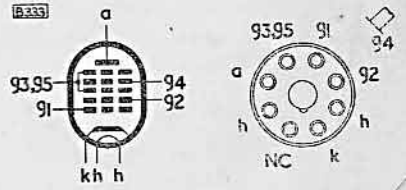
Max. Overall Length	115	mm
Max. Seated Height	99	mm
Max. Diameter	40	mm

For characteristics, operating conditions and limiting values see type 6A8G. Except for basing, dimensions and capacitances the 6A7 and 6A8G are identical.

HEPTODE FREQUENCY CHANGER

6A8G
6A8GT

B7G



Octal

HEATER

V_h	6.3	V
I_h	300	mA

6A8GT—Pin 1 connected to base sleeve.

Mullard

6A8G
6A8GT (Cont.)

HEPTODE FREQUENCY CHANGER

DIMENSIONS

	6A8G	6A8GT	
Max. Overall Length	114	84	mm
Max. Seated Height	100	70	mm
Max. Diameter	40	33	mm

CAPACITANCES

c_{g4-a}	0.26	pF
c_{g4-g2}	0.19	pF
c_{g4-g1}	0.16	pF
c_{g1-g2}	1.1	pF
$c_{in(g4)}$	9.5	pF
$c_{in(g2)}$	4.6	pF
$c_{in(g1)}$	6.0	pF
c_{out}	12	pF

LIMITING VALUES

V_a max.	300	V
V_{g3+g5} max.	100	V
V_{g2} max.	200	V
p_a max.	1.0	W
p_{g3+g5} max.	300	mW
p_{g2} max.	750	mW
I_k max.	14	mA

OPERATING CONDITIONS

V_a	100	250	V
V_{g3+g5}	50	100	V
V_{g2}	100	170	V
V_{g4}	–1.5	–3.0	V
R_{g1-k}	47	47	kΩ
r_a	600	360	kΩ
g_c	360	550	μA/V
I_a	1.1	3.5	mA
I_{g3+g5}	1.3	2.7	mA
I_{g2}	2.0	4.0	mA
I_{g1}	250	400	μA
I_k	4.6	10.6	mA
*V_{g4}	–20	–35	V

*For 100 : 1 reduction in g_c.

REPLACEMENT FOR:

X63—6A8G Direct.
7A8—Change base. Heater current differs. Receiver may require realigning.
7B8—Change base. Receiver may require realigning.

6C5GT

MEDIUM μ TRIODE

HEATER

V_h	6.3	V
I_h	300	mA

DIMENSIONS

Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

LIMITING VALUES

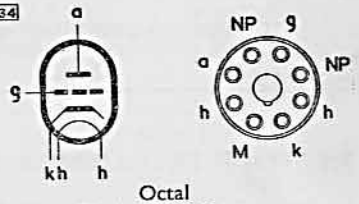
V_a max.	300	V
p_a max.	2.5	W

CHARACTERISTICS

V_a	250	V
V_g	–8.0	V
I_a	8.0	mA
g_m	2.0	mA/V
μ	20	
r_a	10	kΩ

REPLACEMENT FOR: 6C5G—Direct.

B334



Octal
Pin 1—Base sleeve

OPERATING CONDITIONS

V_b	180	300	V
R_a	100	100	kΩ
R_k	5.3	5.3	kΩ
†R_{g1}	250	250	kΩ
$\frac{V_{out}}{V_{in}}$	12	13	

†R_{g1}=Grid resistor of following valve*

Mullard

OUTPUT PENTODE

6F6G

HEATER

V_h	6.3	V
I_h	700	mA

DIMENSIONS

Max. Overall Length	117.5	mm
Max. Seated Height	103.5	mm
Max. Diameter	46	mm

LIMITING VALUES

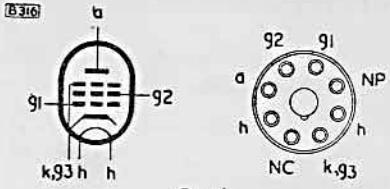
V_a max.	375	V
V_{g2} max.	285	V
p_a max.	11	W
p_{g2} max.	3.75	W

CHARACTERISTICS

V_a	250	285	V
V_{g2}	250	285	V
V_{g1}	–16.5	–20	V
I_a	34	38	mA
I_{g2}	6.5	7.0	mA
g_m	2.5	2.55	mA/V
r_a	80	78	kΩ

REPLACEMENT FOR: KT63—Direct.

B316



Octal

OPERATING CONDITIONS

(As single valve class "A" amplifier)

V_a	250	285	V
V_{g2}	250	285	V
V_{g1}	–16.5	–20	V
$I_{a(0)}$	34	38	mA
I_a (max. sig.)	36	40	mA
$I_{g2(0)}$	6.5	7.0	mA
I_{g2} (max. sig.)	10.5	13	mA
R_a	7.0	7.0	kΩ
$V_{in(r.m.s.)}$	11.7	14.1	V
P_{out}	3.2	4.8	W
D_{tot}	8.0	9.0	%

MEDIUM μ TRIODE

6J5G
6J5GT

HEATER

V_h	6.3	V
I_h	300	mA

DIMENSIONS

	6J5G	6J5GT	
Max. Overall Length	104	84	mm
Max. Seated Height	90	70	mm
Max. Diameter	40	33	mm

LIMITING VALUES

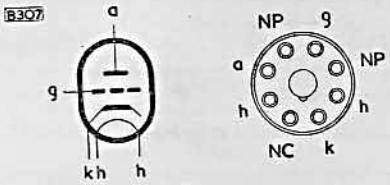
V_a max.	300	V
p_a max.	2.5	W
I_k max.	20	mA

CHARACTERISTICS

V_a	90	250	V
V_g	0	–8	V
I_a	10	9.0	mA
g_m	3.0	2.6	mA/V
μ	20	20	
r_a	6.7	7.7	kΩ

REPLACEMENT FOR:
L63—6J5G Direct.
7A4—Change base.

B307



Octal

6J5GT—Pin 1, base sleeve.

OPERATING CONDITIONS

As Resistance Coupled Amplifier

V_b	280	300	V
R_a	100	100	kΩ
R_k	3.0	2.5	kΩ
$\frac{V_{out}}{V_{in}}$	14	14	
$V_{out(r.m.s.)}$	24	39.5	V

Mullard

6J7G
6J7GT

R.F. PENTODE

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

c_{in}	4.6	pF
c_{out}	12	pF
c_{a-g1}	<0.007	pF

DIMENSIONS

	6J7G	6J7GT	
Max. Overall Length	114	84	mm
Max. Seated Height	100	70	mm
Max. Diameter	40	33	mm

LIMITING VALUES

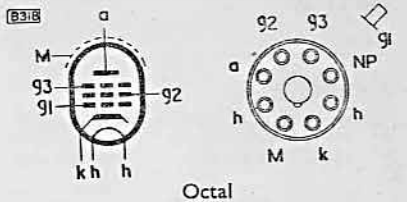
V_a max.	300	V
p_a max.	750	mW
V_{g2} max.	125	V
p_{g2} max.	100	mW

CHARACTERISTICS

V_a	100	250	V
V_{g2}	100	100	V
I_a	2.0	2.0	mA
I_{g2}	500	500	μA
V_{g1}	−3.0	−3.0	V
g_m	1.1	1.25	mA/V
r_a	1.0	1.5	MΩ

REPLACEMENT FOR:

Z63—6J7G, Direct.
KTZ63—6J7GT, Connect pin 5 to pin 8.
Z63, 6W7G—6J7GT, Earth pin 1.
6C6—6J7G, Change base.
36, 77/77E—6J7GT, Change base.
6SJ7, 6SJ7GT—6J7GT, Rewire base.



Octal

6J7G—Pin 1, internal shield.
6J7GT—Pin 1, base sleeve.

OPERATING CONDITIONS
As Resistance Coupled Amplifier

Pentode Connection
(g_3 connected to k)

V_b	200	300	V
R_a	250	250	kΩ
R_{g2}	1.2	1.2	MΩ
R_k	1.5	1.2	kΩ
$\frac{V_{out}}{V_{in}}$	120	140	
†$V_{out(r.m.s.)}$	49.5	70	V

†At start of grid current

Triode Connection

(g_2 and g_3 connected to a), see operating conditions for 6C5GT.

6K7G
6K7GT

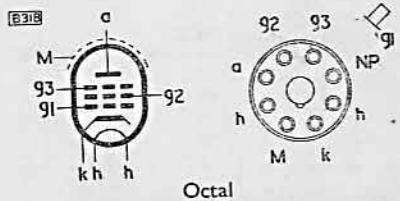
VARIABLE-MU R.F. PENTODE

HEATER

V_h	6.3	V
I_h	300	mA

DIMENSIONS

	6K7G	6K7GT	
Max. Overall Length	114	84	mm
Max. Seated Height	100	70	mm
Max. Diameter	40	33	mm



Octal

6K7G—Pin 1, no connection
6K7GT—Pin 1, base sleeve

6K7G
6K7GT (Cont.)

VARIABLE-MU R.F. PENTODE

CAPACITANCES

	6K7G	6K7GT	
c_{in}	5.0	4.6	pF
c_{out}	12	12	pF
c_{a-g1}	<0.007	<0.005	pF

LIMITING VALUES

V_a max.	300	V
p_a max.	2.75	W
V_{g2} max.	125	V
p_{g2} max.	350	mW

OPERATING CONDITIONS

V_a	100	250	V
V_{g2}	100	125	V
I_a	9.5	10.5	mA
I_{g2}	2.7	2.6	mA
V_{g1}	−1.0	−3.0	V
R_k	—	220	Ω
g_m	1.65	1.65	mA/V
r_a	150	600	kΩ
*V_{g1}	−38	−52	V

*For 100 : 1 reduction in g_m.

REPLACEMENT FOR:

6U7G—6K7G, Direct.
KTW61—6K7G, Bias may require adjustment.
KTW61M, W61M, W63—6K7GT, Bias may require adjustment.
KTW63—6K7G, Connect pin 5 to pin 8.
6D6, 7A7—6K7G, 6K7GT, Change base.
7B7—6K7GT, Change base. Heater current differs.
39/44—6K7G, Change base.

6K8G
6K8GT

TRIODE HEXODE FREQUENCY CHANGER

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES
Hexode Section

c_{out}	4.8	pF
$c_{in(g3)}$	4.6	pF
c_{a-g3}	<0.08	pF

Triode Section

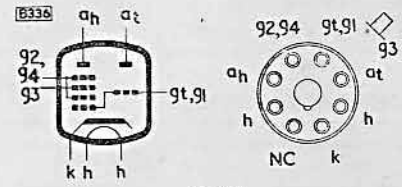
$c_{in(g1)}$	6.5	pF
c_{out}	3.4	pF
c_{a-g1}	1.8	pF
c_{g1-g3}	<0.2	pF
c_{at-g3}	<0.05	pF

LIMITING VALUES
Hexode Section

V_a max.	300	V
p_a max.	750	mW
V_{g2+g4} max.	150	V
p_{g2+g4} max.	700	mW
I_k max.	16	mA

Triode Section

V_a max.	125	V
p_a max.	750	mW



Octal

6K8GT—Pin 1, base sleeve

DIMENSIONS

	6K8G	6K8GT	
Max. Overall Length	114	91	mm
Max. Seated Height	100	77	mm
Max. Diameter	40	33	mm

OPERATING CONDITIONS
Triode Section

V_a	100	V
I_a	3.8	mA
R_g	47	kΩ
I_g	150	μA

6K8G
6K8GT (Cont.)

