



PL 4-400CG

Power Tetrode

CARBON - GRAPHITE



The Penta PL 4-400CG is a power tetrode with a maximum plate dissipation rating of 500 watts. Cooling is by radiation and by forced air through the base, along the envelope, and over the plate seal and radiator-type plate connector. The unique design and quality construction utilized in the Penta PL 4-400CG provide a larger effective plate radiating area, with minimum plate, screen-grid, and control-grid temperatures.

The Penta PL 4-400CG is particularly well suited for applications where long life and consistent tube performance are desired.

ELECTRICAL CHARACTERISTICS

Filament--Thoriated Tungsten

Voltage (±5%)	5.0 volts
Current	14.5 amperes

Grid-Screen mu factor

5.1

Transconductance (2500 v. Eb, 500 v. Ec2, 100ma. Ib)

4000 μmhos

Interelectrode Capacitances

Grid-Plate

0.12 μμf.

Input

12.5 μμf.

Output

4.5 μμf.

Maximum Frequency for Full Ratings

110 Mc.

MECHANICAL CHARACTERISTICS

Base

EIA A5-97

Basing

EIA Type 5BK

Maximum Overall Dimensions

Length

6.38 inches

Diameter

3.56 inches

Mounting Position

Any

Net Weight

9.0 Ounces

Maximum Operating Temperature

Base Seals

200° C.

Plate Seals

225° C.

Recommended Socket

PL-400 series

Recommended Chimney

PL-406

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P E N T A L A B O R A T O R I E S

9740 COZYCROFT AVENUE * CHATSWORTH * CALIFORNIA 91311

(800) 421-4219 * (818) 882-3872 * FAX: (818) 882-3968

ELECTRON TUBES FOR INDUSTRY



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COOLING

Forced air cooling of the base, base seals, envelope, plate seal, and plate connector is required for all classes of operation when the PL 4-400CG is operated at or near the maximum plate dissipation rating. A total quantity of 15 c.f.m. of cooling air, properly distributed to the base, envelope, and plate seal area, is required. Such cooling is most conveniently provided by means of a pressurized chassis upon which the Penta socket and chimney combination is mounted. Under these conditions, the PL 4-400CG will be adequately cooled for operation at maximum ratings when the pressure within the sealed chassis is equal to 0.4 inch of water. At this pressure, the required 15 c.f.m. of air flow will be obtained.

The proper pressure and quantity of air may be obtained through the use of a small centrifugal blower with ratings approximating 100 c.f.m. of free air. Cooling is adequate when the base seal temperatures do not exceed 200°C and the plate seal temperature does not exceed 225°C.

When plate dissipation does not exceed 250 watts, and when operation is at frequencies below 30 Mc., the tube may be operated without forced envelope or plate seal cooling. Under these circumstances, an air flow of 5 c.f.m. through the base alone should adequately cool the PL 4-400CG.

RADIO-FREQUENCY OPERATION

The PL 4-400CG is especially well suited for use as a radio-frequency power amplifier. The compact construction and low interelectrode capacitances permit operation at full ratings at frequencies as high as 110 Mc. Neutralization normally is not required for operation at frequencies below 30 Mc. At frequencies above 45 to 50 Mc., the feedback within the tube is substantially the result of screen-lead inductance. The effects of screen-lead inductance may be eliminated for a specified frequency of operation through

the use of a variable capacitor as the screen-lead bypass. The capacitor is tuned for minimum feedback of energy from the plate circuit to the grid circuit. A variable capacitor with a maximum capacitance of 50 $\mu\text{f.}$ will normally prove adequate for operation in the 100 Mc. region.

Under normal operating conditions, the PL 4-400CG requires an unusually small amount of driving power. The high power sensitivity of the tube permits a reduction in the power requirements imposed upon the preceding driver stage, but requires that adequate precautions be taken to minimize the feedback of energy from the output circuit back to the input circuit of the tube.

AUDIO-FREQUENCY OPERATION

The high power sensitivity of the PL 4-400CG makes it well suited for use as an audio-frequency power amplifier or modulator in push-pull Class-AB₁ or Class-AB₂ service. In these classes of operation, a pair of tubes can provide relatively high audio-frequency power output with low driving power and low harmonic distortion.

