POWER TUBES and ACCESSORIES

THE PENTA LABORATORIES, INC.

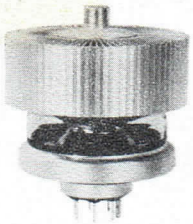
A SUBSIDIARY OF RAYTHEON COMPANY

312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA

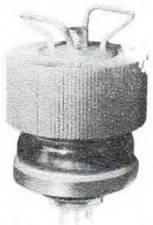
P. O. Box 1469 • Phone 965-4581 • Area Code 805 • TWX 805-449-7206

PL-175A

PL-8432



PL-8295/PL-172



PL-195

PL-6775

PENTA POWER TUBES

Beam Pentodes • Tetrodes • Triodes • Vacuum Switches

Proven reliability, long life, and high efficiency are the resultant effects of "extra care" production and test methods employed by Penta in the manufacture of power tubes. Enjoy all of the benefits that hundreds of power tube users and equipment manufacturers receive by specifying Penta Power Tubes.

POWER TUBES

Type	Fil. Volt.	Fil. Current Amps.	Plate Diss. Max. W.	Plate Volt. Max.	Plate Current Ma., Max.	Screen Voltage Max.	Price
BEAM PENTODES							
PL-4E27A	5.0	7.5	125	4,000	200	750	$ 45.00
PL-172 (See PL-8295/PL-172)							
PL-175A	5.0	14.5	400	4,000	350	800	$ 50.00
PL-177A	6.0	3.2	75	2,000	175	600	$ 29.00
PL-177WA	6.0	3.2	75	2,000	175	600	$ 33.50
PL-195	6.0	17.0	4000	5,000	2000	1000	$350.00
PL-210	6.0	85.0	5000	7,500	2500	1500	$475.00
PL-6549	6.0	3.2	75	2,000	175	600	$ 29.00
PL-8295/PL-172	6.0	8.2	1000	3,000	1000	600	$142.00
PL-8295A	6.0	8.2	1000	3,000	1000	600	$152.00
PL-8432	6.0	8.2	1000	3,000	1000	600	$152.00
PL-8576/PL-264	6.0	17.0	3000	5,000	2000	1000	$370.00
POWER TETRODES							
PL-4-65A (See PL-8165/4-65A)							
PL-4-125A (See PL-4D21 (4-125A))							
PL-4-250A (See PL-5D22 (4-250A))							
PL-4-400A (See PL-8438/4-400A)							
PL-4-1000 (See PL-8166/4-1000A)							
PL-4D21 (4-125A)	5.0	6.5	125	3,000	225	600	$ 36.00
PL-4D21A	5.0	6.5	175	3,000	225	600	$ 37.50
PL-4X500A	5.0	13.5	500	4,000	350	500	$125.00
PL-5D22 (4-250A)	5.0	14.5	250	4,000	350	800	$ 46.50
PL-6775	5.0	14.5	400	4,000	350	800	$ 50.00
PL-8165/4-65A	6.0	3.5	65	2,000	150	600	$ 27.00
PL-8166/4-1000A	7.5	21.0	1000	6,000	700	1000	$132.00
PL-8438/4-400A	5.0	14.5	400	4,000	350	800	$ 48.00
PULSE TETRODES							
PL-8187/4PR65A	6.0	3.5	65	15,000	1a. pk.	2,000	$ 43.00
PL-8188/4PR400A	5.0	14.5	400	20,000	4a. pk.	2,500	$ 64.00
PL-8189/4PR1000A	7.5	21.0	1000	30,000	8a. pk.	2,500	$144.00

THE PENTA LABORATORIES, INC.

A SUBSIDIARY OF RAYTHEON COMPANY

312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

P. O. Box 1469 • Phone 965-4581 • Area Code 805 • TWX 805-449-7206

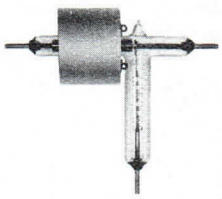
POWER TUBES Cont'd

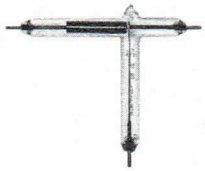
	Fil. Volt.	Fil. Current Amps.	Plate Diss. Max. W.	Plate Volt. Max.	Plate Current Ma., Max.	μ	Price
POWER TRIODES							
PL-254W	5.0	7.5	100	4,000	225	25	$ 25.00
PL-6569	5.0	14.5	250	4,000	300	45	$ 37.50
PL-6580	5.0	14.5	400	4,000	350	45	$ 45.00
HIGH-VOLTAGE RECTIFIER							
PL-250R	5.0	10.5	....	60,000	250	....	$ 36.00

PL-177A

VACUUM SWITCHES

Type	Voltage, Maximum	Current Max. Ampere AC or DC	Current Max. Ampere Pulse	Coil	Price
PL-R1	21,000	6	150	Not supplied; requires 1100 ampere-turns	$33.00
PL-169A	21,000	30	500	Not supplied; requires 1900 ampere-turns	$40.00
PL-186	21,000	6	—	Not supplied; requires 1000 ampere-turns	$38.00
PL 187	21,000	30	500	Integral; 28 V, 500 Ma., D-C	$58.00
PL-190	21,000	6	150	Integral; 28 V, 250 Ma., D-C	$58.00
PL-191	21,000	6	—	Not supplied; requires 1000 ampere-turns	$28.00

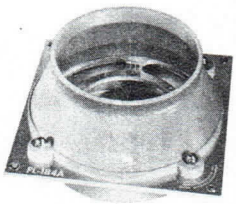


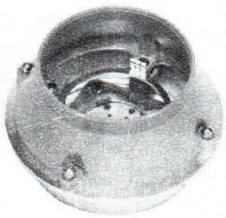


Penta vacuum switches are single-pole, double-throw switches enclosed in evacuated glass envelopes. They are ideal for use wherever compact, fast-acting relays are required to switch high-voltage circuits under a wide range of ambient atmospheric conditions, including explosive atmospheres, and in other applications where exposed-contact relays would be unsuitable.

These vacuum switches are operated by external actuating coils, which are excited by direct current and designed so that the soft-iron pole piece and the armature assembly enclosed in the envelope act to complete the magnetic circuit.

ACCESSORIES





Type	Description	Price
PL-C1	Glass chimney for PL-8438/4-400A, PL-175A, PL-6580, PL-6775.	$ 6.50
PL-C184	Plastic chimney, only for PL-8295/172 and PL-8295A. Same chimney as used on PL-184 and PL-184A sockets (see below).	$ 5.00
PL-C205	Chimney only (for PL-195 and PL-210). Same chimney as used on PL-205A and PL-261A sockets (see below).	$12.00
PL-C209	Chimney only (for PL-8432). Same chimney as used on PL-209A socket (see below).	$ 6.50
PL-C265	Chimney only (for PL-8576/PL-264). Same chimney as used on PL-265A socket (see below).	$12.00
PL-184	Socket for PL-8295/172 and PL-8295A, including the chimney; built-in screen-grid and suppressor-grid by-pass capacitors. Includes contact provisions for all base pins and screen-grid and suppressor-grid ring terminals. Provides proper air distribution for correct tube cooling at full plate dissipation rating.	$53.00
PL-184A	Socket for PL-8295/172 and PL-8295A, including the chimney. Same as socket PL-184 (above), except that suppressor-grid contacts are grounded.	$48.00
PL-205A	Socket for PL-195. Includes chimney, built-in screen-grid by-pass capacitors. Suppressor-grid contacts grounded. Provides proper distribution of air for correct cooling of tube at full plate dissipation.	$60.00
PL-209A	Socket for PL-8432. Includes chimney, screen-grid by-pass capacitors. Suppressor-grid contacts grounded. Distributes air for adequate cooling at full rated plate dissipation.	$48.00
PL-261A	Socket for PL-210. Same features as PL-205A socket (above), similar in appearance.	$60.00
PL-265A	Socket for PL-8576/PL-264. Includes chimney, screen-grid by-pass capacitors. Provides for correct distribution of air for proper tube cooling at full rated plate dissipation.	$48.00

FIELD ENGINEERING REPRESENTATIVES AND DISTRIBUTORS SERVING MAJOR CITIES

PENTA

high-efficiency

POWER TUBES

INTER-CHANGEABILITY TABLE

Type No.	Class	Manufacturer	Equivalent Penta Type No.
4-65A PL-4-65A	Tetrode	Eimac, G.E., RCA Penta	PL-8165/4-65A, PL-177A*, PL-177WA*†
4-125A 4-125A/4D21 GL-4D21/4-125A AX-4-125A/4D21 WL-4D21/4-125A	Tetrode	Eimac G.E., RCA, Tung-Sol General Electric Amperex Westinghouse	PL-4D21, PL-4D21A**
4-250A 4-250A/5D22 AX-4-250A/5D22 GL-5D22/4-250A WL-5D22/4-250A	Tetrode	Eimac G.E., RCA, Tung-Sol Amperex General Electric Westinghouse	PL-5D22, PL-4-400A, PL-175A△, PL-6775†
4-400A AX-4-400A GL-4-400A WL-4-400A	Tetrode	Eimac, G.E., RCA Amperex General Electric Westinghouse	PL-4-400A, PL-175A△, PL-6775†
4-1000A GL-4-1000A PL-4-1000A WL-4-1000A	Tetrode	Eimac, G.E., RCA General Electric Penta Westinghouse	PL-8166/4-1000A
4PR65A	Pulse Tetrode	Eimac	PL-8187/4PR65A
4PR400A	Pulse Tetrode	Eimac	PL-8188/4PR400A
4E27/8001 4E27A/5-125B	Pentode	RCA Eimac, RCA	PL-4E27A°°
4X500A	Tetrode	Amperex, Eimac, RCA	PL-4X500A
PL-172	Pentode	Penta	PL-8295/PL-172, PL-8295A†
250R	Rectifier	Eimac	PL-250R
254W	Triode	Vacuum Tube Products	PL-254W
6155	Tetrode	Amperex	PL-4D21, PL-4D21A**
6156	Tetrode	Amperex	PL-5D22, PL-4-400A, PL-175A△, PL-6775†

(Continued on reverse side)

15 October 1964

Form 92E-5C

THE PENTA LABORATORIES, INC.

A SUBSIDIARY OF RAYTHEON COMPANY

312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

Type No.	Class	Manufacturer	Equivalent Penta Type No.
8165	Tetrode	Eimac	PL-8165/4-65A, PL-177A*, PL-177WA*ᵍ
8166	Tetrode	Eimac	PL-8166/4-1000A
8187/4PR65A	Pulse Tetrode	Eimac	PL-8187/4PR65A
8188/4PR400A	Pulse Tetrode	Eimac	PL-8188/4PR400A

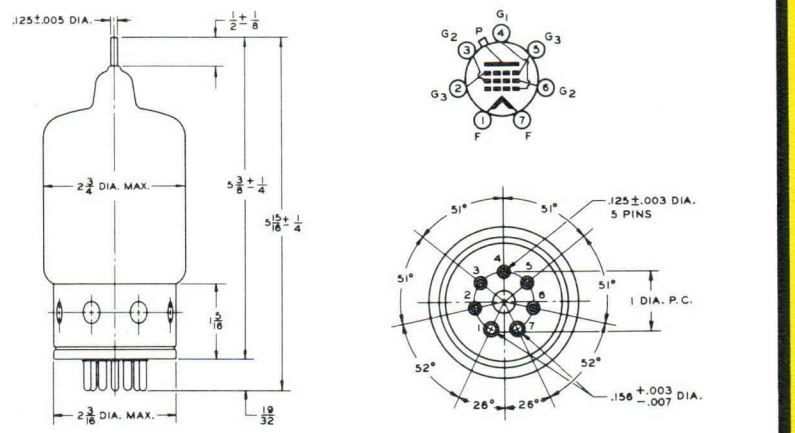
* Pentode. Grid-plate and input capacitances slightly lower; output capacitance higher. Plate dissipation 75 watts. Pins 3 and 5 must be grounded. See data sheet.

** Has slightly higher output capacitance; plate dissipation 175 watts. See data sheet.

△ Pentode. Grid-plate capacitance slightly lower. Input and output capacitances higher. Higher maximum screen voltage rating. Tube base shell must be grounded to chassis. See data sheet.

°° Has slightly higher grid-to-plate capacitance and slightly lower input and output capacitances than the 4E27/8001; 125 watts plate dissipation.

ᵍ Ruggedized tube.



PL-4E27A

Beam Pentode

The Penta PL-4E27A is a beam pentode suitable for use as an amplifier, oscillator, or modulator. In Class-C service it will deliver over 400 watts of usable power output with approximately two watts driving power. As a Class-AB_1 linear amplifier, the PL-4E27A will provide up to 280 watts of usable power output.

The PL-4E27A has a maximum plate dissipation rating of 125 watts and a maximum plate voltage rating of 4000 volts at frequencies up to 75 Mc. Adequate cooling is provided by convection and radiation, except in high ambient temperatures and at frequencies above 75 Mc., where forced-air circulation may be necessary.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	7.5 amperes
Grid-Screen Mu Factor	5.0
Interelectrode Capacitances	
Grid-Plate	0.08 μμf
Input	10.5 μμf
Output	4.7 μμf
Transconductance (2500 v. E_b, 500 v. E_{c2}, 0 v. E_{c3}, 50 ma. I_b)	2500 μmhos
Maximum Frequency for Full Ratings	75 Mc.

MECHANICAL CHARACTERISTICS

Base[1]	Giant 7-pin, metal shell
Maximum Overall Dimensions	
Length	6.19 inches
Diameter	2.75 inches
Net Weight (average)	6 ounces
Mounting Position	Vertical, base up or down

1 Fits E. F. Johnson Co. socket 122-237 or equivalent.

1 July 1962

Form 534R

PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-4E27A

MOUNTING

The PL-4E27A must be mounted vertically, base up or down. The metal base should be grounded. The plate lead should be flexible.

The tube base fits E. F. Johnson Co. No. 122-237 seven-pin ceramic socket. This socket has a central ventilating hole, and if a socket made by another manufacturer is used, it should be made certain that the socket has a similar hole.