TRIODE HEXODE FREQUENCY CHANGER

OPERATING CONDITIONS: Hexode Section

V_a	100	250	V
V_{g2+g4}	100	100	V
V_{g3}	−3.0	−3.0	V
I_a	2.3	2.5	mA
I_{g2}	6.2	6.0	mA
R_k	220	300	Ω
r_a	400	600	kΩ
g_c	330	360	μA/V
*V_{g3}	−30	−30	V

*For 100 : 1 reduction in g_c.

REPLACEMENT FOR:
X65—6K8G. Change triode grid leak to 47kΩ. Receiver may require realigning.
6J8G—6K8G. Bias may require adjustment and receiver realigning.

6L6G

OUTPUT PENTODE

HEATER

V_h	6.3	V
I_h	900	mA

DIMENSIONS

Max. Overall Length	135	mm
Max. Seated Height	121	mm
Max. Diameter	52.5	mm

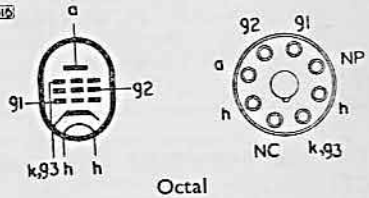
LIMITING VALUES

V_a max.	360	V
p_a max.	19	W
V_{g2} max.	270	V
p_{g2} max.	2.5	W

CHARACTERISTICS

V_a	250	350	V
V_{g2}	250	250	V
V_{g1}	−14	−18	V
I_a	72	54	mA
I_{g2}	5.0	2.5	mA
g_m	6.0	5.2	mA/V
r_a	22.5	33	kΩ

B316



Octal

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	250	350	V
V_{g2}	250	250	V
V_{g1}	−14	−18	V
$I_{a(0)}$	72	54	mA
I_a (max. sig.)	79	66	mA
$I_{g2(0)}$	5.0	2.5	mA
I_{g2} (max. sig.)	7.3	6.0	mA
R_k	170	300	Ω
R_a	2.5	4.2	kΩ
P_{out}	6.5	11	W
D_{tot}	10	15	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

	Class A	Class ABI	
V_a	250	360	V
V_{g2}	250	270	V
V_{g1}	−16	−22.5	V
$I_{a(0)}$	2×60	2×44	mA
I_a (max. sig.)	2×70	2×50	mA
$I_{g2(0)}$	2×5.0	2×2.5	mA
I_{g2} (max. sig.)	2×8.0	2×8.5	mA
*R_k	125	250	Ω
R_{a-a}	5.0	9.0	kΩ
P_{out}	14	24	W
D_{tot}	2.0	4.0	%

*Common cathode bias resistor

REPLACEMENT FOR: 6L6GA—Direct

6N7GT

CLASS "B" DOUBLE TRIODE

HEATER

V_h	6.3	V
I_h	800	mA

DIMENSIONS

Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

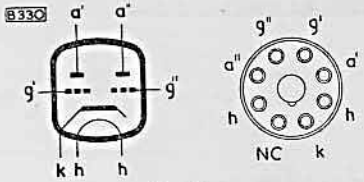
LIMITING VALUES (each section)

V_a max.	300	V
$i_{a(pk)}$ max.	125	mA
p_a max.	5.5	W

CHARACTERISTICS (each section)

V_a	250	V
I_a	3.0	mA
V_g	−5.0	V
g_m	1.6	mA/V
μ	35	
r_a	23	kΩ

B330



Octal

OPERATING CONDITIONS
(As class "B" amplifier)

V_a	300	V
$I_{a(0)}$	35	mA
I_a (max. sig.)	70	mA
V_g	0	V
$V_{in(g-g)r.m.s.}$	59.5	V
$i_{g(pk)}$ (each grid)	22	mA
R_{a-a}	8.0	kΩ
P_{out}	10	W

REPLACEMENT FOR: 6A6—Change base.

6Q7G
6Q7GT

DOUBLE DIODE TRIODE

HEATER

V_h	6.3	V
I_h	300	mA

DIMENSIONS

	6Q7G	6Q7GT	
Max. Overall Length	114	87	mm
Max. Seated Height	100	73	mm
Max. Diameter	40	33	mm

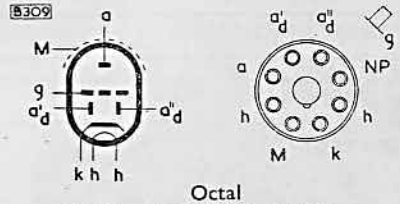
LIMITING VALUE

V_a max.	300	V

CHARACTERISTICS

V_a	100	250	V
V_g	−1.5	−3.0	V
I_a	0.35	1.0	mA
g_m	0.8	1.2	mA/V
μ	70	70	
r_a	88	58	kΩ

B309



Octal
6Q7G—Pin 1, no connection
6Q7GT—Pin 1, base sleeve

OPERATING CONDITIONS
As Resistance Coupled Amplifier

V_a	100	250	250	V
R_a	500	250	250	kΩ
R_g	1.0	1.0	10	MΩ
R_k	9.0	3.0	0	kΩ
*$\frac{V_{out}}{V_{in}}$	33	42	42	
$V_{out(r.m.s.)}$	11	30	28	V
*D_{tot}	2.0	1.0	5.0	%

*For $V_{out(r.m.s.)}$ = 8.5V

6Q7G
6Q7GT (Cont.)

DOUBLE DIODE TRIODE

REPLACEMENT FOR:
DH63—6Q7G, Direct.
DH63 (Met)—6Q7GT, Direct.
6SQ7GT—6Q7GT, Rewire base.
DH149, 7C6—6Q7GT, Change base. Bias may require adjustment. Heater current differs.

6SK7GT

VARIABLE-MU R.F. PENTODE

HEATER

V_h	6.3	V
I_h	300	mA

DIMENSIONS

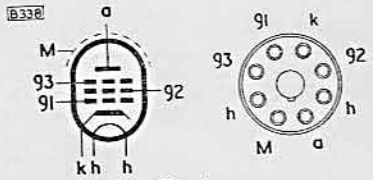
Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

CAPACITANCES

c_{in}	6.5	pF
c_{out}	7.5	pF
c_{a-g1}	<0.005	pF

LIMITING VALUES

V_a max.	300	V
V_{g2} max.	125	V
p_a max.	4.0	W
p_{g2} max.	400	mW



Octal
Pin 1, base sleeve.

OPERATING CONDITIONS

V_a	100	250	V
V_{g2}	100	100	V
V_{g1}	–1.0	–3.0	V
I_a	13	9.2	mA
I_{g2}	4.0	2.6	mA
g_m	2.35	2.0	mA/V
r_a	120	800	kΩ
*V_{g1}	–35	–35	V

*For 200 : 1 reduction in g_m.

6SN7GT

LOW μ DOUBLE TRIODE

HEATER

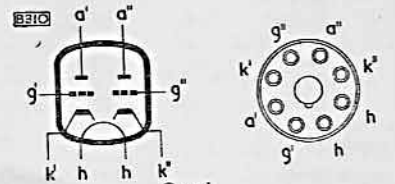
V_h	6.3	V
I_h	600	mA

DIMENSIONS

Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

LIMITING VALUES

V_a max.	300	V
p_a max.	2.5	W
V_{h-k} max.	90	V
I_k max.	20	mA



Octal

CHARACTERISTICS

V_a	90	250	V
V_g	0	–8.0	V
I_a	10	9.0	mA
g_m	3.0	2.6	mA/V
μ	20	20	
r_a	6.7	7.7	kΩ

LOW μ DOUBLE TRIODE

6SN7GT (Cont.)

REPLACEMENT FOR:
B65—Direct.
6F8G—Rewire base.
7N7—Change base.

OUTPUT PENTODE

6V6G
6V6GT

HEATER

V_h	6.3	V
I_h	450	mA

DIMENSIONS

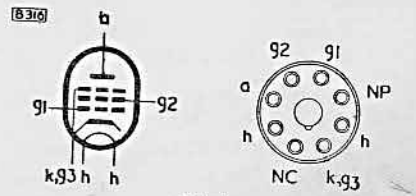
	6V6G	6V6GT	
Max. Overall Length	117	87	mm
Max. Seated Height	103	73	mm
Max. Diameter	46	33	mm

LIMITING VALUES

V_a max.	315	V
V_{g2} max.	315	V
p_a max.	12	W
p_{g2} max.	2.0	W
V_{h-k} max.	90	V

CHARACTERISTICS

V_a	180	250	V
V_{g2}	180	250	V
V_{g1}	–8.5	–12.5	V
I_a	29	45	mA
I_{g2}	3.0	4.5	mA
g_m	3.7	4.1	mA/V
r_a	50	50	kΩ



Octal

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	180	250	V
V_{g2}	180	250	V
V_{g1}	–8.5	–12.5	V
$I_{a(o)}$	29	45	mA
I_a (max. sig.)	30	47	mA
$I_{g2(o)}$	3.0	4.5	mA
I_{g2} (max. sig.)	4.0	7.0	mA
R_k	260	250	Ω
R_a	5.5	5.0	kΩ
P_{out}	2.0	4.5	W
D_{tot}	8.0	8.0	%

REPLACEMENT FOR:

6K6G—Bias may require adjustment.
7B5—Change base. Bias may require adjustment.
7C5—Change base.

6X5GT

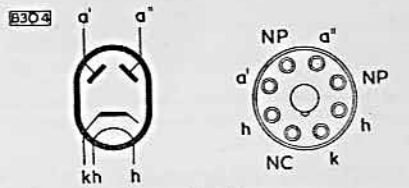
INDIRECTLY HEATED FULL-WAVE RECTIFIER

HEATER

V_h	6.3	V
I_h	600	mA

LIMITING VALUES

P.I.V. max.	1·25	kV
$i_{a(pk)}$ max.	420	mA
$V_{a(r.m.s.)}$ max.	2×325	V
I_{out} max.	70	mA
V_{h-k} max.	450	V
C max.	32	μF
R_{lim} min. (per anode)	150	Ω



Octal

DIMENSIONS

Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

REPLACEMENT FOR:

EZ35, U70, U147, 6X5G—Direct.
PVB6s, U149, 6ZY5G—Change base. Heater current differs.
U82, 7Y4, 84/6Z4—Change base.

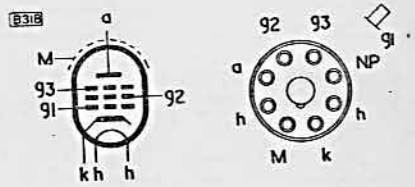
12J7GT

R.F. PENTODE

HEATER

I_h	150	mA
V_h	12.6	V

For characteristics, operating conditions and limiting values see type 6J7GT. Except for the heater ratings, the 6J7GT and 12J7GT are identical.



Octal

Pin 1, base sleeve

REPLACEMENT FOR: 12SJ7GT—Rewire base.

Mullard

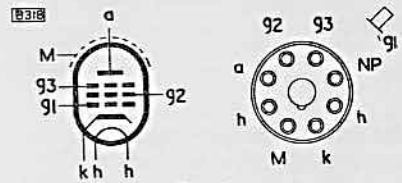
VARIABLE-MU R.F. PENTODE

12K7GT

HEATER

I_h	150	mA
V_h	12.6	V

For characteristics, operating conditions and limiting values see type 6K7GT. Except for the heater ratings, the 6K7GT and 12K7GT are identical.