Under Class-AB₂ operating conditions, both grid bias and screen voltage must be obtained from a source having relatively good regulation. A series-connected string of voltage regulator tubes, connected so as to regulate the output voltage of the screen-voltage supply will normally prove adequate. Grid-bias voltage may be obtained from batteries or from a power supply having a low resistance bleeder.

Under Class-AB₁ operating conditions, the d-c screen voltage must be obtained from a supply having good regulation, but the internal impedance of the grid-bias supply is not of critical importance. It should be noted, however, that the effective grid-circuit resistance per tube must not exceed 250,000 ohms.



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MAXIMUM RATINGS--CCS (Continuous Commercial Service)

(Frequencies below 110 Mc.)	Class C FM or C.W.	Plate Mod. Class C	Class AB ₁ Audio Ampl.	Class AB ₂ Audio Ampl.	
DC Plate Voltage	4000	3200	4000	4000	volts
D-C Screen Voltage	600	600	800	800	volts
D-C Grid Bias	-500	-500			volts
D-C Plate Current	420	330	420	420	ma.
Plate Dissipation	480	325	480	480	watts
Screen Dissipation	35	35	35	35	watts
Grid Dissipation	10	10	10	10	watts

TYPICAL OPERATION—Class C CW or FM Amplifier (Frequencies below 75 Mc.)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	-200	-220	-220	volts
D-C Plate Current	420	420	420	ma.
D-C Screen Current	46	46	42	ma.
D-C Grid Current	18	18	19	ma.
Plate Dissipation	282	300	360	watts
Screen Dissipation	23	23	21	watts
Grid Dissipation	1.8	1.8	1.8	watts
Peak R.F. Grid Voltage	300	320	320	volts
Driving Power @ 20 Mc.	5.5	5.9	6.0	watts
Plate Power Input	875	1050	1400	watts
Plate Power Output	768	960	1320	watts

Note: Driving power increases with operating frequency until at 75Mc. approximately twice as much driving power as shown above will be required.

TYPICAL OPERATION—Class C Amplitude Modulated Amplifier, Carrier Conditions (Frequencies below 75 Mc.)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	-200	-220	-220	volts
D-C Plate Current	330	330	330	ma.
D-C Screen Current	30	28	26	ma.
D-C Grid Current	12	12	12	ma.
Plate Dissipation	204	216	234	watts
Screen Dissipation	15	14	13	watts
Grid Dissipation	1.1	1.1	1.1	watts
Peak A.F. Grid Voltage	290	290	290	volts
Peak A.F. Screen Voltage	350	350	350	volts
Driving Power (approx.)	3.5	3.5	3.5	watts
Plate Power Input	550	688	825	watts
Plate Power Output	456	608	756	watts



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TYPICAL OPERATION—Class AB₁ A-F Power Amplifier or Modulator (Sine wave, two tubes)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	750	750	750	volts
D-C Grid Voltage	-130	-140	-150	volts
Zero-Signal D-C Plate Current	228	198	142	ma.
Max.-Signal D-C Plate Current	762	732	702	ma.
Zero-Signal D-C Screen Current	0	0	0	ma.
Max. Signal D-C Screen Current	28	30	40	ma.
Plate-to-Plate Load Resistance	6800	9000	14,500	ohms
Peak A.F. Grid-to-Grid Signal	255	275	295	volts
Driving Power	0	0	0	watts
Max.-Signal Plate Dissipation(per tube)	660	825	990	watts
Max.-Signal Plate Power Output	456	601	756	watts

TYPICAL OPERATION—Class AB₂ A-F Power Amplifier or Modulator (Sine wave, two tubes)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage*	-75	-80	-90	ma.
Zero-Signal D-C Plate Current	228	198	142	ma.
Max.-Signal D-C Plate Current	840	840	768	ma.
Zero-Signal D-C Screen Current	0	0	0	ma.
Max. Signal D-C Screen Current	50	40	32	ohms
Plate-to-Plate Load Resistance	7200	9000	14,000	volts
Peak A.F. Grid-to-Grid Signal	265	280	280	watts
Average Driving Power (Maximum Signal)	4.3	4.5	3.5	watts
Peak Driving Power (Maximum Signal)	9	10	8	watts
Max.-Signal Plate Dissipation(per tube)	384	480	2100	watts
Max.-Signal Plate Power Output	456	608	756	watts



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