COOLING

A heat-dissipating connector must be used at the plate terminal, and provisions made for the circulation of air through the socket and the hole of the base.

Although convection and radiation cooling will normally be adequate when the tube is operating at frequencies below 75 Mc., it may be necessary to provide forced-air cooling at higher frequencies. The temperature of the plate and base seals must not exceed 225° C. Forced-air cooling, regardless of frequency, will be beneficial to the tube.

Metal-based tubes, such as the PL-4E27A, should not be sub-mounted. Sub-mounting does not improve isolation of the input and output circuits, and can prevent the proper circulation of cooling air.

OPERATION — GENERAL

Maximum ratings and typical operating conditions for the PL-4E27A are given in the accompanying tabular data.

Filament voltage should be maintained as closely as possible to the rated value of 5.0 volts. Variations up to 10 per cent of this value are permissible, but decreased tube life and variations in power output may occur with prolonged operation at voltages more than five per cent from the rated value.

MAXIMUM RATINGS

CCS (Continuous Commercial Service)

	Class C CW or FM	*Class AB_2 Audio or R-F*	*Class AB_1 Audio or R-F*	
D-C Plate Voltage	4000	4000	4000	volts
D-C Screen-Grid Voltage	750	750	750	volts
D-C Suppressor-Grid Voltage	75	75	75	volts
D-C Control-Grid Voltage	-500			volts
D-C Plate Current	200	200	200	ma.
D-C Control-Grid Current	10	10		ma.
Control-Grid Dissipation	5	5		watts
Screen-Grid Input	20	20	20	watts
Suppressor-Grid Input	20	20	20	watts
Plate Dissipation	125	125	125	watts

Screen-grid input exceeding the maximum rating can cause permanent damage to the PL-4E27A. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be arranged so that it is impossible to apply screen voltage without plate voltage.

RADIO-FREQUENCY OPERATION

When care is taken to isolate the input and output circuits, and the suppressor and screen grids are effectively grounded for radio frequencies, the PL-4E27A may in most cases be operated without neutralization. In low-distortion Class-AB linear amplifier service, where reaction on the driver circuit must be eliminated entirely, it is good practice to neutralize the small feedback capacitance of the tube.

For maximum power gain and efficiency, the screen voltage applied to the tube in r-f amplifier applications should be no less than 500 volts, and a positive voltage of approximately 60 volts should be applied to the suppressor grid. The tube may be operated with a screen voltage as low as 350 volts, and with the suppressor grid operated at zero potential. However, either of these conditions will result in an increase in driving power requirements. Additionally, efficiency at low plate voltages will be sacrificed with zero-voltage operation of the suppressor grid.

In Class-AB linear amplifier service, the screen voltage for the PL-4E27A must be obtained from a well-regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.

The suggested Class-AB_1 linear r-f amplifier operating conditions tabulated on page three result in third-order distortion products approximately 25 db below peak envelope power output, without the use of degenerative feedback.

PL-4E27A

In Class-AB applications, grid bias voltage for the PL-4E27A must be obtained from a fixed bias supply. The internal resistance of the bias source should not exceed 2000 ohms. Partial grid leak bias, in combination with fixed or cathode bias, or both, may be used in Class-C application.

Suppressor grid voltage may be obtained from any source capable of supplying approximately 60 volts at 10 ma. Although the suppressor grid voltage requirements are not critical, the voltage should be between 50 and 100 volts for best utilization of the suppressor grid action. A convenient source of suppressor grid voltage is a high-resistance voltage divider between the screen grid and ground.

High-level plate modulation may be accomplished with any of the systems commonly used for screen-grid tubes: by supplying the screen grid through a series resistor from either the modulated or unmodulated plate supply or through an audio-frequency reactor from a separate low-voltage source.

Where maximum extended upward modulation above 100 per cent is desired, it is recommended that modulated voltage be applied to the screen grid. This can be accomplished by taking the screen voltage from the modulated plate supply through a series resistor or, if a low-voltage supply and series screen reactor are used, by connecting a low-capacitance audio coupling capacitor between the screen grid and the modulated plate supply.

Modulation of the suppressor voltage is not necessary in high-level modulated applications. However, the tube and its performance will not be adversely affected if it is necessary to obtain the suppressor grid voltage from the modulated screen supply.

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[1]
Single-Sideband, Suppressed Carrier
Grounded Cathode Circuit

D-C Plate Voltage	2000	2000	2500	2500	volts
D-C Screen-Grid Voltage	750	750	750	750	volts
D-C Suppressor-Grid Voltage	0	60	0	60	volts
D-C Control-Grid Voltage[2]	-130	-132	-134	-136	volts
Zero-Signal D-C Plate Current	40	40	35	35	ma.
Zero-Signal D-C Screen Current	0.5	0.5	0.2	0.2	ma.
Maximum-Signal D-C Plate Current	165	180	165	170	ma.
Maximum-Signal D-C Screen Current	25	16	19	15	ma.
Maximum-Signal Peak R-F Grid Voltage	130	360	134	136	volts
Maximum-Signal Power Input	330	360	413	425	watts
Maximum-Signal Plate Dissipation	125	125	125	125	watts
Maximum-Signal Useful Power Output[3]	195	220	265	280	watts

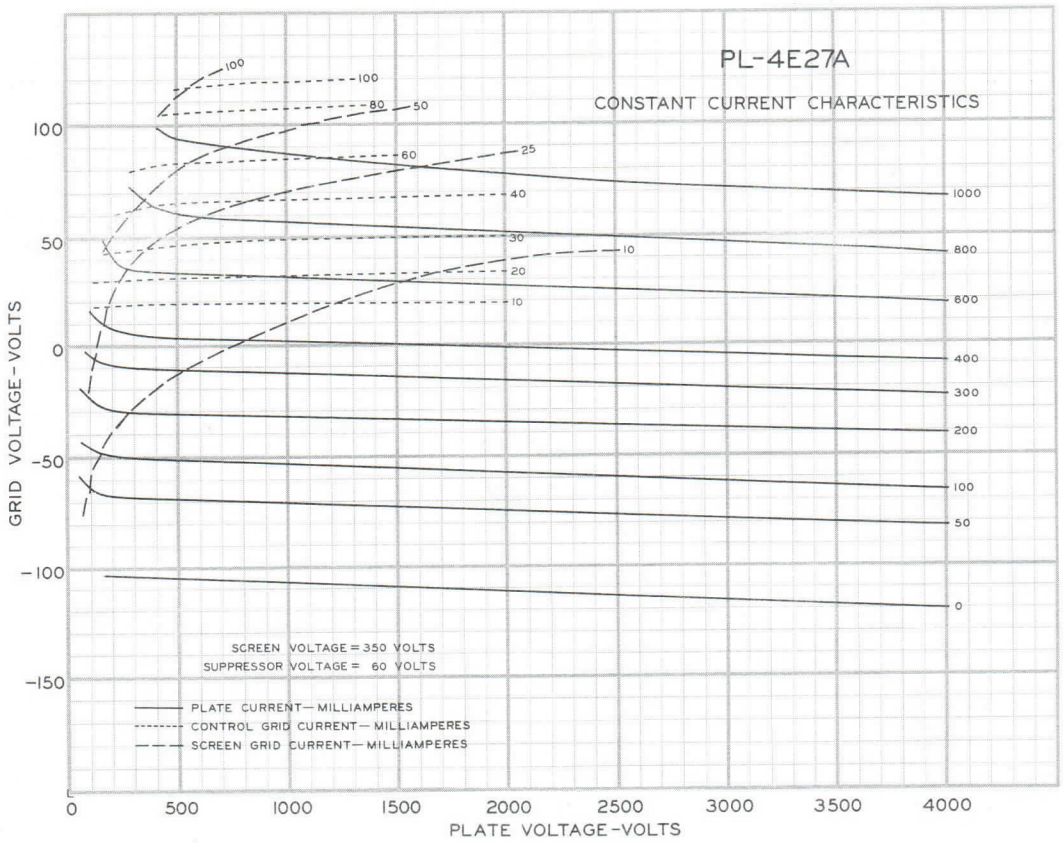
[1] D-C Current values shown are for peak conditions, or for single-tone modulation at full signal.
[2] Approximate value; adjust to give stated zero-signal plate current.
[3] Peak envelope power delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher than values shown.

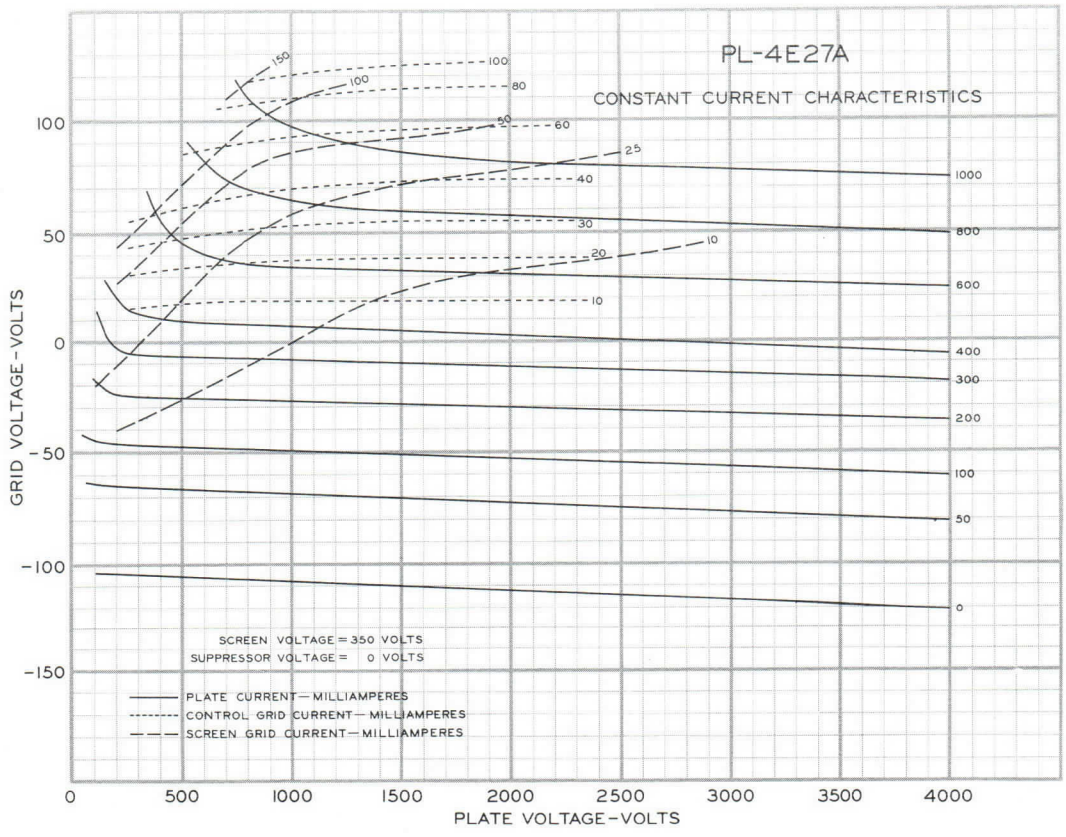
TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded Cathode Circuit

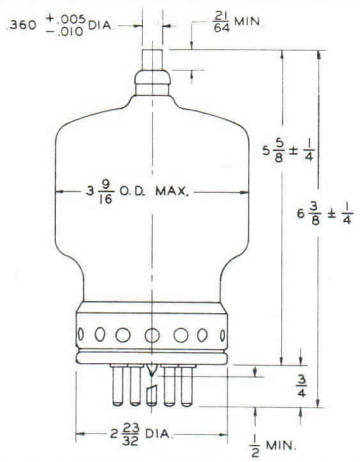
D-C Plate Voltage	2000	2000	2500	2500	3000	3000	volts
D-C Screen-Grid Voltage	500	500	500	500	500	500	volts
D-C Suppressor-Grid Voltage	0	60	0	60	0	60	volts
D-C Control-Grid Voltage	-150	-150	-170	-170	-200	-200	volts
D-C Plate Current	185	220	190	222	163	187	ma.
D-C Screen-Grid Current	29	30	27	26	20	19	ma.
D-C Suppressor-Grid Current	0	6	0	5	0	5	ma.
D-C Control-Grid Current	8	10	8	10	6	7	ma.
Peak R-F Grid Voltage (approx.)	160	174	182	191	190	198	volts
Driving Power (approx.)	1.8	2.4	2.0	2.7	1.6	2.0	watts
Plate Power Input	370	440	475	555	490	560	watts
Plate Dissipation	125	125	130	130	130	125	watts
Useful Power Output[1]	225	285	285	375	325	405	watts

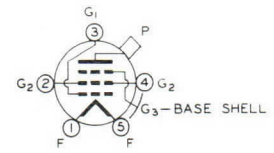
[1] Actual power output delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher than values shown.

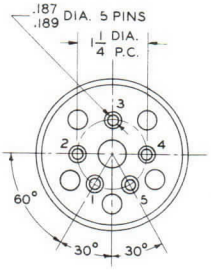
PL-4E27A


PL-4E27A
CONSTANT CURRENT CHARACTERISTICS
GRID VOLTAGE-VOLTS
PLATE VOLTAGE-VOLTS
SCREEN VOLTAGE = 350 VOLTS
SUPPRESSOR VOLTAGE = 60 VOLTS
PLATE CURRENT—MILLIAMPERES
CONTROL GRID CURRENT—MILLIAMPERES
SCREEN GRID CURRENT—MILLIAMPERES


PL-4E27A
CONSTANT CURRENT CHARACTERISTICS
GRID VOLTAGE-VOLTS
PLATE VOLTAGE-VOLTS
SCREEN VOLTAGE = 350 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT—MILLIAMPERES
CONTROL GRID CURRENT—MILLIAMPERES
SCREEN GRID CURRENT—MILLIAMPERES







PL-175A

Beam Pentode

The PL-175A is a 400-watt plate dissipation beam pentode which incorporates the exclusive Penta vane-type suppressor grid. In most cases, the tube may be used to replace directly the 4-400A, with no circuit modifications, and only slight readjustment of tuning controls. In Class-AB_1 amplifier applications, such replacement can result in 20% to 40% greater output. The suppressor grid terminates in the tube base shell, and is designed to be operated at zero voltage. The base shell must be grounded to the chassis by means of suitable spring clips.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Grid-Screen Amplification Factor	4.5
Interelectrode Capacitances	
Grid-Plate	0.06 μμfd.
Input	15.1 μμfd.
Output	9.8 μμfd.

