



# BR/BW1165 Series

R.F. POWER  
TRIODES

## Service Type (BR1165) CV3926

The data should be read in conjunction with the Power Triode Preamble.

### ABRIDGED DATA

Three r.f. power triodes intended for a.m., f.m. or television transmitters and for industrial applications. They differ only in anode dissipation and in the method of anode cooling.

#### Anode cooling:

BR1165	forced-air
BW1165	water; separate jacket
BW1165J3	water; integral jacket

#### Anode dissipation:

BR1165	5.0	kW max
BW1165, BW1165J3	6.0	kW max

Anode voltage	6.0	kV max
Operating frequency	220	MHz max

#### Output power:

class B audio, per valve	6.65	kW
class C telegraphy, f.m. telephony	6.9	kW
class C television, per valve	4.5	kW
class C industrial oscillator	6.5	kW

### GENERAL

#### Electrical

Filament	thoriated tungsten	
Filament voltage (see note 1)	12.6	V
Filament current	33	A
Peak usable cathode current	8.5	A
Amplification factor ( $V_a = 4.0\text{kV}$ , $I_a = 1.0\text{A}$ )	32	
Mutual conductance ( $V_a = 4.0\text{kV}$ , $I_a = 1.0\text{A}$ )	17	mA/V
Inter-electrode capacitances:		
grid to anode	11	pF
grid to filament	16	pF
anode to filament	0.3	pF

## Mechanical

Overall dimensions . . . . . see outline drawings

Net weight:

BR1165 . . . . .	10.1 pounds (4.6kg) approx
BW1165 . . . . .	1 pound (0.45kg) approx
BW1165J3 . . . . .	1.8 pounds (0.7kg) approx

Mounting position:

BR1165, BW1165J3 . . . . .	vertical, either way up
BW1165 . . . . .	vertical, filament pins up

## Accessories

Filament connectors . . . . .	MA146A
Centre-tap dissipating connector . . . . .	MA146A
Grid connector (above 30MHz) . . . . .	MA147A
Grid connector (below 30MHz) . . . . .	MA148A
Insulating pedestal for BR1165 . . . . .	MA149A
Water jacket for BW1165 . . . . .	BW4088A
Sealing ring (supplied with BW1165) . . . . .	MA314

## COOLING

### Anode

The air cooling requirements for BR1165 are given in the following table. The air flow should be delivered immediately before and during the application of any voltages.

Anode dissipation (kW)	Height above sea level (m)	Inlet temperature (max) (°C)	Rate of flow of air (min) (m <sup>3</sup> /min)	Pressure drop (mm water)
1.0	0	35	3.0	8.0
1.0	0	45	3.1	8.0
1.0	1500	35	3.7	9.0
1.0	3000	25	4.1	10
3.0	0	35	5.2	23
3.0	0	45	6.1	29
3.0	1500	35	6.2	26
3.0	3000	25	6.6	26
5.0	0	35	9.2	68
5.0	0	45	10.7	90
5.0	1500	35	11.2	81
5.0	3000	25	11.6	79

The BW1165 anode must be fitted into a water jacket for cooling, the recommended jacket being type BW4088A. The water cooling requirements are given in the following table.

Anode dissipation (kW)	Inlet tempera- ture (°C)	Rate of flow of water		Pressure drop across jacket (atm)
		l./min	gal./min	
1.0	20	2.5	0.55	0.08
1.0	50	3.0	0.66	0.10
2.0	20	2.5	0.55	0.08
2.0	50	5.0	1.10	0.30
4.0	20	4.0	0.88	0.18
4.0	50	9.0	1.98	0.90
6.0	20	6.0	1.32	0.4
6.0	50	14	3.08	2.5

The BW1165J3 has an integral water jacket. Minimum water cooling requirements are shown on page 16; higher rates of flow should be used where possible. A thermal fuse may be fitted (see page 20).

#### Filament, Grid and Anode Seals

It may be necessary to direct a flow of air on to the filament and grid seals in order to maintain their temperatures within the following limits.

Temperature of filament seals . . . . .	210	°C max
Temperature of grid and anode seals . . . . .	180	°C max

#### Filament Centre-tap Pin

A heat dissipating connector such as MA146A must be used on the filament centre-tap pin.

**AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR (Class B)****MAXIMUM RATINGS (Absolute values)**

Anode voltage	6.0	kV max
Anode current	1.5	A max
Anode input power	9.0	kW max
Anode dissipation	6.0	kW max
Grid dissipation	120	W max
Grid circuit resistance	15	k $\Omega$ max
Cathode current (peak)	5.7	A max

**TYPICAL OPERATING CONDITIONS (Class B, 2 valves)**

Anode voltage	3.0	3.5	4.0	kV
Grid voltage	-90	-100	-112	V
Peak a.f. grid drive voltage (per valve)	285	310	318	V
Anode current (zero signal)	2 x 65	2 x 75	2 x 100	mA
Anode current (maximum signal)	2 x 0.80	2 x 0.95	2 x 0.94	A
Grid current (maximum signal)	2 x 0.20	2 x 0.18	2 x 0.19	A
Effective load (anode to anode)	4.4	4.2	4.9	k $\Omega$
Nominal driving power (maximum signal)	2 x 52	2 x 50	2 x 54	W
Anode dissipation	2 x 0.75	2 x 1.0	2 x 1.1	kW
Output power (maximum signal)	3.3	4.6	5.3	kW
Efficiency	69	70	71	%
Total distortion	3.3	2.9	2.6	%
Anode voltage	4.5	5.0	6.0	kV
Grid voltage	-125	-138	-165	V
Peak a.f. grid drive voltage (per valve)	327	330	455	V
Anode current (zero signal)	2 x 100	2 x 110	2 x 125	mA
Anode current (maximum signal)	2 x 0.92	2 x 0.91	2 x 1.50	A
Grid current (maximum signal)	2 x 0.19	2 x 0.14	2 x 0.28	A
Effective load (anode to anode)	6.1	6.4	4.9	k $\Omega$
Nominal driving power (maximum signal)	2 x 27	2 x 42	2 x 115	W
Anode dissipation	2 x 1.15	2 x 1.25	2 x 2.35	kW
Output power (maximum signal)	6.0	6.6	13.3	kW
Efficiency	72	73	74	%
Total distortion	3.7	3.3	4.3	%

## RADIO FREQUENCY POWER AMPLIFIER

(Class B Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

### MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.1	A max
Anode input power	6.6	kW max
Anode dissipation	5.0	kW max
Grid dissipation	120	W max
Cathode current (peak)	4.6	A max

### TYPICAL OPERATING CONDITIONS (frequency 75MHz)

Anode voltage	5.0	6.0	kV
Grid voltage	-145	-180	V
Peak r.f. grid drive voltage	225	250	V
Anode current	900	990	mA
Grid current (100% modulation)	320	300	mA
Driving power (100% modulation)	160	170	W
Anode dissipation	3.0	4.0	kW
Output power	1.45	1.90	kW
Efficiency	32	32	%

## RADIO FREQUENCY POWER AMPLIFIER

(Class C Telegraphy, key down conditions, or F.M. Telephony, per valve)

### MAXIMUM RATINGS (Absolute values)

Anode voltage	6.0	kV max
Anode current	1.5	A max
Anode input power	9.0	kW max
Anode dissipation	5.0	kW max
Grid voltage (negative value)	1.0	kV max
Grid current	0.35	A max
Grid dissipation	120	W max
Cathode current (peak)	8.5	A max

**TYPICAL OPERATING CONDITIONS****(Grounded Cathode)**

Frequency . . . . .	75	75	75	110	MHz
Anode voltage . . . . .	4.0	5.0	6.0	5.0	kV
Grid voltage . . . . .	-200	-300	-400	-300	V
Peak r.f. grid drive voltage . . . . .	500	640	740	640	V
Anode current . . . . .	1.37	1.50	1.50	1.25	A
Grid current . . . . .	350	330	310	300	mA
Nominal driving power . . . . .	190	240	275	250	W
Anode dissipation . . . . .	1.5	1.9	2.1	1.45	kW
Output power . . . . .	4.0	5.6	6.9	4.8	kW
Efficiency . . . . .	73	75	76.5	70	%