Octal

Pin 1, base sleeve

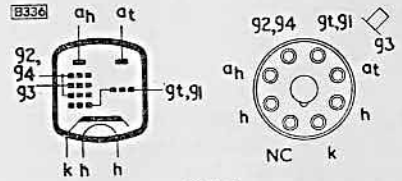
TRIODE HEXODE FREQUENCY CHANGER

12K8GT

HEATER

I_h	150	mA
V_h	12.6	V

For characteristics, operating conditions and limiting values see type 6K8GT. Except for the heater ratings the 6K8GT and 12K8GT are identical.



Octal

Pin 1, base sleeve.

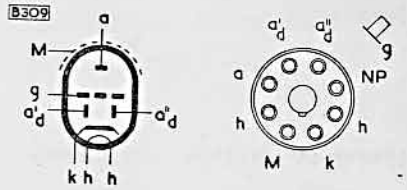
DOUBLE DIODE TRIODE

12Q7GT

HEATER

I_h	150	mA
V_h	12.6	V

For characteristics, operating conditions and limiting values see type 6Q7GT. Except for the heater ratings the 6Q7GT and 12Q7GT are identical.



Octal

Pin 1, base sleeve

REPLACEMENT FOR:

12SQ7GT—Rewire base.
14B6—Change base.

Mullard

R

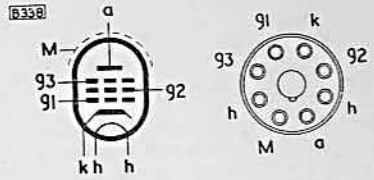
12SK7GT

VARIABLE-MU R.F. PENTODE

HEATER

I_h	150	mA
V_h	12.6	V

For characteristics, operating conditions and limiting values see type 6SK7GT. Except for the heater ratings the 6SK7GT and 12SK7GT are identical.



Octal

Pin, base sleeve.

12SN7GT

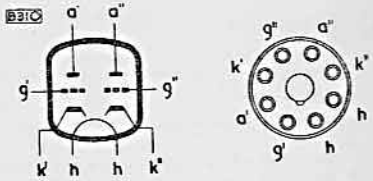
LOW μ DOUBLE TRIODE

HEATER

I_h	300	mA
V_h	12.6	V

For characteristics, operating conditions and limiting values see type 6SN7GT. Except for the heater ratings the 6SN7GT and 12SN7GT are identical.

REPLACEMENT FOR: B36—Direct.



Octal

25A6G

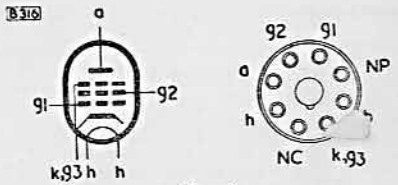
OUTPUT PENTODE

HEATER

I_h	300	mA
V_h	25	V

LIMITING VALUES

V_a max.	160	V
V_{g2} max.	135	V
p_a max.	5.3	W
p_{g2} max.	1.9	W



Octal

DIMENSIONS

Max. Overall Length	117	mm
Max. Seated Height	103	mm
Max. Diameter	33	mm

OUTPUT PENTODE

25A6G (Cont.)

CHARACTERISTICS

V_a	95	135	160	V
V_{g2}	95	135	120	V
I_a	20	37	33	mA
I_{g2}	4.0	8.0	6.5	mA
V_{g1}	–15	–20	–18	V
g_m	2.0	2.45	2.4	mA/V
r_a	45	35	42	kΩ

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	95	135	160	V
V_{g2}	95	135	120	V
$I_{a(0)}$	20	37	33	mA
I_a (max. sig.)	22	39	36	mA
$I_{g2(0)}$	4.0	8.0	6.5	mA
I_{g2} (max. sig.)	8.0	14	12	mA
V_{g1}	–15	–20	–18	V
R_k	625	440	440	Ω
R_a	4.5	4.0	5.0	kΩ
P_{out}	0.9	2.0	2.2	W
D_{tot}	11	9.0	10	%

OUTPUT PENTODE

25L6GT

HEATER

I_h	300	mA
V_h	25	V

DIMENSIONS

Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

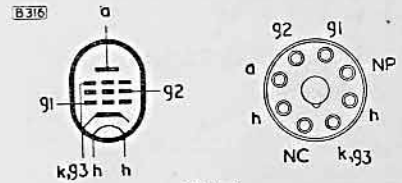
LIMITING VALUES

V_a max.	200	V
V_{g2} max.	125	V
p_a max.	10	W
p_{g2} max.	1.25	W
V_{h-k} max.	90	V

CHARACTERISTICS

V_a	110	200	V
V_{g2}	110	125	V
V_{g1}	–7.5	–8.7	V
I_a	49	46	mA
I_{g2}	4.0	2.2	mA
g_m	8.0	8.0	mA/V
r_a	13	28	kΩ

REPLACEMENT FOR: KT32—Direct.



Octal

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	110	200	V
V_{g2}	110	125	V
V_{g1}	–7.5	—	V
R_k	—	180	Ω
$I_{a(0)}$	49	46	mA
I_a (max. sig.)	50	47	mA
$I_{g2(0)}$	4.0	2.2	mA
I_{g2} (max. sig.)	10	8.5	mA
$V_{in(r.m.s.)}$	5.3	6.0	V
R_a	2.0	4.0	kΩ
P_{out}	2.1	3.8	W
D_{tot}	10	10	%

INDIRECTLY HEATED HALF-WAVE RECTIFIER

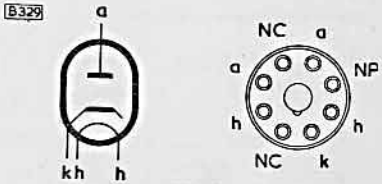
25Z4G

HEATER

I_h	300	mA
V_h	25	V

LIMITING VALUES

P.I.V. max.	700	V
$i_{a(pk)}$ max.	450	mA
$V_{a(r.m.s.)}$ max.	350	V
V_{h-k} max.	350	V



Octal

25Z4G (Cont.)

INDIRECTLY HEATED HALF-WAVE RECTIFIER

OPERATING CONDITIONS

$V_{a(r.m.s.)}$	117	250	V
I_{out} max.	100	100	mA
R_{11m} min.	0	50	Ω
C	32	32	μF

DIMENSIONS

Max. Overall Length	117	mm
Max. Seated Height	103	mm
Max. Diameter	46	mm

REPLACEMENT FOR: 25Z4GT—Direct.
U31—(Providing I_{out} does not exceed 100mA).
1D6—Change base.

25Z6GT

INDIRECTLY HEATED MULTIPLE RECTIFIER

HEATER

I_h	300	mA
V_h	25	V

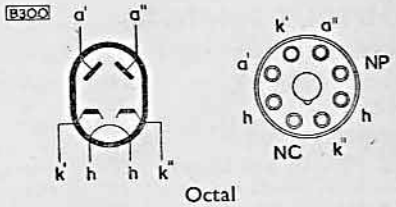
LIMITING VALUES (each section)

P.I.V. max.	700	V
$i_{a(pk)}$ max.	450	mA
I_{out} max.	75	mA
V_{h-k} max.	350	V

OPERATING CONDITIONS
As Half-wave Rectifier

(Both sections strapped)

$V_{a(r.m.s.)}$	150	235	V
I_{out}	150	150	mA
R_{11m} min. (per anode)	40	100	Ω
C	16	16	μF



Octal

DIMENSIONS

Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

OPERATING CONDITIONS
As Voltage Doubler

$V_{a(r.m.s.)}$	117	V
C	2×16	μF
R_{11m} min. (per anode)	30	Ω
I_{out}	75	mA

REPLACEMENT FOR: 25Z5—Change base.

35L6GT

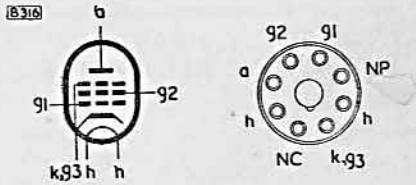
OUTPUT PENTODE

HEATER

I_h	150	mA
V_h	35	V

LIMITING VALUES

V_a max.	200	V
V_{g_2} max.	117	V
P_a max.	8.5	W
P_{g_2} max.	1.0	W



Octal

DIMENSIONS

Max. Overall Length	87	mm
Max. Seated Height	73	mm
Max. Diameter	33	mm

OUTPUT PENTODE

35L6GT (Cont.)

CHARACTERISTICS

V_a	110	200	V
V_{g_2}	110	110	V
I_a	40	41	mA
I_{g_2}	3.0	2.0	mA
V_{g_1}	–7.5	–8.0	V
g_m	5.8	5.9	mA/V
r_a	14	40	kΩ

OPERATING CONDITIONS
(As single valve class "A" amplifier)

V_a	110	200	V
V_{g_2}	110	200	V
V_{g_1}	–7.5	–8.0	V
R_k	170	185	Ω
$I_{a(o)}$	40	41	mA
I_a (max. sig.)	41	44	mA
$I_{g2(o)}$	3.0	2.0	mA
I_{g_2} (max. sig.)	7.0	7.0	mA
R_a	2.5	4.5	kΩ
P_{out}	1.5	3.3	W
D_{tot}	10	10	%

REPLACEMENT FOR: 35A5—Change base.

INDIRECTLY HEATED HALF-WAVE RECTIFIER

35Z4GT

HEATER

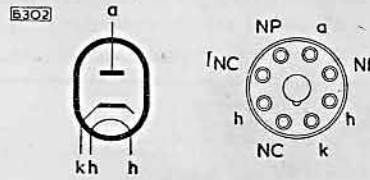
I_h	150	mA
V_h	35	V

LIMITING VALUES

P.I.V. max.	700	V
$i_{a(pk)}$ max.	600	mA
V_{h-k} max.	350	V

OPERATING CONDITIONS

$V_{a(r.m.s.)}$	117	250	V
I_{out} max.	100	100	mA
R_{11m} min.	15	100	Ω
C max.	40	40	μF



Octal

DIMENSIONS

Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

REPLACEMENT FOR: 35Z3—Change base.

HALF-WAVE RECTIFIER

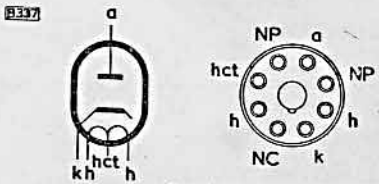
35Z5GT

HEATER

I_h	150	mA
V_h	35	V

LIMITING VALUES

P.I.V. max.	700	V
$V_{a\ (r.m.s.)}$ max.	240	V
$i_{a(pk)}$ max.	600	mA
I_{out} max.	100	mA
V_{h-k} max.	350	V



Octal

DIMENSIONS

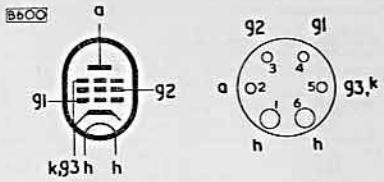
Max. Overall Length	84	mm
Max. Seated Height	70	mm
Max. Diameter	33	mm

42

OUTPUT PENTODE

DIMENSIONS

Max. Overall Length	119	mm
Max. Diameter	46	mm



UX—6 pin

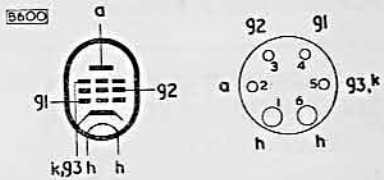
For characteristics, operating conditions and limiting values see type 6F6G. Except for basing and dimensions types 6F6G and 42 are identical.