MECHANICAL CHARACTERISTICS

Base	5-pin, metal shell
Maximum Overall Dimensions	
Length	6.63 inches
Diameter	3.56 inches
Mounting Position	Vertical, base up or down

MAXIMUM RATINGS – CCS (Continuous Commercial Service)

	Class-AB_1 R-F or Audio	Class-C CW or FM	
D-C Plate Voltage	4000	4000	max. volts
D-C Screen Voltage	1000	600	max. volts
D-C Suppressor-Grid Voltage	100	100	max. volts
D-C Plate Current	350	350	max. ma
Screen-Grid Input	25	25	max. watts
Plate Dissipation	400	400	max. watts

20 November 1961

Form 535R-2

PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-175A

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

D-C Plate Voltage	2000	2000	2500	2500	3000	3000	4000	4000	volts
D-C Screen-Grid Voltage	500	600	500	600	500	600	500	600	volts
D-C Suppressor-Grid Voltage	0	0	0	0	0	0	0	0	volts
D-C Control-Grid Voltage	-160	-180	-160	-180	-160	-180	-180	-200	volts
D-C Plate Current	350	350	350	350	350	350	350	350	ma
D-C Screen-Grid Current	46	42	41	40	38	36	34	29	ma
D-C Control-Grid Current	14	8	12	7	11	6	10	6	ma
Peak R-F Control-Grid Voltage	226	226	218	226	214	218	236	239	volts
Driving Power (approx.)	3.1	1.8	2.6	1.6	2.4	1.3	2.4	1.4	watts
Plate Power Input	700	700	875	875	1050	1050	1400	1400	watts
Plate Dissipation (approx.)	200	190	230	220	275	265	360	345	watts
Useful Power Output[1]	460	470	590	600	705	715	945	960	watts

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[2]
Single-Sideband, Suppressed Carrier; Grounded-Cathode Circuit

D-C Plate Voltage	2000	2500	3000	3500	volts
D-C Screen-Grid Voltage	750	750	750	750	volts
D-C Suppressor-Grid Voltage	0	0	0	0	volts
D-C Control-Grid Voltage[3]	-135	-143	-150	-160	volts
Zero-Signal D-C Plate Current	125	100	80	75	ma
Zero-Signal D-C Screen Current	3	1	1	1	ma
Maximum-Signal D-C Plate Current	350	350	350	350	ma
Maximum-Signal D-C Screen Current	37	35	29	24	ma
Maximum-Signal Peak R-F Grid Voltage	135	143	150	160	volts
Intermodulation Distortion Level[4]					
Third Order	-39	-34	-31	-31	db
Fifth Order	-42	-41	-40	-40	db
Maximum-Signal Plate Power Input	700	875	1050	1225	watts
Maximum-Signal Plate Dissipation (approx.)	225	265	305	345	watts
Maximum-Signal Useful Power Output[1]	445	570	680	790	watts

---

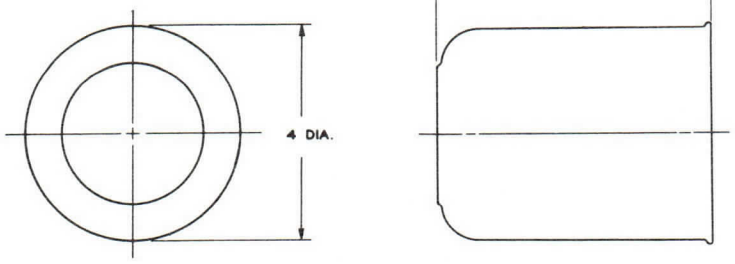
[1] Actual useful power delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher than values shown.

[2] D-C Current values shown are for peak conditions, or for single-tone modulation at full signal.

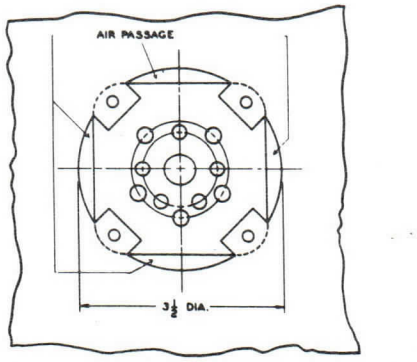
[3] Approximate value; adjust to give stated zero-signal plate current.

[4] Referenced against maximum-signal (or PEP) output. Two equal tones. No degenerative feedback.

COOLING — Forced air cooling of the seals at the base end of the PL-175A is required in all classes of service. A flow of 5 c.f.m. of cooling air should be passed through the base. Adequate envelope cooling at 400 watts plate dissipation requires 15 c.f.m. of cooling air past the envelope and across the plate seal. Proper distribution of cooling air may be obtained by the use of a type PL-C1 chimney, with chassis cut out as shown below.

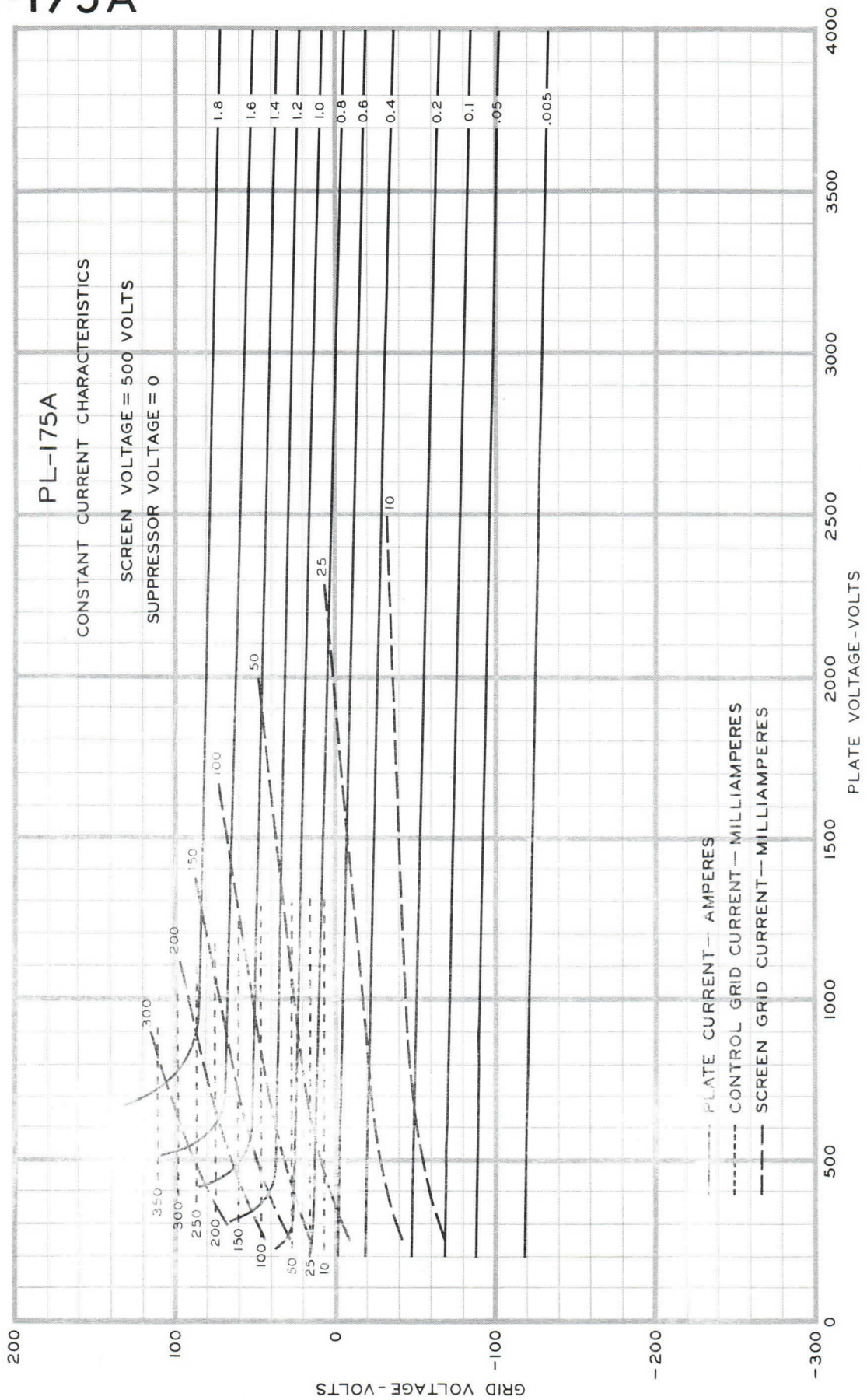


PL-C1
CHIMNEY

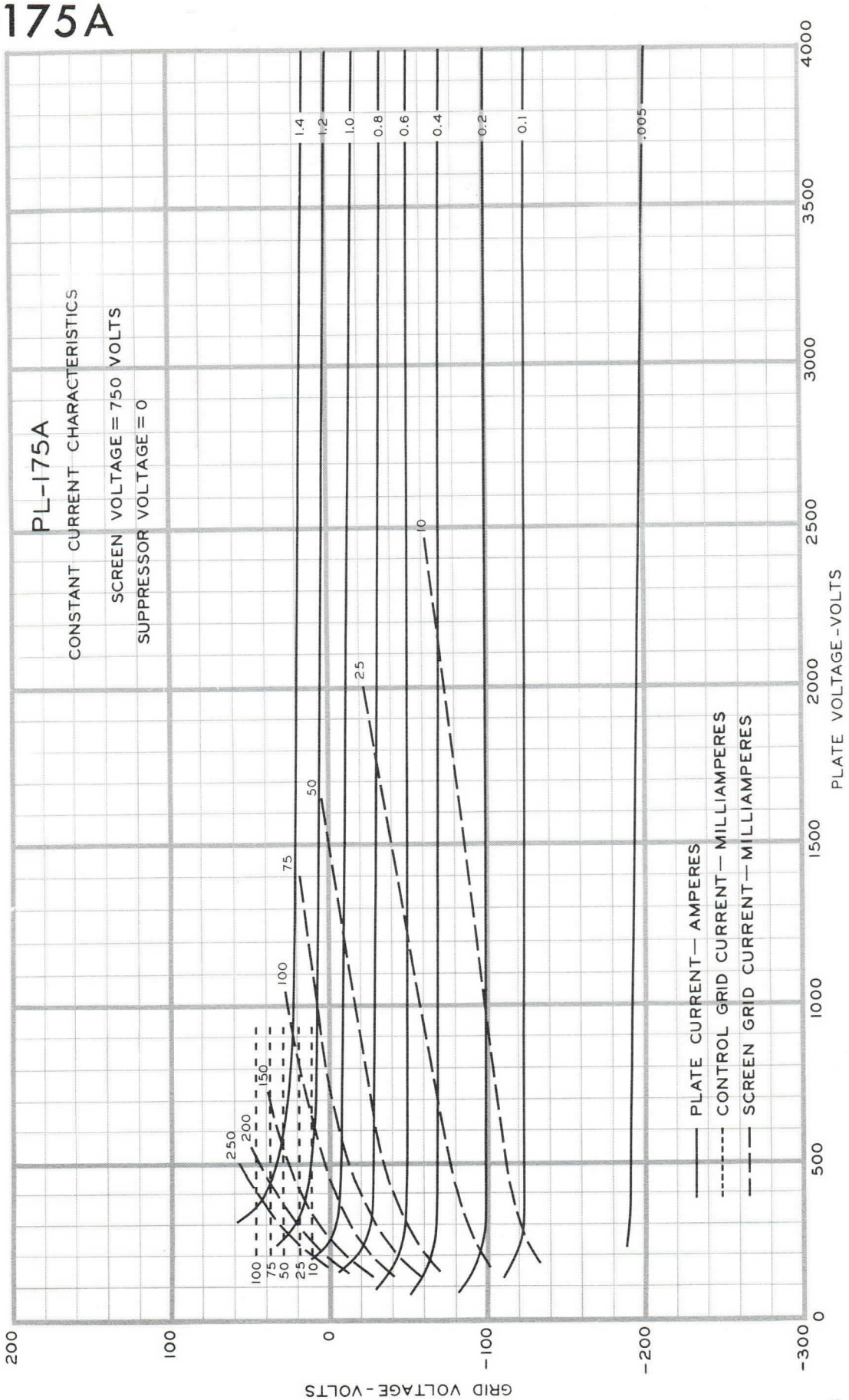


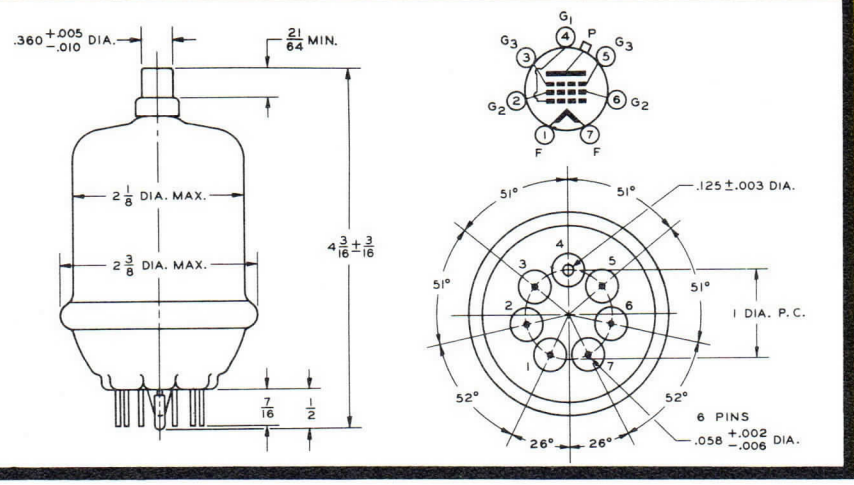
CHASSIS CUT-OUT AND SOCKET MOUNTING FOR PROPER AIR DISTRIBUTION FROM PRESSURIZED CHASSIS (JOHNSON NO. 122-275 SOCKET)