**TYPICAL OPERATING CONDITIONS****(Grounded Grid, 2 valves)**

Frequency . . . . .	75	110	110	220	MHz
Anode voltage . . . . .	6.0	4.0	5.0	4.0	kV
Filament-grid voltage . . . . .	400	200	300	200	V
Peak r.f. drive voltage, filament to filament . . . . .	1480	1000	1280	900	V
Anode current . . . . .	2 x 1.5	2 x 1.37	2 x 1.5	2 x 1.25	A
Grid current . . . . .	2 x 310	2 x 350	2 x 330	2 x 220	mA
Nominal driving power . . . . .	2 x 1190	2 x 705	2 x 965	2 x 395	W
Anode dissipation . . . . .	2 x 2.1	2 x 1.7	2 x 2.2	2 x 2.5	kW
Output power (see note 2) . . . . .	15.6	8.6	12	5.6	kW
Efficiency . . . . .	77	69	71	50	%

## ANODE MODULATED R.F. POWER AMPLIFIER

(Class C Telephony, carrier conditions per valve for use with a maximum modulation factor of 1.0)

### MAXIMUM RATINGS (Absolute values)

Anode voltage	5.0	kV	max
Anode current	1.3	A	max
Anode input power	6.5	kW	max
Anode dissipation	3.4	kW	max
Grid voltage (negative value)	1.0	kV	max
Grid current	0.35	A	max
Grid dissipation	120	W	max
Cathode current (peak)	5.7	A	max

### TYPICAL OPERATING CONDITIONS

Frequency	75	75	75	MHz
Anode voltage	3.0	3.5	4.0	kV
Grid voltage	-250	-300	-300	V
Peak r.f. grid drive voltage	510	600	600	V
Anode current	1.0	1.2	1.2	A
Grid current	0.3	0.3	0.3	A
Nominal driving power	170	205	205	W
Anode dissipation	0.8	1.2	1.3	kW
Output power	2.2	3.0	3.5	kW
Efficiency	73	71.5	73	%

Frequency	75	75	110	MHz
Anode voltage	4.5	5.0	4.0	kV
Grid voltage	-350	-400	-350	V
Peak r.f. grid drive voltage	650	690	600	V
Anode current	1.2	1.2	0.93	A
Grid current	0.3	0.3	0.24	A
Nominal driving power	230	205	130	W
Anode dissipation	1.3	1.3	0.92	kW
Output power	4.1	4.7	2.8	kW
Efficiency	76	78	75	%

## CLASS C TELEVISION SERVICE, GRID-MODULATED

### MAXIMUM RATINGS (Absolute values)

	Up to 75MHz	Up to 220MHz	
Anode voltage	5.0	4.0	kV max
Anode current	1.9	1.6	A max
Anode input power	9.5	6.5	kW max
Anode dissipation (sync. level)	5.0	4.0	kW max
Grid voltage (negative value) (sync. level)	1.0	1.0	kV max
Grid current	0.25	0.25	A max
Grid dissipation (sync. level)	120	120	W max
Cathode current (peak)	10	10	A max

### TYPICAL OPERATING CONDITIONS

#### (Negative modulation, positive synchronisation) (2 valves)

Frequency	48 to 75	170 to 220	MHz
Anode voltage	5.0	4.0	kV
Grid voltage:			
peak sync.	-200	-150	V
black level	-300	-225	V
white level	-550	-500	V
Peak r.f. grid to grid voltage (sync. level)	1.0	1.0	kV
Anode current:			
peak sync.	2 x 1.9	2 x 1.6	A
black level	2 x 1.3	2 x 1.3	A
Grid current:			
peak sync.	2 x 0.250	2 x 0.20	A
black level	2 x 0.175	2 x 0.11	A
Nominal driving power (sync. level)	2 x 250	2 x 400	W
Output power (sync. level)	9.0	6.0	kW
Power into load (sync. level) (see note 3)	6.3	4.2	kW
Bandwidth (see note 4):			
to -3db points	8.00	10	MHz
to -1.5db points	5.25	6.5	MHz