43

OUTPUT PENTODE

DIMENSIONS

Max. Overall Length	119	mm
Max. Diameter	46	mm



UX—6 pin

For characteristics, operating conditions and limiting values see type 25A6G. Except for basing and dimensions, types 25A6G and 43 are identical.

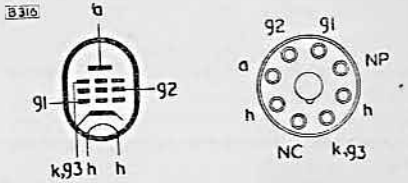
REPLACEMENT FOR: 43E—Direct.

50L6GT

OUTPUT PENTODE

HEATER

I_h	150	mA
V_h	50	V



Octal

For characteristics, operating conditions and limiting values see type 25L6GT. Except for heater ratings, types 25L6GT and 50L6GT are identical.

75

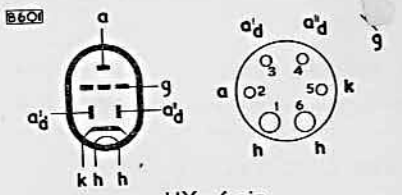
DOUBLE DIODE TRIODE

HEATER

V_h	6.3	V
I_h	300	mA

LIMITING VALUES

V_a max.	250	V
V_{h-k} max.	100	V



UX—6 pin.

DIMENSIONS

Max. Overall Length	115	mm
Max. Seated Height	99	mm
Max. Diameter	40	mm

Mullard

DOUBLE DIODE TRIODE

75 (Cont.)

CHARACTERISTICS

V_a	100	250	V
V_g	−1.0	−2.0	V
I_a	400	900	μA
g_m	0.9	1.1	mA/V
μ	100	100	
r_a	110	91	kΩ

OPERATING CONDITIONS As Resistance Coupled Amplifier

V_b	180	300	V
R_a	500	500	kΩ
R_g	2.0	2.0	MΩ
R_k	8.8	7.0	kΩ
$\frac{V_{out}}{V_{in}}$	58	63	
†$V_{out(r.m.s.)}$	27	47	V

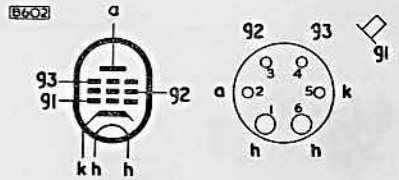
†At start of grid current.

VARIABLE-MU R.F. PENTODE

78

CAPACITANCES

C_{a-g1}	<0.007	pF
C_{in}	4.5	pF
C_{out}	11	pF



UX—6 pin.

For characteristics, operating conditions and limiting values see type 6K7G. Except for basing, dimensions and capacitances, types 6K7G and 78 are identical.

REPLACEMENT FOR: 78/78E—Direct.

DIMENSIONS

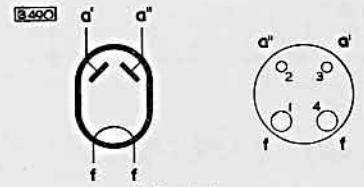
Max. Overall Length	115	mm
Max. Diameter	40	mm

DIRECTLY HEATED FULL-WAVE RECTIFIER

80

DIMENSIONS

Max. Overall Length	119	mm
Max. Diameter	46	mm



UX—4 pin.

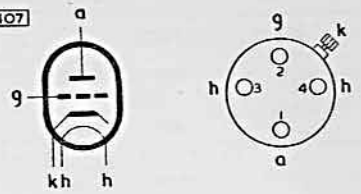
For characteristics, operating conditions and limiting values see type 5Y3G. Except for basing and dimensions, types 5Y3G and 80 are identical.

Mullard

154V

LOW IMPEDANCE TRIODE (OBSOLETE)

B4G7



Brit. 4-pin

HEATER

V_h	4.0	V
I_h	650	mA

LIMITING VALUE

V_a max.	200	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
r_a	7.5	kΩ
μ	15	
g_m	2.0	mA/V

DIMENSIONS

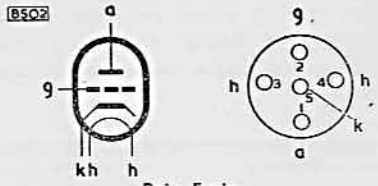
Max. Overall Length	112	mm
Max. Diameter	46	mm

REPLACED BY: TDD4—Change base. Connect diodes to cathode.

164V

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

B5G2



Brit. 5-pin

HEATER

V_h	4.0	V
I_h	650	mA

LIMITING VALUE

V_a max.	200	V

CHARACTERISTICS

V_a	200	V
I_a	12	mA
V_g	−9.0	V
g_m	3.4	mA/V
μ	16	
r_a	4.7	kΩ

DIMENSIONS

Max. Overall Length	110	mm
Max. Diameter	43	mm

OPERATING CONDITIONS
As Resistance Coupled Amplifier

V_b	200	V
I_a	6.0	mA
R_k	1.8	kΩ
R_a	20	kΩ
$V_{out(r.m.s.)}$	94	V
D_{tot}	5.0	%

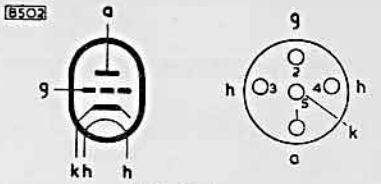
REPLACED BY: 354V—Bias will require adjustment.

Mullard

244V

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

B5G2



Brit. 5-pin

HEATER

V_h	4.0	V
I_h	650	mA

LIMITING VALUE

V_a max.	200	V

CHARACTERISTICS

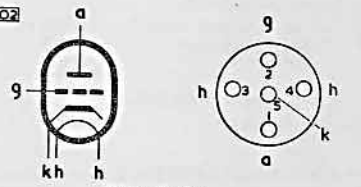
V_a	100	V
V_g	0	V
g_m	2.8	mA/V
μ	25	
r_a	9.0	kΩ

REPLACED BY: 354V—Direct.

354V

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

B5G2



Brit. 5-pin

HEATER

V_h	4.0	V
I_h	650	mA

LIMITING VALUES

V_a max.	250	V
p_a max.	2.0	W
I_k max.	10	mA
V_{h-k} max.	50	V

CHARACTERISTICS

V_a	250	V
V_g	−4.5	V
I_a	6.5	mA
g_m	3.5	mA/V
μ	40	
r_a	11.5	kΩ

DIMENSIONS

Max. Overall Length	110	mm
Max. Diameter	43	mm

OPERATING CONDITIONS
As Resistance Coupled Amplifier

V_b	250	V
R_a	40	kΩ
I_a	1.9	mA
V_g	−3.4	V
R_k	1.8	kΩ
$\frac{V_{out}}{V_{in}}$	23.5	
$V_{out\ (r.m.s.)}$	42.5	V

REPLACEMENT FOR:
A30D, A430N, AC/HL, D4, HL4+, HLA2, MH4, T41 (Ekco), 41MHF, 41MHL, 41MPL, 41MTL, 244V—Direct.
HL4g, HL4gs, HL41—Change base.
MHL4, 164V, 484V—Bias may require adjustment.

Mullard

484V

MEDIUM IMPEDANCE TRIODE (OBSOLETE)

HEATER

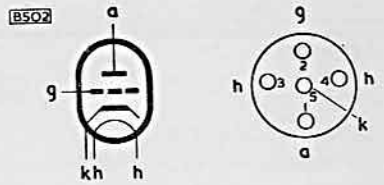
V_h	4.0	V
I_h	1.0	A

LIMITING VALUE

V_a max.	200	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
g_m	2.2	mA/V
μ	48	
r_a	21.8	kΩ



Brit. 5-pin

REPLACED BY: 354V—Direct.

904V

HIGH IMPEDANCE TRIODE (OBSOLETE)

HEATER

V_h	4.0	V
I_h	650	mA

DIMENSIONS

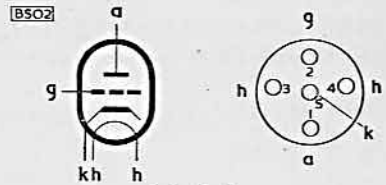
Max. Overall Length	110	mm
Max. Diameter	43	mm

LIMITING VALUE

V_a max.	200	V

CHARACTERISTICS

V_a	200	V
V_g	–2.0	V
I_a	2.0	mA
g_m	2.0	mA/V
μ	72	
r_a	36	kΩ



Brit. 5-pin

OPERATING CONDITIONS
As Resistance Coupled Amplifier

V_a	200	V
I_a	1.3	mA
R_k	1.8	kΩ
R_a	75	kΩ
$V_{out(r.m.s.)}$	70	V
D_{tot}	5.0	%

994V

HIGH IMPEDANCE TRIODE (OBSOLETE)

HEATER

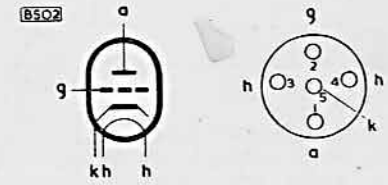
V_h	4.0	V
I_h	650	mA

LIMITING VALUE

V_a max.	200	V

CHARACTERISTICS

V_a	100	V
V_g	0	V
g_m	3.6	mA/V
μ	125	
r_a	35	kΩ



Brit. 5-pin

6153T

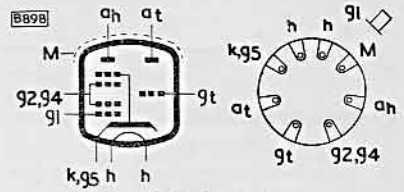
TRIODE HEXODE (OBSOLETE)

HEATER

V_h	6.3	V
I_h	950	mA

DIMENSIONS

Max. Overall Length	138	mm
Max. Diameter	37	mm



Side Contact

LIMITING VALUES

Hexode Section

V_a max.	300	V
p_a max.	1.0	W
V_{g2+g4} max.	125	V
p_{g2+g4} max.	600	mW
I_k max.	25	mA
V_{h-k} max.	50	V

Triode Section

V_a max.	125	V
p_a max.	1.0	W

CHARACTERISTICS

Hexode Section

V_a	250	V
V_{g2+g4}	100	V
V_{g1}	–2.0	V
I_a	12.7	mA
g_m	3.0	mA/V

Triode Section

V_a	100	V
V_g	–2.0	V
I_a	16	mA
g_m	3.8	mA/V

REPLACED BY: ECH21—Change base.