PL-175A


PL-175A
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT-- AMPERES
CONTROL GRID CURRENT-- MILLIAMPERES
SCREEN GRID CURRENT-- MILLIAMPERES
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.1
.05
.005
350
300
250
200
150
100
50
25
10
GRID VOLTAGE - VOLTS
200
100
0
-100
-200
-300
0
500
1000
1500
2000
2500
3000
3500
4000
PLATE VOLTAGE - VOLTS

PL-175A


PL-175A
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
SUPPRESSOR VOLTAGE = 0
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.1
.005
50
75
100
25
10
250
200
150
100
75
50
25
10
PLATE CURRENT— AMPERES
CONTROL GRID CURRENT— MILLIAMPERES
SCREEN GRID CURRENT— MILLIAMPERES
PLATE VOLTAGE-VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
GRID VOLTAGE-VOLTS
200
100
0
-100
-200
-300



PL-177A

Beam Pentode

The PL-177A is a 75-watt radiation-cooled beam pentode incorporating the exclusive Penta vane-type suppressor grid, which allows optimum performance with zero suppressor-grid voltage in many applications. Outstanding features of the PL-177A are its capabilities for high power output at relatively low plate voltage and low distortion as a linear r-f or audio amplifier.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	6.0 volts
Current	3.2 amperes
Grid-Screen Amplification Factor	5
Interelectrode Capacitances	
Grid-Plate	0.06 μμfd.
Input	7.5 μμfd.
Output	4.2 μμfd.
Transconductance (500 v. Eb, 400 v. Ec2, 150 ma. Ib)	4500 μmhos

MECHANICAL CHARACTERISTICS

Base[1]	7-pin Septar, EIA E7-2
Maximum Overall Dimensions	
Length	4.38 inches
Diameter	2.38 inches
Mounting Position	Vertical, base up or down

MAXIMUM RATINGS — CCS (Continuous Commercial Service)

(Frequencies up to 175 Mc.)	Class-AB_1 R-F or Audio	Class-C CW or FM	
D-C Plate Voltage	2000	2000	max. volts
D-C Screen-Grid Voltage	600	600	max. volts
D-C Suppressor-Grid Voltage	100	100	max. volts
D-C Plate Current	175	150	max. ma.
Screen-Grid Input	10	10	max. watts
Plate Dissipation	75	75	max. watts

[1] Fits E. F. Johnson Co. sockets 122-101 or 122-247.

10 August 1962 Form 505R-3

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-177A

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

D-C Plate Voltage	600	750	1000	1500	2000 volts
D-C Screen-Grid Voltage	400	400	400	400	400 volts
D-C Suppressor-Grid Voltage	0	0	0	0	0
D-C Control-Grid Voltage	-90	-90	-105	-115	-125 volts
D-C Plate Current	150	150	150	150	150 ma.
D-C Screen-Grid Current	18	17	16	14	12 ma.
D-C Control-Grid Current	6	6	5	5	5 ma.
Peak R-F Grid Voltage (approx.)	130	125	140	155	165 volts
Driving Power (approx.)	0.75	0.75	0.70	0.75	0.80 watts
Screen-Grid Power Input	7.2	6.8	6.8	6.4	4.8 watts
Plate Power Input	90	112	150	225	300 watts
Plate Dissipation	30	38	40	45	50 watts
Useful Power Output[2]	55	66	100	160	220 watts

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[3]
Single-Sideband, Suppressed Carrier; (Intermittent Modulation)
Grounded-Cathode Circuit

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen-Grid Voltage	600	600	600 volts
D-C Suppressor-Grid Voltage	0	0	0
D-C Control-Grid Voltage[4]	-98	-110	-115 volts
Zero-Signal D-C Plate Current	40	30	25 ma.
Zero-Signal D-C Screen Current	0	0	0
Maximum-Signal D-C Plate Current	175	175	175 ma.
Maximum-Signal D-C Screen Current	10	8	7 ma.
Maximum-Signal Peak R-F Grid Voltage	96	108	112 volts
Intermodulation Distortion Level[5]			
Third Order	-34	-30	-30 db
Fifth Order	-40	-40	-41 db
Maximum-Signal Plate Power Input	175	262	350 watts
Maximum-Signal Plate Dissipation[6]	70	110	125 watts
Maximum-Signal Useful Power Output[2]	96	140	210 watts

---

2 Actual useful power output delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher, and is equal to difference between power input and plate dissipation.

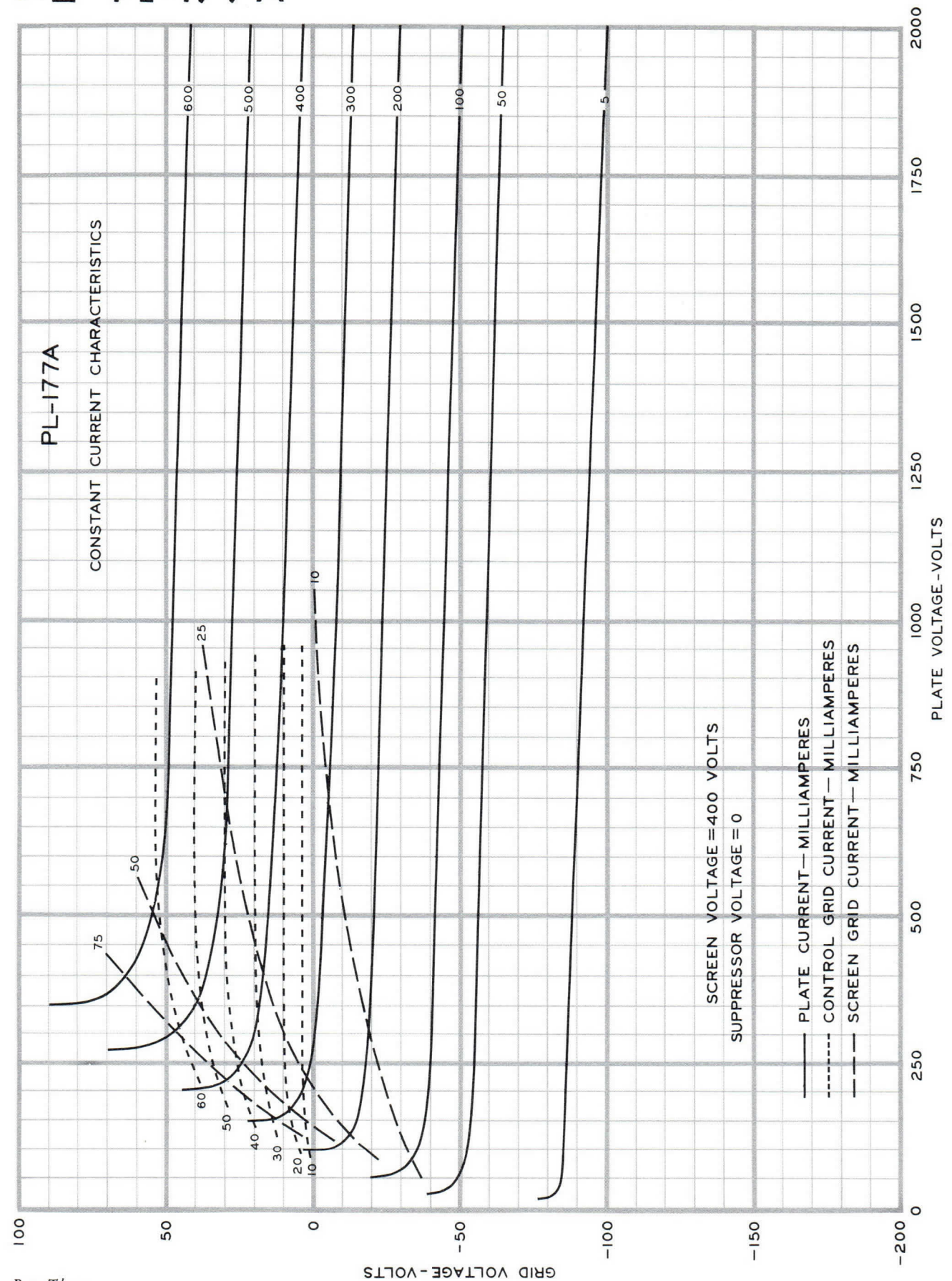
3 D-C current and power values shown are for peak conditions, or for single-tone modulation at full signal.

4 Approximate value; adjust to give stated zero-signal plate current.

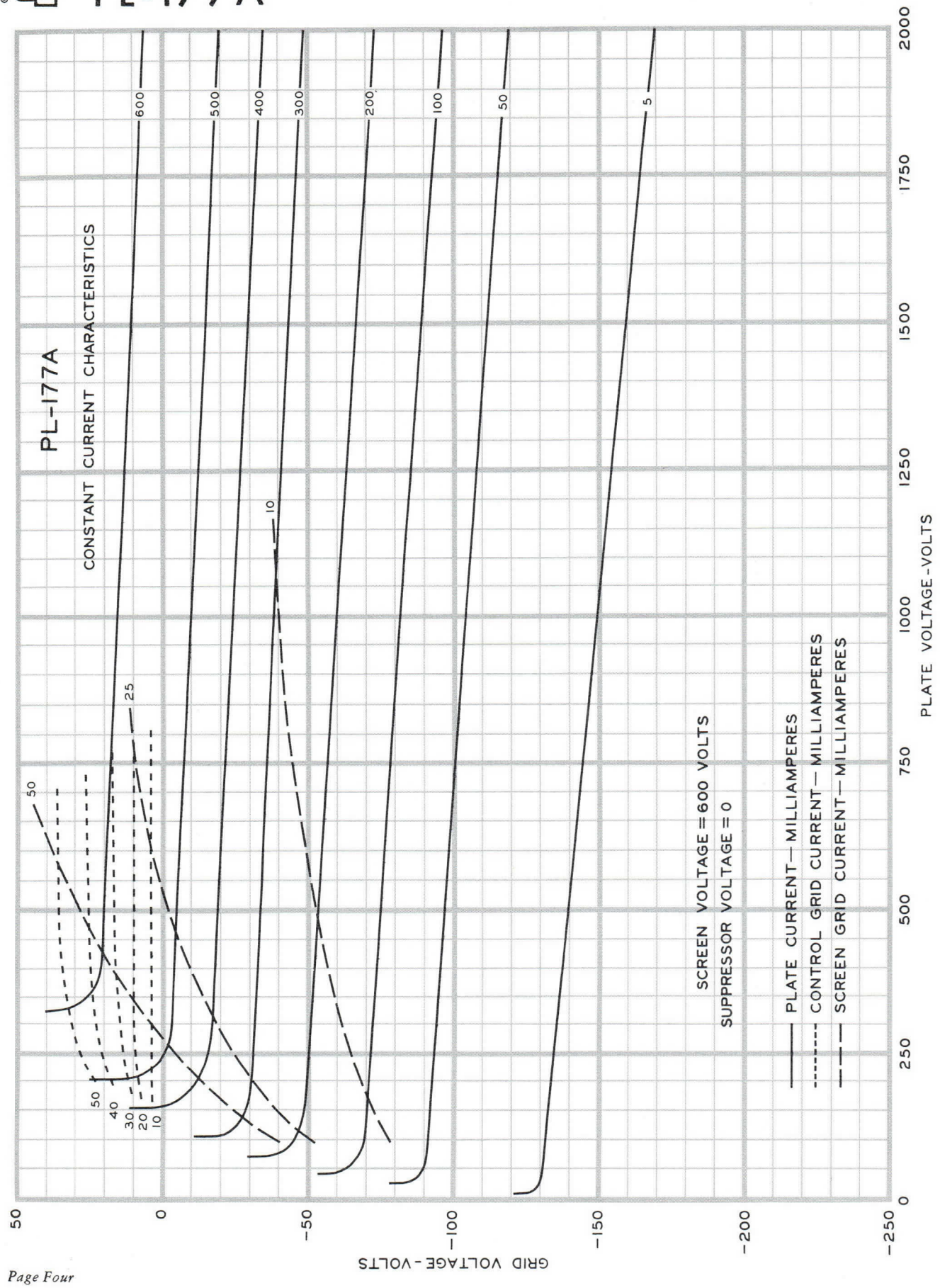
5 Referenced against maximum-signal (or PEP) output. Two equal tones. No degenerative feedback.

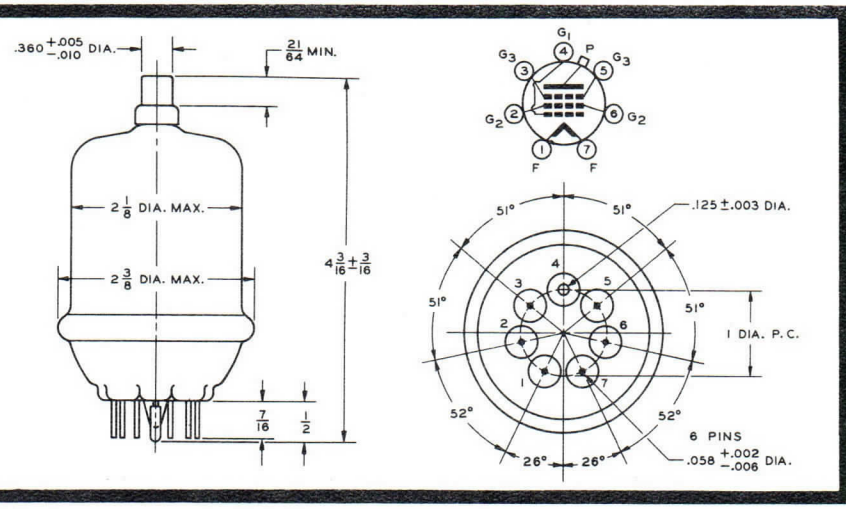
6 Plate dissipation values shown for information only. During normal operation with intermittent modulation, average plate dissipation will not exceed 75-watt maximum rating.