**TYPICAL OPERATING CONDITIONS****(Positive modulation, negative synchronisation) (2 valves)**

Frequency . . . . .	48 to 75	MHz
Anode voltage . . . . .	5.0	kV
Grid voltage:		
white level . . . . .	-200	V
black level . . . . .	-460	V
peak sync. . . . .	-580	V
Peak r.f. grid to grid voltage (white level) . . . . .	1.0	kV
Anode current:		
white level . . . . .	2 x 1.9	A
black level . . . . .	2 x 0.4	A
Grid current:		
white level . . . . .	2 x 250	mA
black level . . . . .	0	mA
Nominal driving power (white level) . . . . .	2 x 250	W
Output power (white level) . . . . .	9.0	kW
Power into load (white level) (see note 3) . . . . .	6.3	kW
Bandwidth (see note 4):		
to -3db points . . . . .	8.0	MHz
to -1.5db points . . . . .	5.25	MHz

**RADIO FREQUENCY OSCILLATOR FOR INDUSTRIAL SERVICE****(Class C, anode supply from unfiltered two-phase half-wave rectifier)****MAXIMUM RATINGS (Absolute values)**

Anode voltage . . . . .	5.4	kV max
Anode current . . . . .	1.35	A max
Anode input power . . . . .	9.0	kW max
Anode dissipation . . . . .	5.0	kW max
Grid voltage (negative value) . . . . .	900	V max
Grid current . . . . .	0.31	A max
Grid dissipation . . . . .	120	W max

**TYPICAL OPERATING CONDITIONS**

Output voltage (r.m.s.) from transformer . . . . .	5.1	6.0	kV
Anode voltage . . . . .	4.6	5.4	kV
Anode current . . . . .	1.15	1.35	A
Grid current . . . . .	0.27	0.31	A
Anode dissipation . . . . .	1.84	2.3	kW
Grid resistor . . . . .	1.1	1.3	k $\Omega$
Nominal driving power . . . . .	160	210	W
Output power . . . . .	4.5	6.5	kW
Efficiency . . . . .	70	72	%

## RADIO FREQUENCY OSCILLATOR FOR INDUSTRIAL SERVICE

(Class C, anode supply unrectified a.c.)

### MAXIMUM RATINGS (Absolute values)

Output voltage (r.m.s.) from transformer . . . . .	6.8	kV	max
Anode current . . . . .	0.8	A	max
Anode input power . . . . .	9.0	kW	max
Anode dissipation . . . . .	5.0	kW	max
Grid voltage (negative value) . . . . .	640	V	max
Grid current . . . . .	190	mA	max
Grid dissipation . . . . .	120	W	max
Operating frequency . . . . .	75	MHz	max

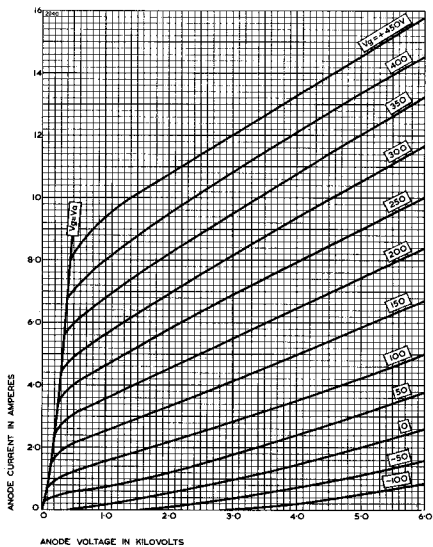
### TYPICAL OPERATING CONDITIONS

Output voltage (r.m.s.) from transformer . . . . .	5.9	6.8	kV
Grid voltage . . . . .	-173	-200	V
from grid resistor . . . . .	1050	1050	$\Omega$
Anode current . . . . .	0.7	0.8	A
Grid current (approx) . . . . .	165	190	mA
Anode dissipation . . . . .	1.24	1.5	kW
Output power . . . . .	3.36	4.55	kW
Efficiency . . . . .	73	75	%

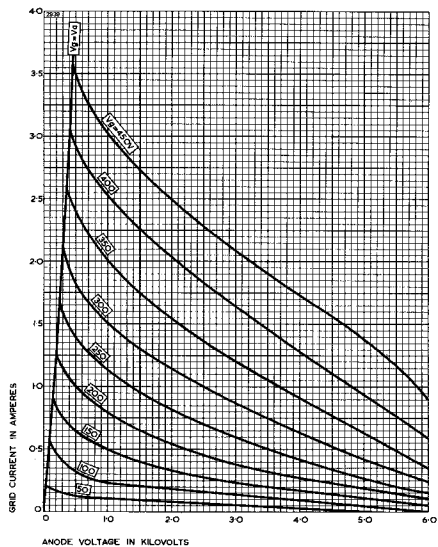
### NOTES

1. The valve must be operated at the stated filament voltage. Fluctuation in filament voltage must not exceed +5% or -10%. The centre-tap pin may be used for the anode current return but must not be used for the filament current supply. At frequencies above 30MHz, all three filament pins should be interconnected with suitable capacitors.
2. This includes the power transferred from the drive circuit.
3. Assuming circuit transfer efficiency of 70%.
4. For a bandwidth based on one inductor-capacitor circuit.