TELEVISION TUBE EQUIVALENT LIST

Tube Type	Mullard Direct Equivalent	Other Equivalents
C9A	—	CRM91, CRM92
C9B	—	—
C12A	—	CRM121
C12B	—	—
C12D	—	—
C12FM	MW31–74	121K, 12XP4
C14BM	—	—
C14FM	—	—
C14GM	—	—
C14HM	—	—
C14JM	—	—
C15B	—	—
C17BM	—	—
C17FM	—	—
C17GM	—	—
C17HM	—	—
C17JM	—	—
C21HM	—	—
C36–24	MW36–24	—
CRM71	—	—
CRM91	—	C9A
CRM92	—	C9A
CRM92A	—	C9A
CRM121	—	C12A
CRM121A	—	C12A
CRM121B	—	—
CRM122	—	—
CRM123	—	—
CRM124	—	—
CRM141	—	—
CRM142	—	—
CRM151	—	—
CRM152	—	—
CRM152A	—	—
CRM152B	—	—
CRM153	—	—
CRM171	—	—
MW6–2	MW6–2	—
MW22–7	See Page 271	—
MW22–14	See Page 271	—
MW22–14C	See Page 271	—
MW22–16	MW22–16	—
MW22–17	See Page 273	—
MW22–18	See Page 273	—
MW31–7	See Page 273	—
MW31–14	See Page 274	—
MW31–14C	See Page 274	—
MW31–16	MW31–74	C12FM, 12XP4, 121K
MW31–17	See Page 274	—
MW31–18	See Page 274	112K
MW31–20	See Page 275	—
MW31–21	See Page 275	—
MW31–22	See Page 275	—
MW31–23	See Page 275	—
MW31–74	MW31–74	12XP4A
MW36–22	MW36–24	14KP4
MW36–24	MW36–24	14KP4A, 141K
MW36–44	MW36–44	—
MW41–1	MW41–1	—
MW43–43	MW43–43	—
MW43–64	MW43–64	172K
T9/2	—	—
T9/3	—	—
T9/4	—	—
T9/5	—	—
T12/2	—	—
T12/44	—	—
T12/46	—	—
T12/54	—	—
T12/56	—	—
T12/71U	—	—
T12/72U	—	—
T12/81U	—	—

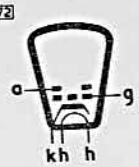
Tube Type	Mullard Direct Equivalent	Other Equivalents
T12/82U	—	—
T12/91	—	—
T12/92	—	—
T12/100	—	—
T12/404	—	—
T12/449	—	—
T12/504	—	—
T12/549	—	—
T900	—	—
T901	MW41–1	—
T901A	MW41–1	—
T908	—	—
T911	—	—
TA10	—	—
TA15	—	—
TR14/1	—	—
TR14/2	—	—
TR14/4	—	—
TR14/12	—	—
TR14/13	—	—
TR17/1	—	—
TR17/2	—	—
TR17/7	—	—
TR17/8	—	—
TR21/20	—	—
TR21/21	—	—
3/1	—	—
3/2	—	—
3/3	—	—
3/4	—	—
3/5	—	—
3/6A	—	—
3/16	—	—
3/18	—	—
3/20	—	—
3/31	—	—
3/32	—	—
3NP4	MW6–2	—
4/13	—	—
4/14	—	—
4/15	—	—
6/5	—	—
6/6	—	—
6/7	—	—
12XP4	MW31–74	C12FM, 121K
12XP4A	MW31–74	—
14KP4	MW36–24	—
14KP4A	MW36–24	141K
14LP4	MW36–24	—
15EP4	—	—
17ARP4	—	—
17ASP4	—	171K
17AXP4	—	—
65K	—	—
65K/2	—	—
75K	—	—
85K	—	—
105K	—	—
108K	—	—
112K	See Page 276	C12FM, 12XP4
121K	MW31–74	—
141K	MW36–24	14KP4A
171K	—	17ASP4
172K	MW43–64	—
6504A	—	—
6505A	—	—
6506A	—	—
6703A	—	—
6704A	—	—
6705A	—	—
6706A	—	—
6801A	—	—
6802A	—	—
6901A	—	—
7101A	—	—
7102A	—	—
7201A	—	—
7202	—	—
7203A	—	—
7204	—	—
7401A	—	—

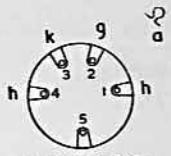
MW6-2

TELEVISION TUBE

Projection television tube with $2\frac{1}{2}$-in. diameter metal-backed screen.

B572





M, Spark trap.

5-side contact

DIMENSIONS

Max. Overall Length	268	mm
Max. Screen Diameter	65.5	mm
Max. Neck Diameter	22	mm

HEATER

Indirectly heated.
This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note.—(applies to series operation only)
The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

SPARK TRAP AND EXTERNAL COATING

This tube has an external coating, M, and the capacitance of this to the anode may be used to provide smoothing for the e.h.t. supply.
Incorporated within the tube is a spark trap so positioned that it prevents any internal flash-over taking place between the anode and the grid. The spark trap and external conductive coating must both be connected to the chassis.

OPERATING CONDITIONS

V_a	25	kV
$I_{a(av)}$	150	μA
V_g for cut-off	–40 to –90	V

LIMITING VALUES (Design centre ratings).

V_a max.	25	kV
$-V_g$ max.	200	V
$+V_{g(pk)}$ max.	2.0	V
V_{h-k} max.	125	V
R_{g-k} max.	1.5	MΩ
R_{h-k} max.	20	kΩ
Min. raster area	14	cm^2

X-RADIATION PROTECTION

For the purpose of normal adjustment, centering, etc. when it is necessary to view the tube outside an optical unit, the tube should be operated at the minimum brightness consistent with examination of the picture. No protection against X-radiation is then necessary.
Should it be desired, however, to operate the tube at full brightness outside an optical unit, the use of a lead glass shield is recommended. The location and dimensions of the shield should be such as to interrupt the X-radiation between the tube and the observer. The equivalent lead thickness of the shield must not be less than 0.5mm. This precaution is desirable in the region within 40-in. of the tube screen, and is necessary *only when operating the tube outside an optical unit.*

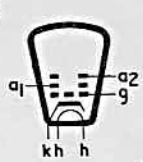
REPLACEMENT FOR: 3NP4—Direct

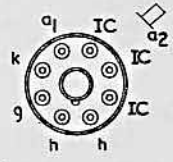
MW22-7

TELEVISION TUBE (OBSOLETE)

Television tube with 9-in. diameter screen without external coating or ion trap.

B8B5





B8G

HEATER

V_h	6.3	V
I_h	600	mA

OPERATING CONDITIONS

V_{a_2}	7.0	kV
V_{a_1}	200	V
V_g for cut-off	–40	V

DIMENSIONS

Max. Overall Length	378	mm
Max. Screen Diameter	232	mm
Max. Neck Diameter	35.5	mm

LIMITING VALUES (Design centre ratings)

V_{a_2} max.	7.0	kV
V_{a_1} max.	400	V
V_{h-k} max.	150	V

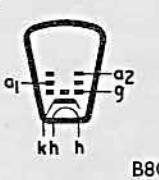
REPLACED BY: MW22-16—Change base. Earth external coating and fit and adjust ion-trap magnet type IT6. In some cases this may necessitate modifying the rear tube support. This modification cannot be made to some receivers, and in such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

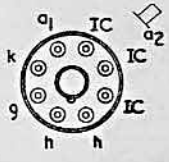
MW22-14
MW22-14C

TELEVISION TUBE (OBSOLETE)

Television tube with 9-in. diameter screen not incorporating an ion trap.

B8B5





B8G

The MW22-14 has an external coating M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

The MW22-14C has no external coating.

HEATER

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

V_{a_2}	7.0	kV
V_{a_1}	200	V
V_g for cut-off	–40	V

DIMENSIONS

Max. Overall Length	376	mm
Max. Screen Diameter	230	mm
Max. Neck Diameter	35.5	mm

LIMITING VALUES (Design centre ratings)

V_{a_2} max.	7.0	kV
V_{a_1} max.	300	V
V_{h-k} max.	150	V

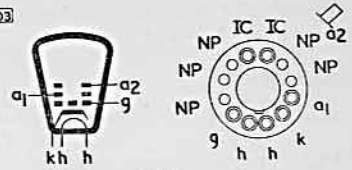
REPLACED BY: MW22-16—Change base. Earth external coating when replacing MW22-14C. Fit and adjust ion-trap magnet type IT6. In some cases this may necessitate modifying the rear tube support. This modification cannot be made to some receivers and in such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

MW22-16

TELEVISION TUBE

Television tube with 9-in. diameter screen, external coating and incorporating an ion trap.

B2Q3



B12A

DIMENSIONS

Max. Overall Length	380	mm
Max. Screen Diameter	231	mm
Max. Neck Diameter	35.5	mm

HEATER

Indirectly heated.

This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note.—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL COATING

This tube has an external coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

OPERATING CONDITIONS

V_{a_2}	7.0	9.0	kV
V_{a_1}	250	350	V
V_g for cut-off	–32 to –71	–44 to –99	V

LIMITING VALUES (Design centre ratings)

V_{a_2} max.	9.0	kV
V_{a_2} min.	4.5	kV
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	200	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ

ION TRAP

A space of 30mm along the neck of the tube from the edge of the base should be kept clear for the ion-trap magnet. A clamp of non-magnetic material not more than 10mm wide may be placed between this space and the focus coil.

Ion-trap magnet type IT6

REPLACEMENT FOR: MW22-7, MW22-14, MW22-14C, MW22-17, MW22-18. See instructions given under these types.

TELEVISION TUBE (OBSOLETE)

MW22-17
MW22-18

Television tube with 9-in. diameter screen.

Except for the following differences, types MW22-17 and MW22-18 are identical with type MW22-16.

MW22-17 has no ion trap or external coating.

MW22-18 has no ion trap.

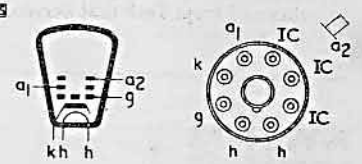
For operating conditions and limiting values see type MW22-16.

REPLACED BY: MW22-16. Earth external coating when replacing MW22-17. Fit and adjust ion-trap magnet type IT6. In some cases this may necessitate modifying the rear tube support. This modification cannot be made to some receivers, and in such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

TELEVISION TUBE (OBSOLETE)

MW31-7

B8G



HEATER

V_h	6.3	V
I_h	600	mA

For further details refer to type MW31-14C. Except for heater ratings, these two tubes are identical.

REPLACED BY: MW31-74—Change base. Earth external coating. Fit and adjust ion trap magnet type IT6. In some cases this may necessitate modifying the rear tube support. This modification cannot be made in some receivers, and in such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

MW31-14
MW31-14C

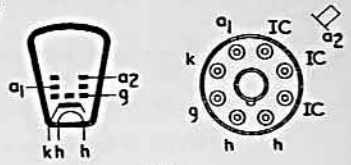
TELEVISION TUBE (OBSOLETE)

Television tube with 12-in. diameter screen, not incorporating an ion trap.

The MW31–14 has an external coating M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

The MW31–14C has no external coating.

B8G



HEATER

V_h	6.3	V
I_h	300	mA

OPERATING CONDITIONS

V_{a_2}	7.0	7.0	kV
V_{a_1}	160	200	V
V_g for cut-off	–35	–40	V

DIMENSIONS

Max. Overall Length	465	mm
Max. Screen Diameter	307	mm
Max. Neck Diameter	35.5	mm

LIMITING VALUES
(Design centre ratings)

V_{a_2} max.	7.0	kV
V_{a_1} max.	300	V
V_{h-k} max.	150	V

REPLACED BY: MW31–74—Change base. Earth external coating when replacing MW31–14C. Fit and adjust ion-trap magnet type IT6. In some cases this may necessitate modifying the rear tube support. This modification cannot be made to some receivers and in such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

MW31-16
MW31-17
MW31-18

TELEVISION TUBE (OBSOLETE)

Television tube with 12-in. diameter screen.