PL-177A


PL-177A
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 400 VOLTS
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT — MILLIAMPERES
CONTROL GRID CURRENT — MILLIAMPERES
SCREEN GRID CURRENT — MILLIAMPERES
600
500
400
300
200
100
50
5
75
50
25
10
60
50
40
30
20
10
100
50
0
-50
-100
-150
-200
GRID VOLTAGE - VOLTS
0
250
500
750
1000
1250
1500
1750
2000
PLATE VOLTAGE - VOLTS

PL-177A


PL-177A
CONSTANT CURRENT CHARACTERISTICS
600
500
400
300
200
100
50
5
10
25
50
40
30
20
10
SCREEN VOLTAGE = 600 VOLTS
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT— MILLIAMPERES
CONTROL GRID CURRENT— MILLIAMPERES
SCREEN GRID CURRENT— MILLIAMPERES
50
0
-50
-100
-150
-200
-250
GRID VOLTAGE - VOLTS
0
250
500
750
1000
1250
1500
1750
2000
PLATE VOLTAGE - VOLTS



PL-177WA

Beam Pentode

The PL-177WA beam pentode is a ruggedized version of the Penta PL-177A, with which it is directly interchangeable. The PL-177WA may be mounted in any position, and will withstand high levels of shock and vibration.

Cooling of the 75-watt PL-177WA is by radiation. The tube incorporates the exclusive Penta vane-type suppressor grid, which permits high power output at relatively low plate voltages, and provides excellent characteristics for use as a linear r-f or audio amplifier.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	6.0 volts
Current	3.2 amperes
Grid-Screen Amplification Factor	5
Interelectrode Capacitances	
Grid-Plate	0.06 μμfd.
Input	7.5 μμfd.
Output	4.2 μμfd.
Transconductance (500 v. Eb, 400 v. Ec2, 150 ma. Ib)	4500 μmhos

MECHANICAL CHARACTERISTICS

Base[1]	7-pin Septar, EIA E7-2
Maximum Overall Dimensions	
Length	4.38 inches
Diameter	2.38 inches
Mounting Position	Any

MAXIMUM RATINGS — CCS (Continuous Commercial Service)

(Frequencies up to 175 Mc.)	Class-AB_1 R-F or Audio	Class-C CW or FM	
D-C Plate Voltage	2000	2000	max. volts
D-C Screen-Grid Voltage	600	600	max. volts
D-C Suppressor-Grid Voltage	100	100	max. volts
D-C Plate Current	175	150	max. ma.
Screen-Grid Input	10	10	max. watts
Plate Dissipation	75	75	max. watts

[1] Fits E. F. Johnson Co. sockets 122-101 or 122-247.

15 May 1962 Form 542

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-177WA

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

D-C Plate Voltage	600	750	1000	1500	2000 volts
D-C Screen-Grid Voltage	400	400	400	400	400 volts
D-C Suppressor-Grid Voltage	0	0	0	0	0
D-C Control-Grid Voltage	-90	-90	-105	-115	-125 volts
D-C Plate Current	150	150	150	150	150 ma.
D-C Screen-Grid Current	18	17	16	14	12 ma.
D-C Control-Grid Current	6	6	5	5	5 ma.
Peak R-F Grid Voltage (approx.)	130	125	140	155	165 volts
Driving Power (approx.)	0.75	0.75	0.70	0.75	0.80 watts
Screen-Grid Power Input	7.2	6.8	6.8	6.4	4.8 watts
Plate Power Input	90	112	150	225	300 watts
Plate Dissipation	30	38	40	45	50 watts
Useful Power Output[2]	55	66	100	160	220 watts

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[3]
Single-Sideband, Suppressed Carrier; (Intermittent Modulation)
Grounded-Cathode Circuit

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen-Grid Voltage	600	600	600 volts
D-C Suppressor-Grid Voltage	0	0	0
D-C Control-Grid Voltage[4]	-98	-110	-115 volts
Zero-Signal D-C Plate Current	40	30	25 ma.
Zero-Signal D-C Screen Current	0	0	0
Maximum-Signal D-C Plate Current	175	175	175 ma.
Maximum-Signal D-C Screen Current	10	8	7 ma.
Maximum-Signal Peak R-F Grid Voltage	96	108	112 volts
Intermodulation Distortion Level[5]			
Third Order	-34	-30	-30 db
Fifth Order	-40	-40	-41 db
Maximum-Signal Plate Power Input	175	262	350 watts
Maximum-Signal Plate Dissipation[6]	70	110	125 watts
Maximum-Signal Useful Power Output[2]	96	140	210 watts

---

2 Actual useful power output delivered to load from typical amplifier. So-called "plate power output" is approximately 10 per cent higher, and is equal to difference between power input and plate dissipation.

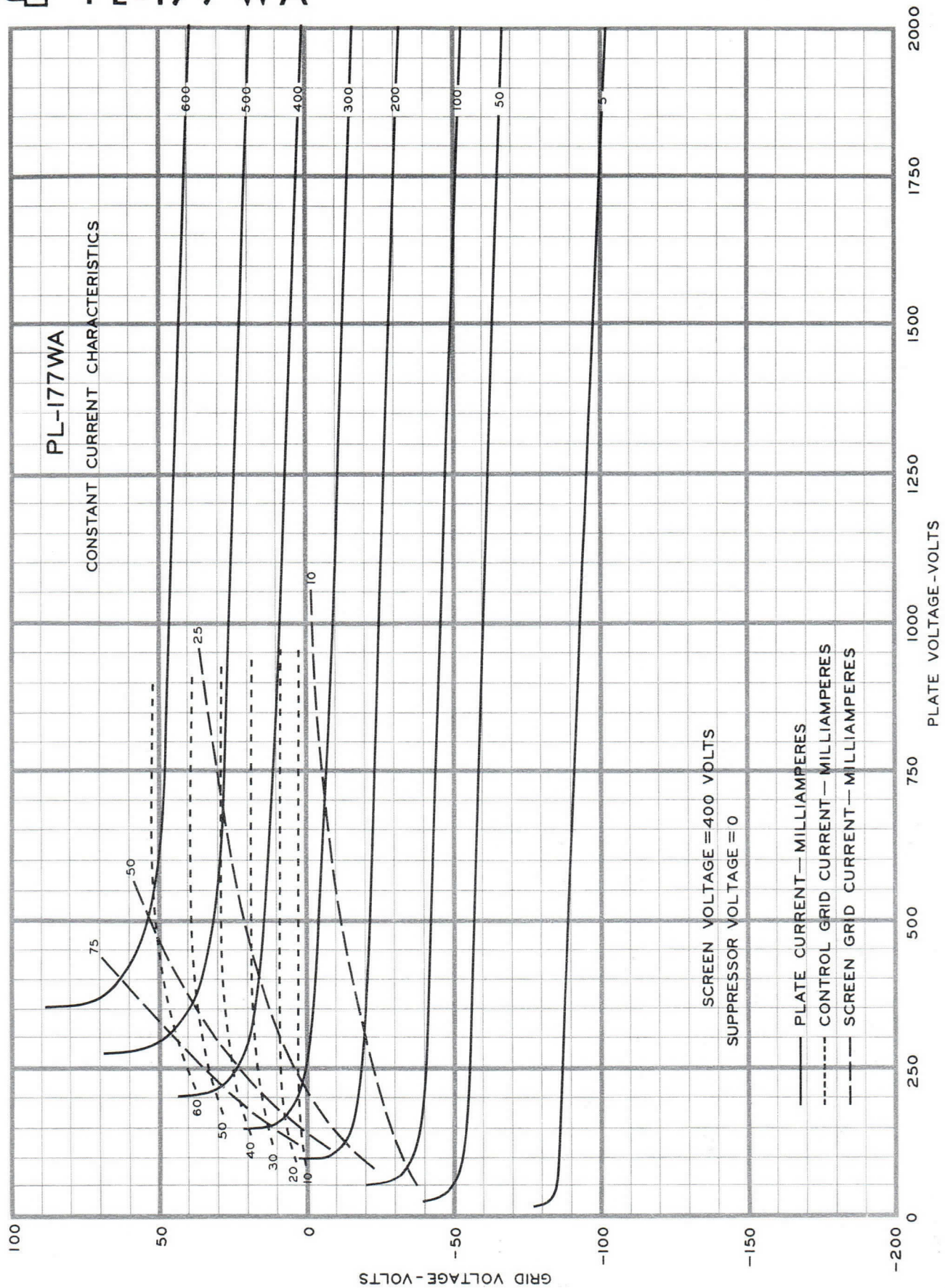
3 D-C current and power values shown are for peak conditions, or for single-tone modulation at full signal.

4 Approximate value; adjust to give stated zero-signal plate current.

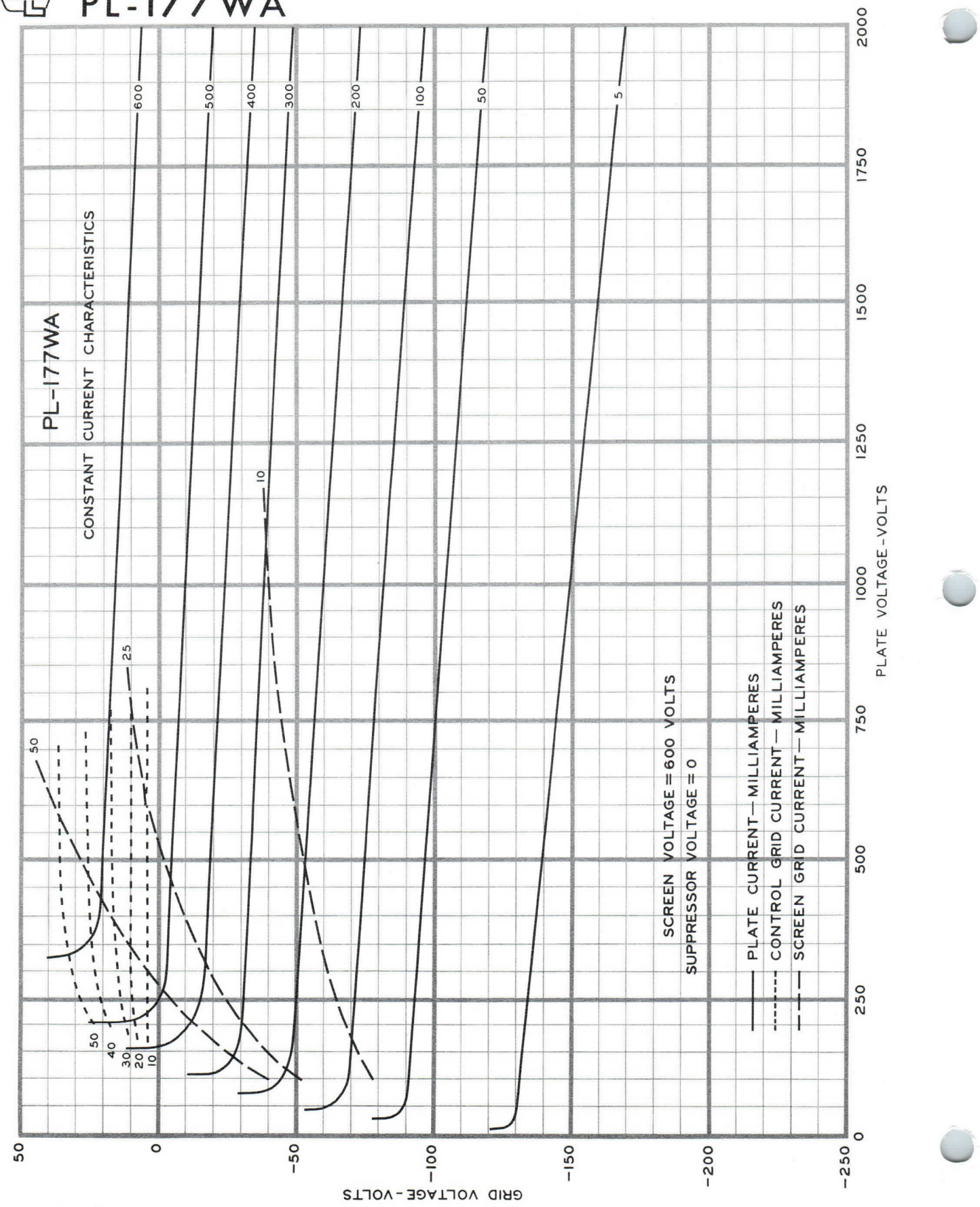
5 Referenced against maximum-signal (or PEP) output. Two equal tones. No degenerative feedback.

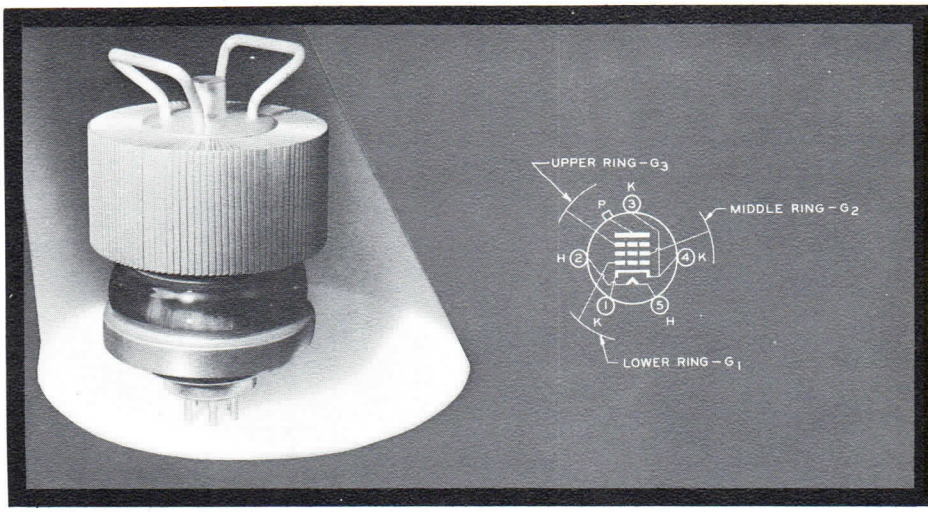
6 Plate dissipation values shown for information only. During normal operation with intermittent modulation, average plate dissipation will not exceed 75-watt maximum rating.