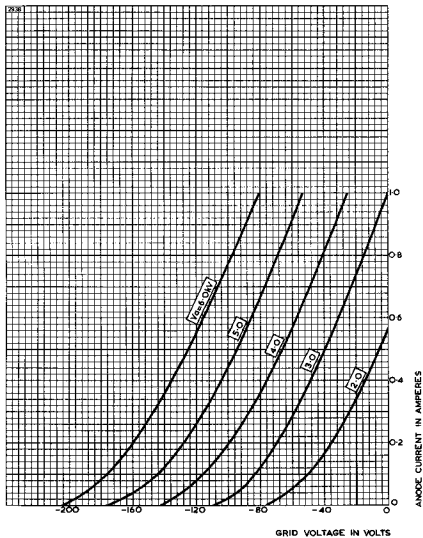
# TYPICAL ANODE CHARACTERISTICS



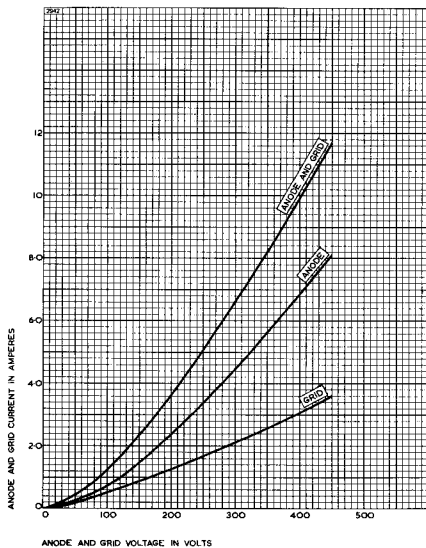
# TYPICAL GRID CHARACTERISTICS



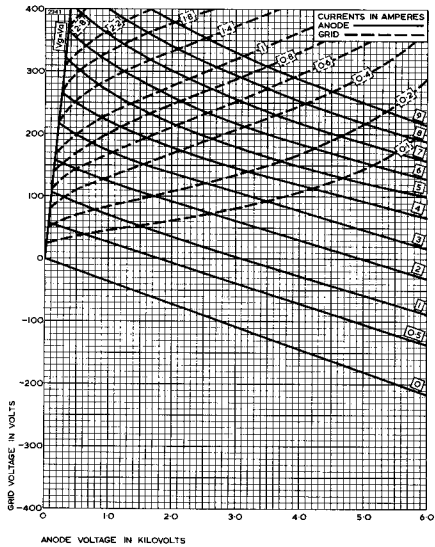
TYPICAL ANODE CURRENT – GRID VOLTAGE CHARACTERISTICS



# TYPICAL STRAPPED CHARACTERISTICS

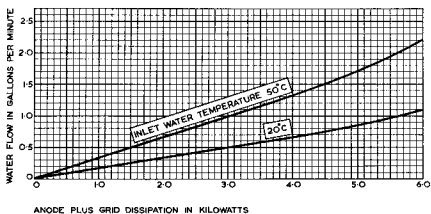
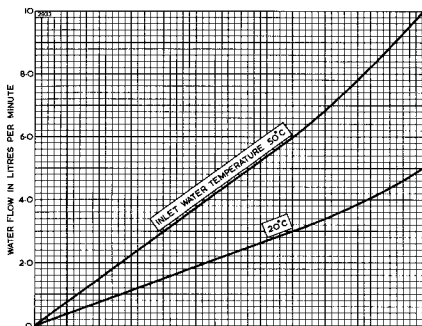


TYPICAL CONSTANT CURRENT CHARACTERISTICS



# MINIMUM WATER COOLING REQUIREMENTS FOR BW1165J3

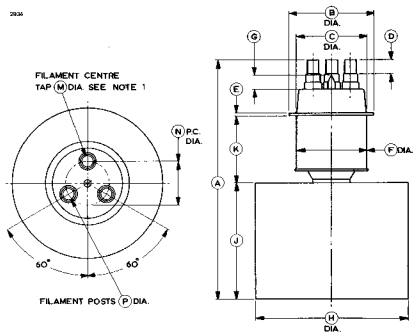
Higher rates of flow should be used where possible.