Except for the following differences, types MW31–16, MW31–17 and MW31–18 are identical with type MW31–74.

MW31–16 has a clear glass screen.

MW31–17 has a clear glass screen, no ion trap or external coating.

MW31–18 has a clear glass screen and no ion trap.

For operating conditions and limiting values see type MW31–74.

REPLACED BY:

MW31–16 – MW31–74—Direct.

MW31–17 – MW31–74—Earth external coating. Fit and adjust ion-trap magnet type IT6.*

MW31–18 – MW31–74—Fit and adjust ion-trap magnet type IT6.*

*This may necessitate modifying the rear tube support and in some receivers this modification cannot be made. In such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

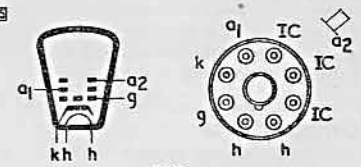
MW31-20
MW31-21

TELEVISION TUBE (OBSOLETE)

Television tube with 12-in. diameter metal-backed, clear glass screen but not incorporating an ion trap.

The MW31–21 has an external coating M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply. The MW31–20 has no external coating.

B8G



HEATER

V_h	6.3	V
I_h	300	mA

LIMITING VALUES

V_{a_2}	11	kV
V_{a_1} max.	350	V
$-V_g$ max.	150	V
V_{h-k} max.	150	V

DIMENSIONS

Max. Overall Length	471	mm
Max. Screen Diameter	308	mm
Max. Neck Diameter	35.5	mm

REPLACED BY: MW31–74—Change base. Earth external coating when replacing MW31–20. Fit and adjust ion trap magnet type IT6. This may necessitate modifying the rear tube support and in some receivers this modification cannot be made. In such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

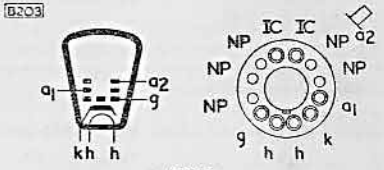
MW31-22
MW31-23

TELEVISION TUBE (OBSOLETE)

Television tube with 12-in. diameter metal-backed clear glass screen, but not incorporating an ion trap.

The MW31–23 has an external coating M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.
The MW31–22 has no external coating.

B12A



HEATER

V_h	6.3	V
I_h	300	mA

LIMITING VALUES

V_{a_2} max.	11	kV
V_{a_1} max.	350	V
$-V_g$ max.	150	V
V_{h-k} max.	150	V

DIMENSIONS

Max. Overall Length	471	mm
Max. Screen Diameter	308	mm
Max. Neck Diameter	35.5	mm

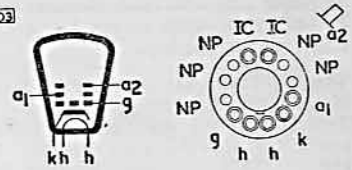
REPLACED BY: MW31–74—Change base. Earth external coating when replacing MW31–22. Fit and adjust ion trap magnet type IT6. This may necessitate modifying the rear tube support and in some receivers this modification cannot be made. In such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

MW31-74

TELEVISION TUBE

Television tube with 12-in. diameter grey glass screen, external coating and incorporating an ion-trap.

B12A



DIMENSIONS

Max. Overall Length	471	mm
Max. Screen Diameter	308	mm
Max. Neck Diameter	35.5	mm

HEATER Indirectly heated.

This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL COATING

This tube has an external coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

OPERATING CONDITIONS

V_{a_2}	7.0	9.0	kV
V_{a_1}	250	350	V
V_g for cut-off	–32 to –71	–44 to –99	V

LIMITING VALUES (Design centre ratings)

V_{a_2} max.	9.0	kV
V_{a_2} min.	4.5	kV
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	200	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ

ION TRAP

A space of 30mm along the neck of the tube from the edge of the base should be kept clear for the ion-trap magnet. A clamp of non-magnetic material not more than 10mm wide may be placed between this space and the focus coil.

Ion-trap magnet type IT6

REPLACEMENT FOR:

C12FM, MW31-16, 12XP4, 12XP4A, 121K—Direct.
MW31-7, MW31-14, MW31-14C, MW31-17, MW31-18, MW31-20, MW31-21, MW31-22, MW31-23.—See notes under these types for detailed information.

112K—Fit and adjust ion-trap magnet type IT6. This may necessitate modifying the rear tube support, and in some receivers this modification cannot be made. In such cases further instructions regarding replacements can be obtained from Technical Service Dept., Mullard Ltd.

TELEVISION TUBE (OBSOLETE)

MW36-22

Television tube with 14-in. diagonal rectangular screen.

Except for the following difference, type MW36–22 is identical with type MW36–24.

MW36–22 has a clear glass screen.

For operating conditions and limiting values see type MW36–24.

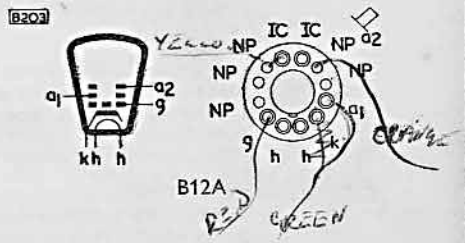
REPLACED BY: MW36–24—Direct.

TELEVISION TUBE

MW36-24

Television tube with 14-in. diagonal rectangular grey glass screen. This tube incorporates an ion trap.

B12A



DIMENSIONS

Max. Overall Length	429	mm
Max. Screen Dimensions	319.5×248.5	mm
Max. Neck Diameter	38	mm

HEATER Indirectly heated.

This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL COATING

This tube has an external coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

OPERATING CONDITIONS

V_{a_2}	10	kV
V_{a_1}	250	V
V_g for cut-off	–33 to –72	V

LIMITING VALUES (Design centre ratings).

V_{a_2} max.	14	kV
V_{a_2} min.	7.0	kV
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	150	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ

ION TRAP

Ion-trap magnet type IT9

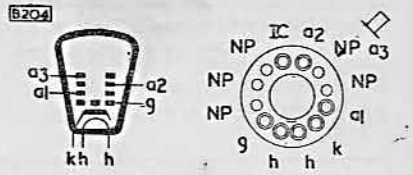
If V_{a_2} exceeds 10kV, the ion-trap magnet assembly should be earthed.

REPLACEMENT FOR: C36–24, MW36–22, 14KP4, 14KP4A, 14LP4, 141K—Direct.

MW36-44

TELEVISION TUBE

Television tube with 14-in. diagonal rectangular grey glass screen. This tube incorporates an ion trap and the electron gun is designed to give uniform focus over the whole screen.



B12A

DIMENSIONS

Max. Overall Length	429	mm
Max. Screen Dimensions	319.5×248.5	mm
Max. Neck Diameter	38	mm

HEATER Indirectly heated.

This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL COATING

This tube has an external coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

PREFOCUSING

The spot size and uniformity of focus depend upon V_{a_2}. At V_{a_2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a_2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased, resulting in inferior focus at the edges of the screen.

With increased V_{a_2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a_3}	10	kV
V_{a_2}	0	V
V_{a_1}	250	V
V_g for cut-off	–33 to –72	V

LIMITING VALUES (Design centre ratings).

V_{a_3} max.	14	kV
V_{a_3} min.	7.0	kV
V_{a_2} max.	410	V
V_{a_2} min.	–100	V
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	150	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

ION TRAP

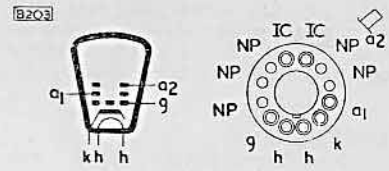
Ion-trap magnet type IT9

If V_{a_3} exceeds 10kV, the ion-trap magnet assembly should be earthed.

MW41-1

TELEVISION TUBE

Television tube with 16-in. diameter screen. It has a metal cone envelope and incorporates an ion trap.



B12A

Final anode (a_2) is lip of metal cone

DIMENSIONS

Max. Overall Length	459	mm
Max. Screen Diameter	406	mm
Max. Neck Diameter	38	mm

HEATER Indirectly heated.

This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

METAL CONE

The metal cone and glass face operate at a high voltage. Any material in contact with the cone or the face must have insulating properties adequate for 17kV.

OPERATING CONDITIONS

V_{a_2}	12	kV
V_{a_1}	300	V
V_g for cut-off	–39 to –86	V

LIMITING VALUES (Design centre ratings)

V_{a_2} max.	14	kV
V_{a_2} min.	7.0	kV
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	150	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ

ION TRAP

Ion-trap magnet type IT9

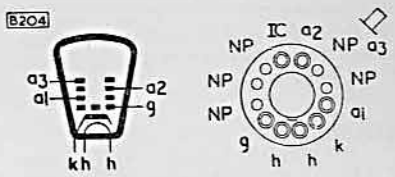
If V_{a_2} exceeds 10kV, the ion-trap magnet assembly should be earthed.

REPLACEMENT FOR : T901, T901A—Direct.

MW43-43

TELEVISION TUBE

Television tube with 17-in. diagonal rectangular grey-glass screen. This tube has a metal cone envelope and incorporates an ion trap. The electron gun is designed to give uniform focus over the whole screen.



B12A

Final anode (a_3) is lip of metal cone

DIMENSIONS

Max. Overall Length	482.5	mm
Max. Screen Dimensions	409×315.5	mm
Max. Neck Diameter	38	mm

HEATER Indirectly heated.
This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

METAL CONE
The metal cone and glass face operate at a high voltage. Any material in contact with the cone or the face must have insulating properties adequate for 17kV.

PREFOCUSING
The spot size and uniformity of focus depend upon V_{a_2}. At V_{a_2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a_2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased; resulting in inferior focus at the edges of the screen.
With increased V_{a_2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a_3}	14	kV
V_{a_2}	0	V
V_{a_1}	300	V
V_g for cut-off	–43 to –77	V

LIMITING VALUES (Design centre ratings)

V_{a_3} max.	14	kV
V_{a_3} min.	10	kV
V_{a_2} max.	410	V
V_{a_2} min.	–100	V
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	150	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

ION TRAP

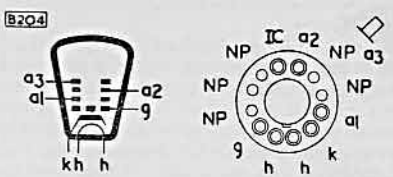
Ion-trap magnet type	IT9

If V_{a_3} exceeds 10kV, the ion-trap magnet assembly should be earthed.

MW43-64

TELEVISION TUBE

Television tube with 17-in. diagonal rectangular grey-glass screen. This tube incorporates an ion trap and the electron gun is designed to give uniform focus over the whole screen.



B12A

DIMENSIONS

Max. Overall Length	491	mm
Max. Screen Dimensions	392.7×314.2	mm
Max. Neck Diameter	38	mm

HEATER Indirectly heated.
This tube is suitable for series or parallel operation.

V_h	6.3	V
I_h	300	mA

Note—(applies to series operation only).—The surge heater voltage must not exceed $9.5V_{r.m.s.}$ when the supply is switched on. When used in a series heater chain a current limiting device may be necessary in the circuit to ensure that this voltage is not exceeded.

EXTERNAL COATING
This tube has an external coating, M, and the capacitance of this to the final anode may be used to provide smoothing for the e.h.t. supply.