PL-177WA


PL-177WA
CONSTANT CURRENT CHARACTERISTICS
600
500
400
300
200
100
50
5
75
50
25
10
60
50
40
30
20
10
SCREEN VOLTAGE = 400 VOLTS
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT — MILLIAMPERES
CONTROL GRID CURRENT — MILLIAMPERES
SCREEN GRID CURRENT — MILLIAMPERES
PLATE VOLTAGE - VOLTS
0
250
500
750
1000
1250
1500
1750
2000
GRID VOLTAGE - VOLTS
100
50
0
-50
-100
-150
-200

PL-177WA


PL-177WA
CONSTANT CURRENT CHARACTERISTICS
600
500
400
300
200
100
50
5
10
25
50
40
30
20
10
50
SCREEN VOLTAGE = 600 VOLTS
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT— MILLIAMPERES
CONTROL GRID CURRENT— MILLIAMPERES
SCREEN GRID CURRENT— MILLIAMPERES
PLATE VOLTAGE-VOLTS
0
250
500
750
1000
1250
1500
1750
2000
GRID VOLTAGE-VOLTS
50
0
-50
-100
-150
-200
-250



PL-195

Beam Pentode

DESCRIPTION

The PL-195 is a forced-air cooled, 4000-watt plate dissipation beam pentode especially suited for low-distortion Class-AB_1 linear amplifier service, in which a single tube will deliver over 5000 watts of useful power output. The tube, which has a high power gain and good efficiency at relatively low plate voltages, is of the oxide-coated, unipotential-cathode type, with modest heater power requirements.

ELECTRICAL CHARACTERISTICS

Cathode — Coated Unipotential	
Heater Voltage	6.0 volts
Heater Current	17 amperes
Minimum Cathode Heating Time	5 minutes
Transconductance (1500 v. E_b, 750 v. Ec_2, 2 a. I_b)	37,000 μmhos
Interelectrode Capacitances	
Grounded-Cathode Circuit Configuration	
Grid-Plate	0.12 μμfd
Input	88 μμfd
Output	33 μμfd
Grounded-Grid Circuit Configuration	
Grid-Plate	0.026 μμfd
Input	42 μμfd
Output	34 μμfd

MECHANICAL CHARACTERISTICS

Base	5-pin, EIA 5-97
Base Connections	See Base Diagram
Recommended Socket	PL-205A
Maximum Overall Dimensions	
Length	8.84 inches
Diameter	5.53 inches
Net Weight	11 pounds

Cooling*

Plate Dissipation (Watts)	*Air Flow (c.f.m.)*	*Pressure (Inches of Water)*
3000	70	0.26
4000	110	0.45

*At sea level, 50° C. maximum incoming air temperature. Pressure drop includes drop across PL-205A socket.

Mounting Position	Axis vertical, base up or down

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

MOUNTING

The PL-195 must be mounted with the axis of the tube vertical, with the base up or down, and must be supported by either the lower edge or the upper flat portion of the suppressor-grid terminal ring, or by the anode cooler. The tube must not be supported by the glass, by the pins, or by the control- or screen-grid rings.

Contact to the suppressor, screen and control-grid contact surfaces should be made by spring contact material in at least three places around the periphery of each surface.

The base of the PL-195 fits a standard five-pin Jumbo socket, such as the E. F. Johnson Co. type 122-275. The socket should be so located that the glass at the base of the tube does not contact the socket when the tube is seated in its support.

The PL-205A, a special socket having air-directing provisions and contacts for all base pins and suppressor, screen and control-grid terminals, is available. The socket has built-in by-pass capacitors for the screen-grid, and the suppressor-grid contacts are grounded to the frame.

COOLING

Cooling air requirements for the PL-195, when used with the Penta PL-205A socket, are shown in the graph below. Any additional pressure drops in the air system between the blower and socket, such as might occur in an air duct, must be added to the pressure drop figure taken from the chart to determine the static pressure which must be maintained at the blower.

Sufficient cooling air should be diverted over the base end of the tube from the anode cooling supply, either before or after entering the anode cooler, to limit the temperature of the base seals, suppressor, screen and control-grid contact surfaces to a maximum of 175° C. Adequate base-seal cooling is provided when the PL-195 is used with the PL-205A socket and a pressurized chassis, under the recommended tube cooling conditions.

OPERATION - GENERAL

Maximum ratings and typical operating conditions for the PL-195 are given in the accompanying tabular data.

Heater voltage for the tube should be maintained as closely as possible to the rated value of 6.0 volts. Voltage variations of up to 10 per cent are permissible, but decreased tube life and variations in power output may occur with prolonged operation at heater voltages of more than five per cent from the rated value.

Permanent damage to the PL-195 can be caused by screen-grid input in excess of the maximum rating. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be so arranged that it is impossible to apply screen voltage without plate voltage. The use of a screen-grid overcurrent relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

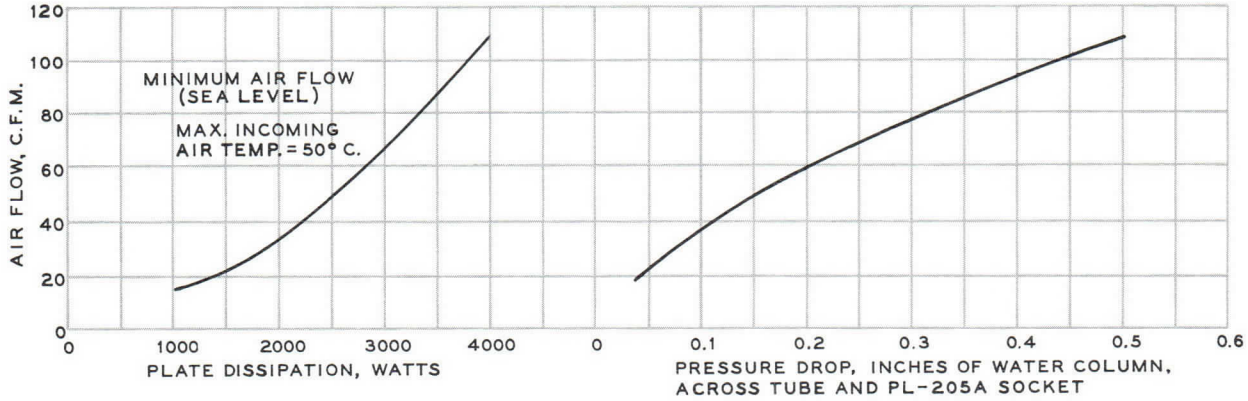
Grid-bias voltage must be obtained from a fixed bias supply in Class-AB_1 or AB_2 applications. The total grid circuit resistance should not exceed 2,500 ohms.

RADIO-FREQUENCY OPERATION

While the PL-195 may be operated without neutralization, provided the suppressor and screen-grids are effectively grounded for radio frequencies, it will usually be found advisable in low-distortion Class-AB_1 linear amplifier service, where reaction on the driver circuit must be eliminated, to neutralize the small feedback capacitance of the PL-195.

The input and output circuits of an amplifier using the PL-195 should be separated by a metal chassis or equivalent means. Reasonable precautions should be observed in regard to by-passing and shielding of the supply leads to prevent coupling between input and output through external circuits.

For Class-AB_1 linear amplifier service, the screen voltage for the PL-195 must be obtained from a well-regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.



MAXIMUM RATINGS

CCS (Continuous Commercial Service)

D-C Plate Voltage	5000 volts
D-C Screen-Grid Voltage	1000 volts
D-C Suppressor-Grid Voltage	100 volts
D-C Control-Grid Voltage	−250 volts
D-C Plate Current	2.0 amp.
Screen-Grid Input	75 watts
Plate Dissipation	4000 watts

TYPICAL OPERATION — Class-AB$_1$ Linear R-F Amplifier

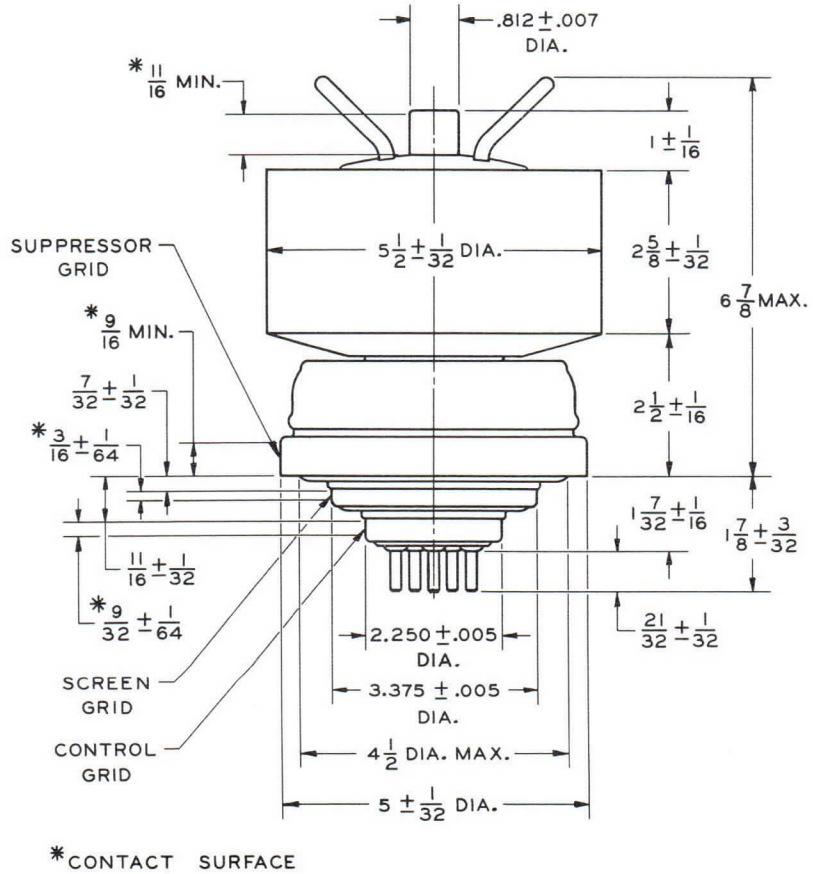
Single-Sideband, Suppressed Carrier; Grounded-Cathode Circuit

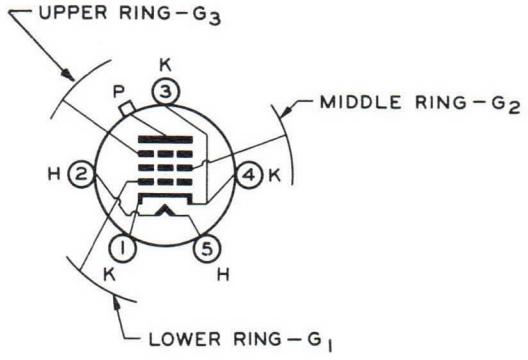
D-C Plate Voltage	3000	4000	5000	volts
D-C Screen-Grid Voltage	750	750	750	volts
D-C Suppressor-Grid Voltage	0	0	0	
D-C Control-Grid Voltage[1]	−104	−105	−105	volts
Zero-Signal D-C Plate Current	400	400	400	ma.
Maximum-Signal D-C Plate Current, Single Tone	1.47	1.55	1.65	amp.
Maximum-Signal D-C Plate Current, Two Tone	1.0	1.00	1.06	amp.
Zero-Signal D-C Screen-Grid Current	9	8	7	ma.
Maximum-Signal D-C Screen-Grid Current, Single Tone	75	65	65	ma.
Maximum-Signal D-C Screen-Grid Current, Two Tone	36	30	30	ma.
Maximum-Signal Peak R-F Control-Grid Voltage	104	105	105	volts
Intermodulation Distortion Level[2] Third-Order	−31	−30	−29	db
Maximum-Signal Useful Power Output[3]	2750	4000	5500	watts

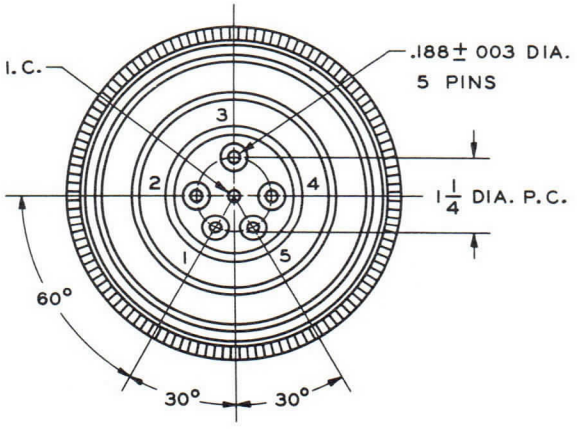
[1]Approximate value; adjust to give stated zero-signal plate current.