OUTLINE FOR BR1165 (All dimensions without limits are nominal)

2834



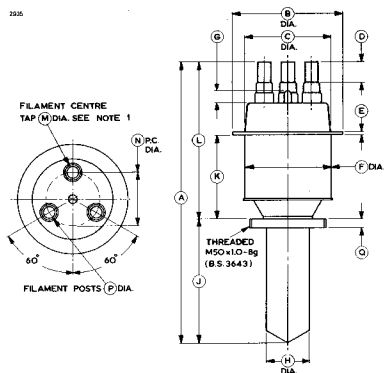
Ref	Millimetres	Inches
A	195.0 max	7.677 max
B	70.00 ± 0.50	2.756 ± 0.020
C	59.00 max	2.323 max
D	12.00 min	0.472 min
E	2.50	0.098
F	64.00 max	2.520 max
G	20.00 max	0.787 max
H	122.3 ± 0.5	4.815 ± 0.020
J	84.00	3.701
K	54.00 ± 0.50	2.126 ± 0.020
M	9.10	0.358
N	35.00 ± 1.00	1.378 ± 0.040
P	9.10	0.358

Inch dimensions have been derived from millimetres.

**Note** The filament centre tap pin is marked O.

OUTLINE FOR BW1165 (All dimensions without limits are nominal)

2835



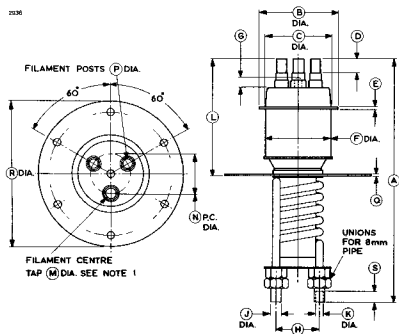
Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	190.0 max	7.480 max	J	83.00 max	3.268 max
B	70.00 ± 0.50	2.756 ± 0.020	K	56.00	2.205
C	59.00 max	2.323 max	L	106.0	4.173
D	12.00 min	0.472 min	M	9.10	0.358
E	2.50	0.098	N	35.00 ± 1.00	1.378 ± 0.040
F	64.00 max	2.520 max	P	9.10	0.358
G	20.00 max	0.787 max	Q	6.25	0.246
H	30.00 max	1.181 max			

Inch dimensions have been derived from millimetres.

**Note** The filament centre tap pin is marked O.

OUTLINE FOR BW1165J3 (All dimensions without limits are nominal)

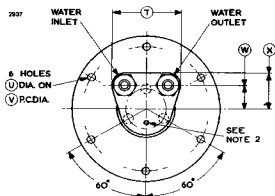
2236



Ref	Millimetres	Inches	Ref	Millimetres	Inches
A	218.0 max	8.583 max	K	8.20	0.323
B	$70.00 \pm 0.50$	$2.756 \pm 0.020$	L	105.0	4.134
C	59.00 max	2.323 max	M	9.10	0.358
D	12.00 min	0.472 min	N	$35.00 \pm 1.00$	$1.378 \pm 0.040$
E	2.50	0.098	P	9.10	0.358
F	64.00 max	2.520 max	Q	2.00	0.079
G	20.00 max	0.787 max	R	$130.0 \pm 0.5$	$5.118 \pm 0.020$
H	39.00	1.535	S	10.0	0.394
J	10.00	0.394			

Inch dimensions have been derived from millimetres.

View of BW1165J3 from below



Ref	Millimetres	Inches
T	61.00 max	2.402 max
U	6.50	0.256
V	110.0 ± 1.00	4.331 ± 0.040
W	21.00	0.827
X	32.00	1.260

Inch dimensions have been derived from millimetres.

**Outline Notes for BW1165J3**

1. The filament centre tap pin is marked O.
2. Hole threaded 4B.A. to accept thermal fuse.