PREFOCUSING
The spot size and uniformity of focus depend upon V_{a_2}. At V_{a_2} zero or negative with respect to cathode the spot size at the centre of the screen and the width of the electron beam are such that optimum uniformity of focus is obtained over the whole screen. If V_{a_2} is increased, the spot size at the centre of the screen is reduced but the width of the electron beam is increased, resulting in inferior focus at the edges of the screen.
With increased V_{a_2}, the power of the external focusing magnet has to be increased.

OPERATING CONDITIONS

V_{a_3}	14	kV
V_{a_2}	0	V
V_{a_1}	300	V
V_g for cut-off	–40 to –86	V

LIMITING VALUES (Design centre ratings).

V_{a_3} max.	14	kV
V_{a_3} min.	10	kV
V_{a_2} max.	410	V
V_{a_2} min.	–100	V
V_{a_1} max.	410	V
V_{a_1} min.	200	V
$-V_g$ max.	150	V
V_{h-k} max. (heater positive)	125	V
V_{h-k} max. (heater negative)	200	V
$v_{h-k(pk)}$ max. (heater negative)	410	V
R_{g-k} max.	500	kΩ
Max. a_1 supply source impedance	1.5	MΩ
Max. a_2 supply source impedance	1.5	MΩ

ION TRAP

Ion-trap magnet type	IT9

If V_{a_3} exceeds 10kV, the ion-trap magnet assembly should be earthed.

REPLACEMENT FOR : 172K—Direct.

ADJUSTMENT OF ION-TRAP MAGNET

Ion Traps

When installing a Mullard ion-trap picture tube it is necessary to fit an external magnet in order to deflect the electron stream towards the luminescent screen. The ion-trap magnet is fitted to a clamping ring so that it may be fixed to the neck of the tube. An arrow is marked on the magnet assembly so that when looking along the arrow the north pole is on the right-hand side. An electron beam travelling between the pole pieces, in the direction of the arrow, will be deflected away from the actual magnet, which is located on the same side of the assembly as the arrow. Conversely, when the beam travels through the pole pieces in the direction opposite to that of the arrow it will be attracted towards the magnet. Hence there are two possible ways of using an ion-trap magnet to make the beam negotiate the bend in the gun; with the arrow pointing toward the screen or towards the base. The following procedure which has been found to give the better spot size should be adopted for adjusting the position of the magnet.

1 **a** With the voltage supplies to the tube switched off and the base socket removed slip the magnet assembly over the tube base with the arrow pointing *away* from the screen, and diametrically *opposite* the line marked on the neck of the tube. This line will normally be approximately in line with the position reserved for Pin No. 3 on the base. Adjust the assembly so that it is slightly in advance of the tube base.

b Fit the socket to the tube. Switch on the voltage supplies and adjust the brightness control. If necessary, adjust the position of the ion-trap magnet until a raster is obtained. Ensure that the picture centering controls are set at zero shift.

c Move the magnet assembly along the neck of the tube towards the screen until the raster brightness begins to decrease. Then move the magnet back towards the base until the brightness once more begins to decrease. Return the magnet to the position of maximum brightness lying between these two extremes. The magnet should now be rotated slightly to find the midpoint of the range of rotation which gives maximum brightness.

d Lock the magnet in position, taking care not to alter its position.

2 With the procedure given above more accurate centering of the beam in the final aperture can be produced if the beam diameter is increased by underfocusing. Where there is penetration of the field of the focus unit into the ion-trap region, an adjustment of the focus control will move the electron beam in the final aperture. This movement may be sufficiently large to 'black out' the picture. Accurate centering with an under-focused beam reduces this possibility.

3 The movement produced by the focusing field, and hence 'blacking out', may also be reduced by the following additional procedure:—
Note the angle between the centre line of the ion-trap assembly set by the procedure in (1), and the plane which passes through the bend in the gun of the cathode ray tube. If this angle is more than $\pm 10°$, rotate the magnet in a direction to reduce the angle and compensate any reduction in brightness by adjusting the angle between the focus unit and the tube neck. By successive adjustments, it will be possible to place the ion-trap magnet in line with the plane containing the bend of the gun.

CONVERSION OF TELEVISION RECEIVERS TO EMPLOY MULLARD PICTURE TUBES

When a receiver is to be converted to use a Mullard Picture Tube, the following notes should be used as a general guide.

Mounting

Whilst most moulded flexible masks and plastic implosion guards can be expected to fit the Mullard tubes, it would be advisable in some instances to check this by mounting the tube in the receiver, at the same time noting that the e.h.t. connector can be positioned clear of any metal work and that there is sufficient space to accommodate the ion-trap magnet on the tube neck. As a general guide, about 30mm ($1\frac{1}{4}$ in.) of the glass neck above the base is needed to allow for the adjustment of this magnet. When more space is required, the focus unit in the majority of receivers can be moved towards the deflection coils without any difficulty. In others, it may also be necessary to move the tube clamp along the neck nearer to the focus unit. Alternatively, it may require to be repositioned so as to clamp either the tube base or the neck between the deflection coils and the focus unit.

In a few instances, it may be found that the clamp has to be replaced by one made of a non-ferrous metal in order to avoid affecting the influence of the ion-trap magnet. When this is the case, a rubber grommet can usually be fitted in the back plate of the rear tube support. It will be necessary to enlarge the hole in the back plate sufficiently for the grommet to fit closely, and care should be taken to ensure that this is done symmetrically.

Heater Voltage

The Mullard tubes MW22-16 and MW31-74 have heaters rated at 6.3V, 300mA. If the receiver being converted originally used a tube with a 6.3V heater or one with a 300mA rating for inclusion in a series connected chain, no modification is needed, but it is advisable in the latter case to check that the heater current is within the specified limits.

The heater current of a series connected tube should be within 5% of its nominal value and for parallel connected heater the voltage should be within 7% of the nominal.

Measurements should be made with the nominal supply voltage connected to the appropriate tap.

Where the heater voltage is different, then one of the following courses can be taken:—

1. If the original tube had a 2 or 4V heater, it may be practicable to add turns to the mains transformer, about four for each additional volt required. The extra turns must be well clear of any e.h.t. winding and must be joined in the correct phase, and in series with the original winding.

2. In some earlier receivers, it is possible to add the existing 2V winding in phase and in series with one of the 4V windings supplying the valves and thereby obtain the requisite voltage for the tube.

3. When the receiver is already fitted with a small heater transformer, it is not a difficult matter to rewind the secondary, normally the outer winding, for 6.3V. Allowing 10 turns per volt, for this type of transformer, 60 turns of 28 s.w.g. enamelled copper wire will be required. Alternatively, to avoid dismantling the core, additional turns (at 10 turns per volt) could no doubt be added to the existing winding as previously described.

4. There are many receivers in which the 6.3V supply for the tube heater can be taken from the transformer winding which supplies the valves.

5. Having given due consideration to these alternatives, the fitting of a replacement or separate heater transformer may prove in some instances to be the simplest method.

Before proceeding, some thought must be given to the potential which may exist between the heater and the cathode of the tube. When the heater is fed from an isolated winding on the transformer, this potential is held at a minimum by simply connecting a small $\frac{1}{2}$W fixed resistor of up to 1MΩ between one side of the heater and cathode.

However, when the tube heater is fed from a source which is common to the valve heaters, care must be taken to ensure that the maximum heater-to-cathode potential of the tube is not exceeded. On Mullard tubes, it is permissible to run the cathode up to 200V positive, and to keep within this limit the video potential divider as shown in Figure 1 is sometimes necessary.

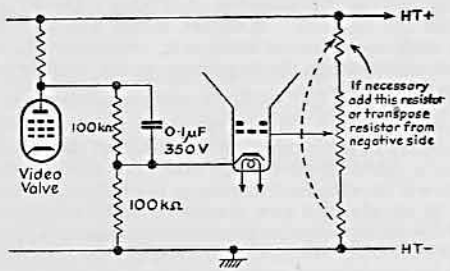


Fig. 1—Showing potential divider across video stage and compensation of brightness control circuit.

It will be seen that by using this potential divider in some receivers to reduce the cathode potential, two useful purposes can be served:—

a Limiting of heater-to-cathode potential

and

b Effectively increasing the first anode potential with respect to cathode.

The d.c. component should not be reduced by more than 3:1, otherwise the fly-back lines may become visible at normal settings of the brightness and contrast controls.

The various methods of obtaining this anode potential are now to be described.

First Anode Voltage

An h.t. supply of between 200 and 400V with respect to the tube cathode is required for the first anode of the Mullard tube. This voltage may be obtained in a number of ways, the following having been successfully tested:—

1. From one of the higher voltage h.t. lines. Frequently the voltage of the boost capacitor in the line timebase will be found to be adequate.
In some cases in order to prevent damping the line timebase, a filter network consisting of a 470kΩ resistor decoupled by a 0.1μF capacitor may be used.

2. From a small additional rectifier connected to the highest tapping on the primary of the mains transformer. This arrangement shown in Figure 2 provides a little over 300V.

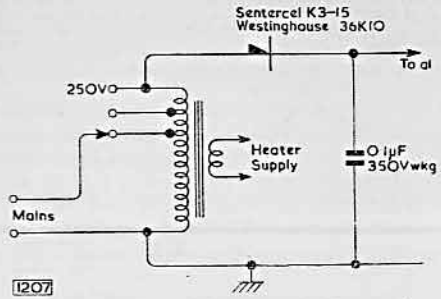


Fig. 2—Method of obtaining the first anode potential by rectifying the mains input voltage.

3. From a small additional rectifier employed in conjunction with the existing h.t. source as a voltage doubler (see Figure 3) between 400 and 500V can then be obtained. In some a.c. mains-operated receivers where the additional first anode voltage required is not large, it may be found more satisfactory to place a potential divider across half the secondary winding of the mains transformer. The voltage doubling arrangement should be fed from the junction of the divider. When calculating the values of the resistors forming the potential divider a bleeder current of 1mA is usually taken.

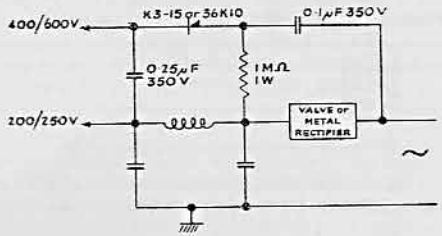


Fig. 3—Voltage doubler circuit using an additional rectifier in conjunction with existing h.t. source.

4. By means of a tap on the potential divider, which is connected across the e.h.t. source in some receivers. The divider usually consists of 1W carbon resistors connected in series, one resistor being required for each kV of e.h.t. The value of the most earthy resistor is chosen to provide about 400V for the first anode supply.

5. By adding a tap on the Metrosil resistor which is sometimes employed to stabilise the e.h.t. voltage. The tap may take the form of a small narrow clamp, or it may be made by means of a loop, as shown in Figure 4, of 30 s.w.g. tinned copper wire (15A fuse wire) so that the loop can be tensioned firmly around the body of the Metrosil and soldered in position after adjustment. The clamp or loop should be positioned $\frac{3}{16}$ in. from the earthy end. The tapping point will be found to be critical. It should be adjusted to provide 400 to 500V with respect to the chassis by measurement on a high impedance voltmeter.

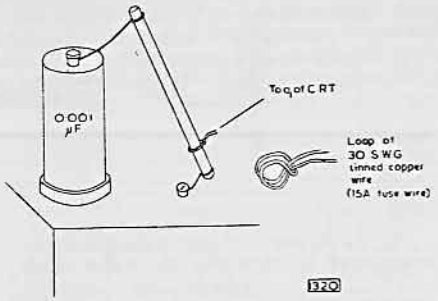


Fig. 4—Method of tapping Metrosil.