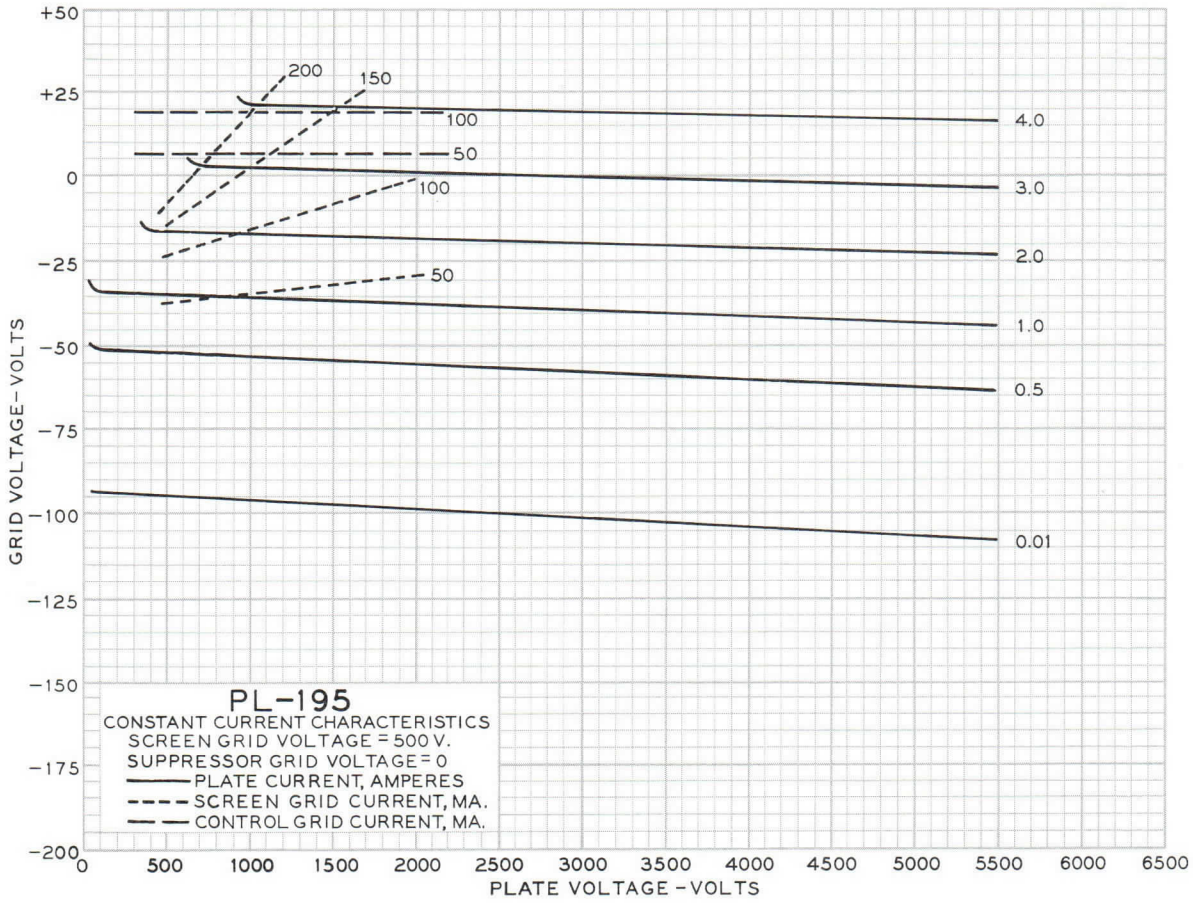
[2]At maximum output. Referenced against one tone of two equal-tone signal. No degenerative feedback. Fifth and higher-order distortion products more than 45 db below one tone.

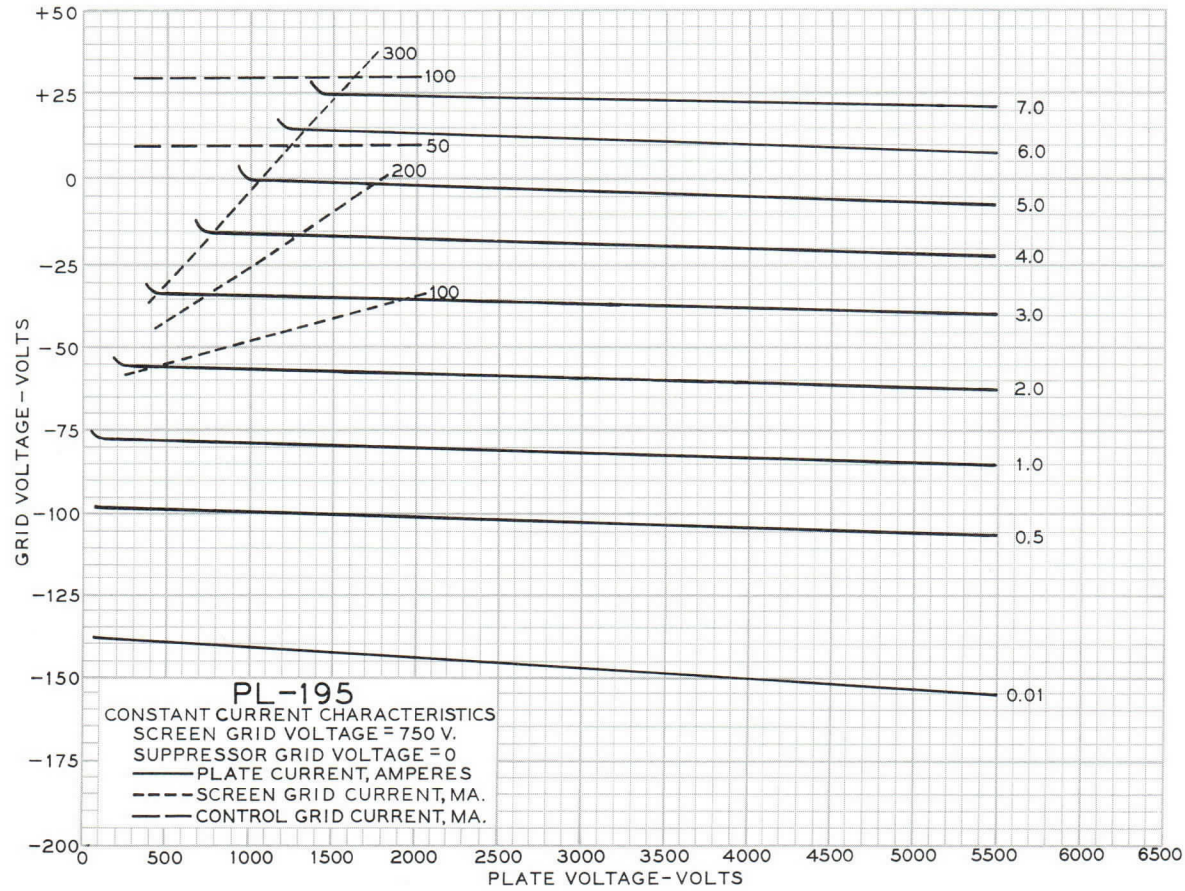
[3]Single-tone or peak envelope power delivered to load from typical amplifier.

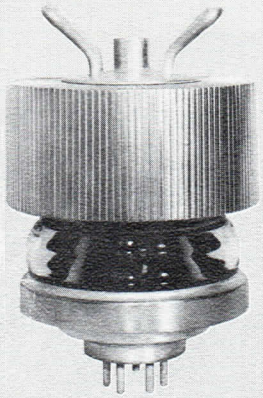


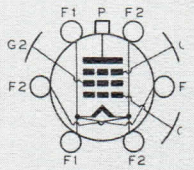





+50
+25
0
−25
−50
−75
−100
−125
−150
−175
−200
GRID VOLTAGE – VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
PLATE VOLTAGE – VOLTS
200
150
100
50
100
50
4.0
3.0
2.0
1.0
0.5
0.01
PL–195
CONSTANT CURRENT CHARACTERISTICS
SCREEN GRID VOLTAGE = 500 V.
SUPPRESSOR GRID VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.


+50
+25
0
−25
−50
−75
−100
−125
−150
−175
−200
GRID VOLTAGE – VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
PLATE VOLTAGE – VOLTS
300
100
50
200
100
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.01
PL–195
CONSTANT CURRENT CHARACTERISTICS
SCREEN GRID VOLTAGE = 750 V.
SUPPRESSOR GRID VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.





PL-210
Beam Pentode

DESCRIPTION

The PL-210 is a 5000-watt plate dissipation beam pentode providing outstanding performance as a low-distortion Class-AB_1 linear amplifier, in which service a single tube will deliver over 10,000 watts of useful power output. Cooling is provided by forced air. The PL-210, which utilizes a thoriated tungsten filament, offers high power gain and good efficiency, with excellent intermodulation distortion characteristics.

ELECTRICAL CHARACTERISTICS

Filament — Thoriated Tungsten	
Voltage	6.0 volts
Current	85 amperes
Transconductance (2500 v. E_b, 1250 v. Ec_2, 2.5 a. I_b)	44,000 μmhos
Interelectrode Capacitances	
Grounded-Cathode Circuit Configuration	
Input	97 $\mu\mu$fd
Output	34 $\mu\mu$fd
Grid-Plate	0.14 $\mu\mu$fd
Grounded-Grid Circuit Configuration	
Input	39 $\mu\mu$fd
Output	34 $\mu\mu$fd
Plate-Filament	0.03 $\mu\mu$fd

MECHANICAL CHARACTERISTICS

Base	Special, 6-pin
Base Connections	See outline drawing
Recommended Socket	PL-261A
Maximum Overall Dimensions	
Length	8.84 inches
Diameter	5.53 inches
Net Weight	10 pounds
Cooling:	
Volume of cooling air through cooler at 5000 watts plate dissipation, 50° C. max. incoming air temperature	170 c.f.m.
Total pressure drop across tube and PL-261A socket (at 170 c.f.m.)	0.95 inches water
Mounting Position	Axis vertical, base up or down

10 February 1964

Form 92C-311B

PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-210

MOUNTING

The PL-210 must be mounted with the axis of the tube vertical, with the base up or down, and must be supported by either the lower edge or the upper flat portion of the suppressor-grid terminal ring, or by the anode cooler. The tube must not be supported by the glass or base pins.

Contact to the suppressor, screen, and control-grid contact surfaces should be made by spring contact material in at least three places around the periphery of each surface.

The PL-261A, a special socket designed for use with the PL-210 and having air-directing provisions and contacts for all base pins and suppressor, screen and control-grid terminals, is available. The socket has built-in by-pass capacitors for the screen grid, and the suppressor-grid contacts are grounded to the frame.

COOLING

Cooling air requirements for the PL-210, when used with the Penta PL-261A socket, are shown in the graph below. Any additional pressure drops in the air system between the blower and socket, such as might occur in an air duct, must be added to the pressure drop figure taken from the chart to determine the static pressure which must be maintained at the blower.

Sufficient cooling air must be provided to the base seals, suppressor, screen and control-grid contact surfaces to limit their temperature to a maximum of 175° C. When the PL-210 is used with the PL-261A socket and a pressurized chassis and the cooling air specified for 5000 watts plate dissipation is supplied, adequate base-seal cooling will be provided. At the stated cooling air requirements for values of plate dissipation less than 5000 watts sufficient supplementary cooling air must be directed at the base seals and contact surfaces to limit their temperatures to 175° C., maximum.

OPERATION — GENERAL

Maximum ratings and typical operating conditions for the PL-210 are given in the accompanying tabular data.

Filament voltage for the tube should be maintained as closely as possible to the rated value of 6.0 volts, measured at the socket. Decreased tube life and variations in power output may occur with prolonged operation at filament voltages more than five per cent from the rated value.

Screen-grid input in excess of the maximum rating can cause permanent damage to the PL-210. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be so arranged that it is impossible to apply screen voltage without plate voltage. The use of a screen-grid overcurrent relay is recommended to remove screen voltage immediately in case of excessive screen current due to circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

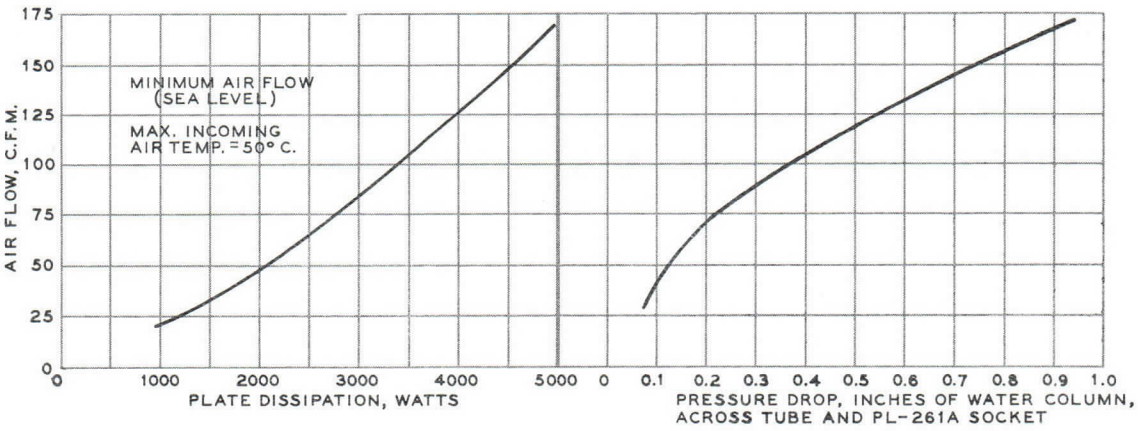
Grid-bias voltage must be obtained from a fixed bias supply in Class-AB_1 and AB_2 applications. The total grid circuit resistance should not exceed 25,000 ohms.

RADIO-FREQUENCY OPERATION

While the PL-210 may be operated without neutralization, provided the suppressor and screen-grids are effectively grounded for radio frequencies, it will usually be found advisable in low-distortion Class-AB_1 linear amplifier service, where reaction on the driver circuit must be eliminated, to neutralize the small feedback capacitance of the tube.

The input and output circuits of an amplifier using the PL-210 should be separated by a metal chassis or equivalent means. Reasonable precautions should be observed in regard to by-passing and shielding of the supply leads to prevent coupling between input and output through external circuits.

For Class-AB_1 linear amplifier service, the screen voltage for the PL-210 must be obtained from a well-regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.