6. By rectifying a part of the voltage which appears across the line coil or at the tap on the line transformer. Metrosil is frequently employed for this purpose (see Figure 5).

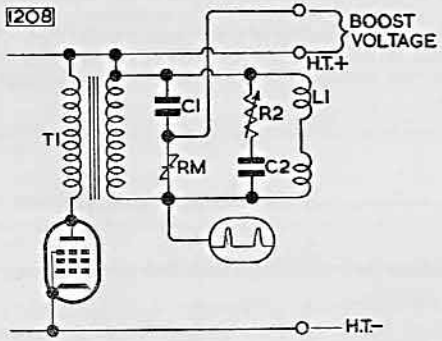


Fig. 5—Method of obtaining the first anode potential from the line deflector coils.

The choice of one of these methods is governed mainly by the general circuit arrangement used in the receiver being modified, and it is impossible to lay down any hard and fast rules. However, a few minutes spent in considering the problem before any work is undertaken will be well repaid in ensuring that the best possible picture is obtained. The value of the first anode voltage has a very definite effect upon the picture. For example, the higher the voltage is made, within the limits specified, the sharper will be the focus, and the greater the highlight intensity, but the lower the tube sensitivity. Whilst the permitted variation is 200 to 400V it is advisable to use a potential which is as near 300V as possible, this being found to give the best all-round results. It is most important to remember that the first anode potential is measured with respect to the tube cathode and not to the chassis of the receiver; thus to reduce the cathode voltage of the tube is in

effect increasing the first anode voltage. This point is important because in receivers in which difficulty is experienced in obtaining a sufficiently high first anode voltage, the cathode potential of the tube can be reduced by the inclusion of a divider network across the output of the video valve. This arrangement as shown in Figure 1 will be found to be equally suitable for tubes which are grid or cathode modulated. Having added a divider in the video stage, it is important to check that the range of the brightness control is adequate. If correction to the brightness control circuit is required, then it is either necessary to add a fixed resistor in the positive lead to the control, or transpose one already connected in the earthy or negative side to the positive side.

Focusing Arrangements

When substituting a tetrode tube in place of one having a triode gun, it is necessary to reduce the focusing field strength by about 20%. If an electromagnet is used it is only necessary to reduce the current in the coil. This is achieved by shunting the coil if it is connected in series with the h.t. rail, or by increasing the series resistance if the coil is across the h.t. supply. Figure 6 indicates the position of the additional resistor in both cases.

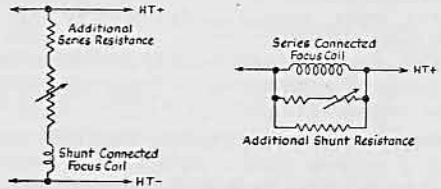


Fig. 6—Method of limiting current through focus coil.

If the receiver is fitted with a permanent magnet, the range of adjustment provided on the gap size may be sufficient to allow for the required reduction in field strength. If not, a system of magnetic shunts must be employed. This arrangement is simple to apply and consists merely of placing three or four shunting pieces across the pole pieces of the magnet. These shunts might take the form of mild steel strips $\frac{1}{16}$ in. or $\frac{1}{8}$ in. thick and $\frac{1}{4}$ in. to $\frac{1}{2}$ in. in width and long enough to fit between or, where this is not easy, to bridge the pole pieces (end plates) of the magnet. Where the focusing system uses a combination of permanent magnet and electromagnet sections, mild steel shunts as described should be used and in addition a pre-set resistor should be connected in parallel with the coil (which is normally included in the h.t. feed to one of the valves) to reduce the current in the coil to the required amount. When adjusting this resistor, the normal focus control should be set in the optimum position.

E.H.T. Supply

In early post war receivers where the e.h.t. voltage was of the order of 4 to 5kV it may be found necessary in order to improve the picture brightness, to raise the e.h.t. to approx. 7kV. This can be achieved by rectifying the peak voltage appearing at the anode of the line output valve and adding this to the existing e.h.t. supply. An article on this subject appeared in the January 1951 issue of *Wireless World*, pages 27 and 28.

In the case of any difficulty being encountered with any specific model our Technical Service Department is available to offer advice and information.

REPLACEMENT OF MULLARD NON-ION-TRAP TUBES BY ION-TRAP TUBES

Make of receiver	Replacement instructions
ALBA	**411, 421.** Direct substitution. Earth aquadag coating where clear tube was previously fitted. **MT431, MT362, MT441, MT442, T331, T352, T431, T432.** Remove existing retaining clip on neck of tube and replace with rubber grommet as fitted in later sets. Earth aquadag coating in cases where clear tube previously fitted.
BUSH	**TV1, TV91.** Replace wooden clamp by small metal clamp*. Earth aquadag coating. **TV2.** Replace wooden clamp by small metal clamp.* Earth aquadag coating. In some models the first anode voltage is low, and should be increased by adjusting the bleeder in the e.h.t. circuit. **TV11, TV12, TV22, TUG12, TUG12B.** Replace existing clamp by a narrower clamp*. Earth aquadag coating except with TV22 where provision for earthing is already made.
FERGUSON	**941, 943, 945, 951, 953, 955.** Move forward the rear tube holding bracket to full extent of slots. Care should be taken to ensure that when the picture shift plate (of the p.m. focus assembly) is operated, it does not damage the deflection coil winding. Earth aquadag coating. **841, 841/12, 842, 843.** To make room for ion-trap magnet adjustment, cut away sleeve of rubber grommet holding the tube. Earth aquadag coating. **968, 978.** Direct substitution.
INVICTA	**T108, T110.** Direct substitution. **T102, T103, T104.** To give sufficient room on the neck of the tube for the correct adjustment of the ion-trap magnet, it may be found necessary to move forward the rear tube holding bracket. Care should be taken to ensure that when the picture shift plate (of the p.m. focus assembly) is operated, it does not damage the deflection coil winding.
McMICHAEL	**912.** Reverse the rear plate supporting the tube neck and transpose the two plates clamping the neck of the tube. The four 4BA shank-bushes used for securing the two clamp plates have either to be drilled out to clear 4BA or alternatively 6BA screws can be used. The two clamp plates together with their two sponge rubber pads now bear on the tube base. With the back plate reversed there is now ample room for adjustment of the ion trap magnet IT6. *Parts are available at a nominal cost on application to Bush Radio Ltd.

Make of receiver	Replacement instructions
MULLARD	**MTS389, MTS521.** Direct substitution. Earth aquadag coating where clear tube previously fitted. **MTS501, MTS684.** Replace ferrous support bracket with non-ferrous type.* Earth aquadag coating where clear tube previously fitted.
PETO SCOTT	**TV124, TV126.** Direct substitution. **TV91, TV92, TV92M, TV121, TV122, TV122M.** Ensure focus coil is as far up neck of tube as possible. Earth aquadag coating.
PHILIPS	**383, 463, 1502U.** Direct substitution. Earth aquadag coating where clear tube previously fitted. **520A, 563, 663A.** Direct substitution. Earth aquadag coating where clear tube previously fitted. On some of these models there is insufficient room to adjust ion-trap magnet, and in these cases the IT9 should be used. **385U, 485U, 492U, 683U.** Replace ferrous support bracket with non-ferrous type.* Earth aquadag coating where clear type previously fitted.
PYE	**BV30, BV30C, BV51, LV30C, LV51.** Direct substitution. **B16T, D16T.** Direct substitution. Earth aquadag coating. **B18T.** Change base. May be necessary to use IT9 ion-trap magnet.
RAYMOND	**F26.** Direct substitution. Earth aquadag coating.
STELLA	**ST1480, ST1522.** Direct substitution. Earth aquadag coating.
VIDOR	**390, 391, 405, 406, CN4201, CN4202.** Direct substitution. Earth aquadag coating. **CN4206, CN4207, CN4208, CN4209, CN4210, CN4211.** Direct substitution. IMPORTANT: In all cases where a clear tube is replaced by one with external aquadag coating, it is essential that this coating is effectively earthed. *Limited supplies are available from the manufacturer's Service Dept.

COMMUNICATIONS AND INDUSTRIAL TYPES

In addition to the normal receiving types shown in this book, Mullard Ltd., manufacture the following Communications and Industrial valves and cathode ray tubes.

BATTERY SUBMINIATURES
DAF70
DC70
DF72
DF73
DL70
DL73
DL75
DY70

INDIRECTLY HEATED SUB-MINIATURES
EA76
EC70
EF70
EF71
EF72
EF73
EY70

VOLTAGE STABILISERS AND REFERENCE TUBES
75B1
85A1
85A2
90C1
95A1
108C1/OB2
150B2
150C2/OA2
150C3/OD3
4687
4687A
7475
13201A

COLD CATHODE TUBES
Z300T/1267
Z800U
Z801U
Z803U
Z900T/5823

PHOTO-ELECTRIC CELLS
20CG
20CV
58CG
58CV
61SV
90AG
90AV
90CG
90CV

INSTRUMENT CATHODE RAY TUBES
DB4–1
DB4–2
DB7–5
DB7–6
DB13–2
DG4–1
DG4–2
DG7–5
DG7–6
DG7–32
DG7–36
DG13–2
DG16–21
DP4–1
DP4–2
DP7–5
DP7–6
DP13–2
MC13–16

RADAR AND MONITOR CATHODE RAY TUBES
MF13–1
MF31–22
MF31–55
MF41–10
MW13–35
MW22–22
MW36–67
MW43–67

FLASH TUBES
LSD2
LSD3
LSD5
LSD7
LSD8
LSD24

DECADE COUNTER TUBE
E1T

IMAGE CONVERTER TUBES
ME1200AA
ME1201AA
ME1202CA

R.F. POWER TRIODES
MZ2–200
TX12–12W
TY2–125
TY3–250
TY4–500
TY12–50A
TY12–50W
TYS4–500
TYS5–1000
TYS5–3000

R.F. POWER TETRODES
QV03–12/5763
QV04–7
QV05–25/807
QV06–20/6146
QV1–150A/4X–150A
QY3–65/4–65A
QY3–125
QY4–250
QY5–3000A
QY5–3000W

R.F. POWER DOUBLE TETRODES
QQV03–10
QQV03–20A
QQV06–40A

DISC SEAL TRIODES
TD03–5
TD03–10
TD04–20

MAGNETRONS
JP9–7/2J42
JP9–7A
JP9–15/2J42A

KLYSTRONS
KS9–20/723A/B
KS9–20A/2K25

THYRATRONS
AN1
CST1-6000
CST2–12
CT10–12
EN32
EN70
EN91/2D21
XG1–2500/MT57
XG5–500/MT17
XGQ2–6400/MT105
XR1–3200/5544
XR1–6400/5545

POWER RECTIFIERS
RG1–240A
RG3–250
RG3–250A/866A
RG3–1250
RR3–250/3B28
RR3–1250/4B32
XG15–12

HYDROGEN THYRATRONS
XH3–045/3C45
XH8–100/4C35
XH16–200/5C22

ELECTROMETER VALVES
ME1400
ME1401
ME1402
ME1403

MISCELLANEOUS
EC90/6C4
EL85
EL821/6CH6
EL822
EY84
E90CC
E180F

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