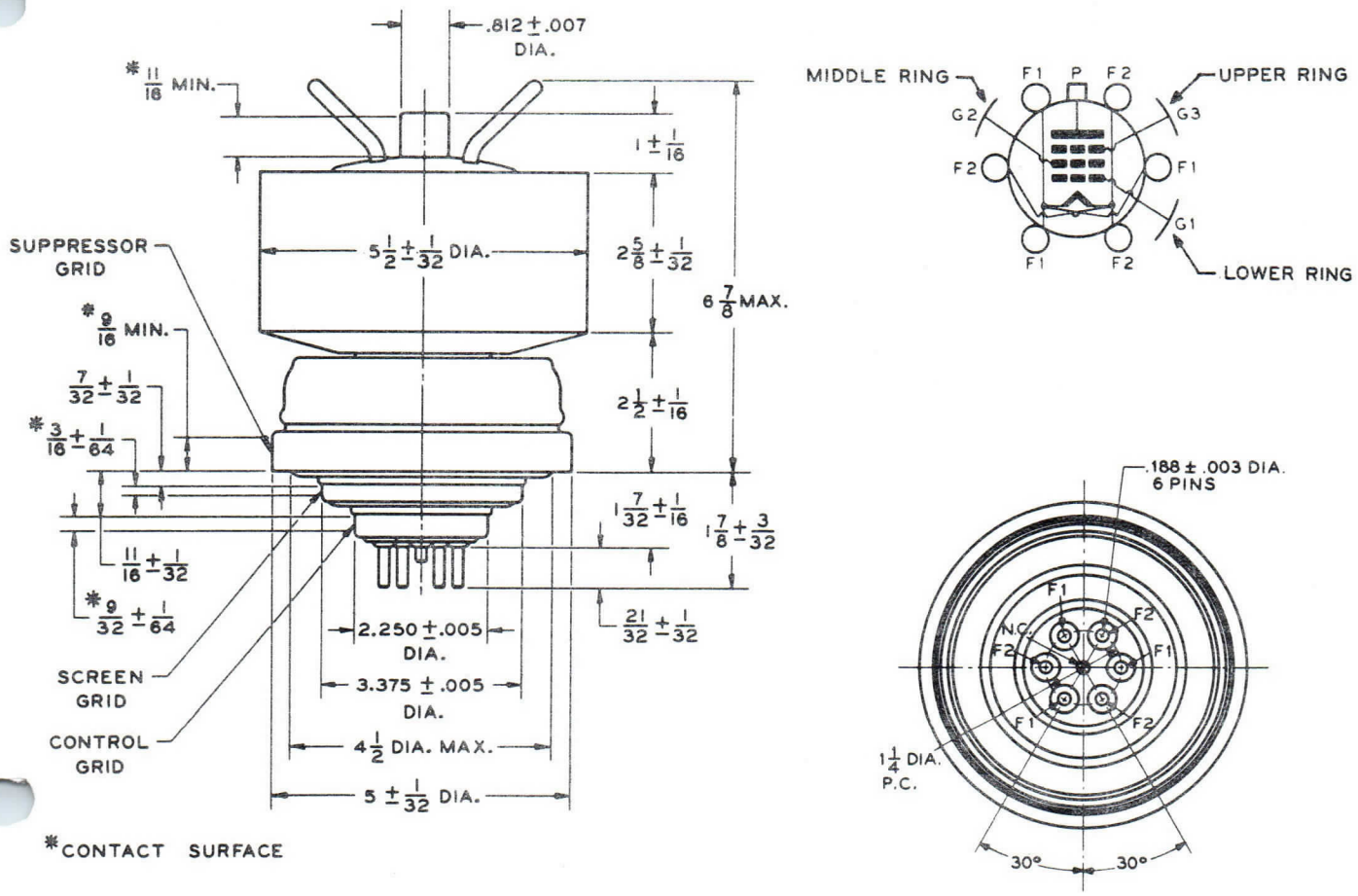
MAXIMUM RATINGS
CCS (Continuous Commercial Service)

D-C Plate Voltage	7500 volts
D-C Screen-Grid Voltage	1500 volts
D-C Suppressor-Grid Voltage	100 volts
D-C Control-Grid Voltage	−500 volts
D-C Plate Current	2.5 amperes
Screen-Grid Input	200 watts
Plate Dissipation	5000 watts

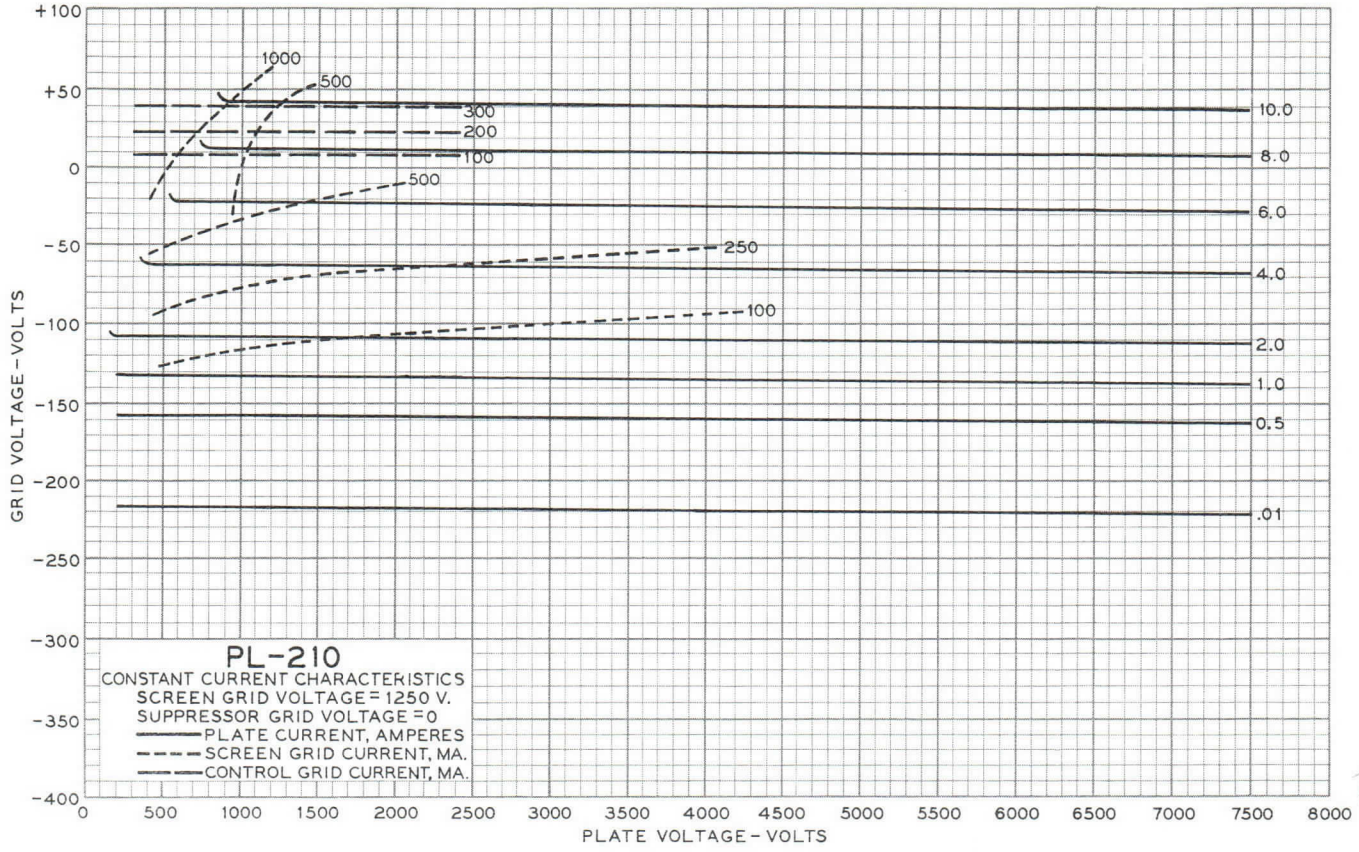
TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier
Single-Sideband, Suppressed Carrier; Grounded-Cathode Circuit

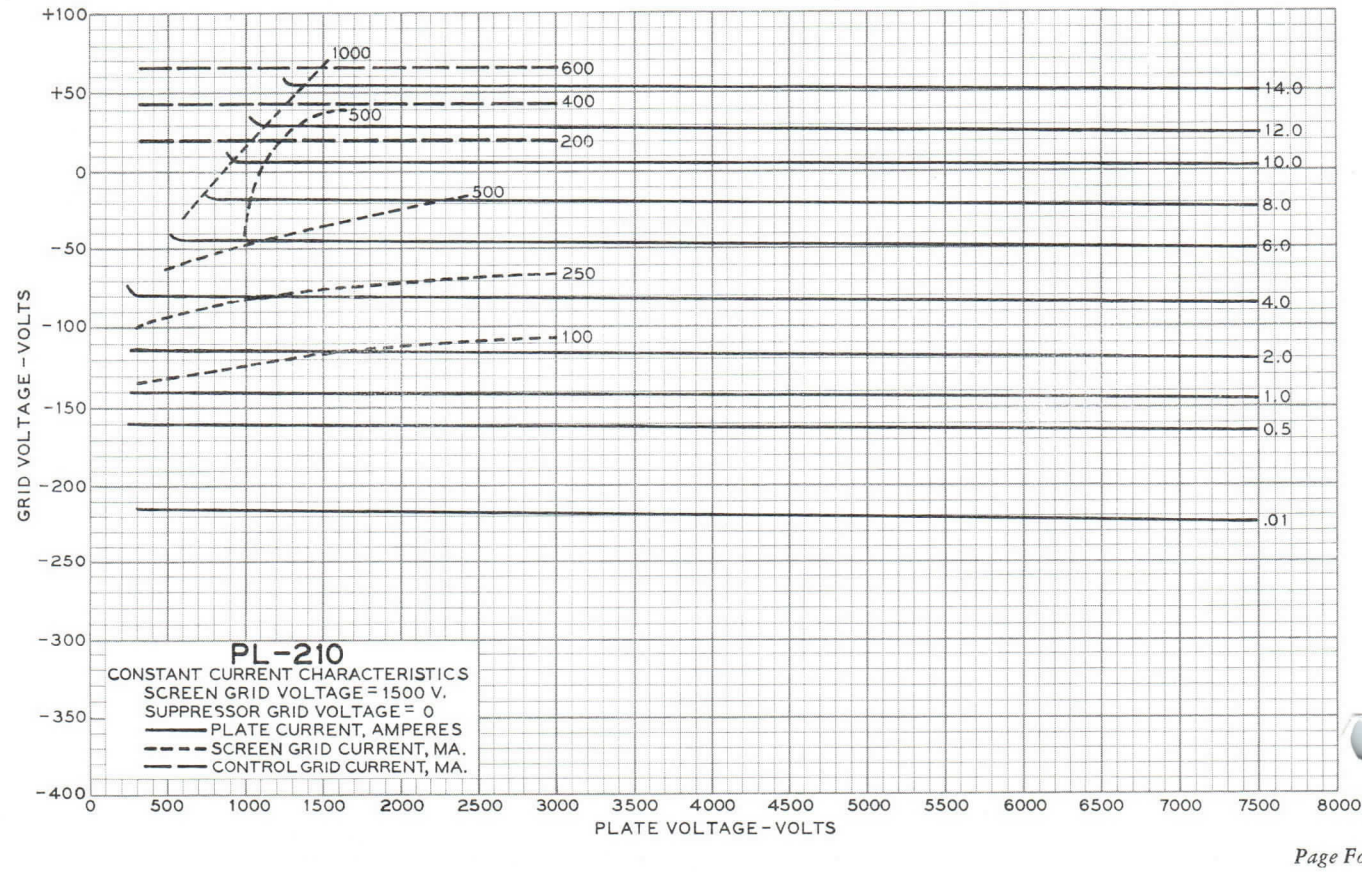
D-C Plate Voltage	5000	6000	7500	volts
D-C Screen-Grid Voltage	1250	1250	1250	volts
D-C Suppressor Grid Voltage	0	0	0	
D-C Control-Grid Voltage[1]	−160	−165	−165	volts
Zero-Signal D-C Plate Current	400	400	400	ma.
Maximum-Signal D-C Plate Current, Single Tone	1.90	1.95	2.1	amp.
Maximum-Signal D-C Plate Current, Two Tone	1.10	1.15	1.20	amp.
Zero-Signal D-C Screen-Grid Current	6	6	5	ma.
Maximum-Signal D-C Screen-Grid Current, Single Tone	135	135	125	ma.
Maximum-Signal D-C Screen-Grid Current, Two Tone	75	75	65	ma.
Maximum-Signal Peak R-F Control-Grid Voltage	160	160	165	volts
Intermodulation Distortion Level[2]				
Third Order	−40	−40	−35	db
Fifth Order	−45	−45	−42	db
Maximum-Signal Useful Power Output[3]	5680	7040	10,400	watts

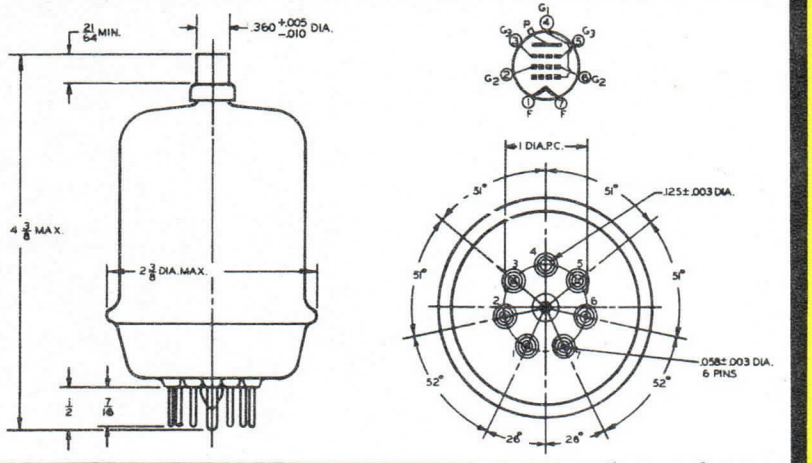
[1]Approximate value; adjust to give stated zero-signal plate current.
[2]At maximum output. Referenced against one tone of two equal-tone signal. No degenerative feedback.
[3]Single-tone or peak envelope power delivered to load from typical amplifier.



PL-210


+100
+50
0
-50
-100
-150
-200
-250
-300
-350
-400
GRID VOLTAGE - VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
PLATE VOLTAGE - VOLTS
1000
500
300
200
100
500
250
100
10.0
8.0
6.0
4.0
2.0
1.0
0.5
.01
PL-210
CONSTANT CURRENT CHARACTERISTICS
SCREEN GRID VOLTAGE = 1250 V.
SUPPRESSOR GRID VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.


+100
+50
0
-50
-100
-150
-200
-250
-300
-350
-400
GRID VOLTAGE - VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
PLATE VOLTAGE - VOLTS
1000
600
400
500
200
500
250
100
14.0
12.0
10.0
8.0
6.0
4.0
2.0
1.0
0.5
.01
PL-210
CONSTANT CURRENT CHARACTERISTICS
SCREEN GRID VOLTAGE = 1500 V.
SUPPRESSOR GRID VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.



PL-6549

Beam Pentode

DESCRIPTION

The Penta PL-6549 is a 75-watt dissipation aligned-grid pentode featuring good performance at low plate voltage, but also capable of good performance at relatively high voltage, for medium-power applications. The improved current-division characteristics resulting from the use of a suppressor grid permit the use of screen voltages approaching the plate voltage in low power applications. This feature of the PL-6549 results in excellent power gain and output characteristics, both as an audio and radio-frequency amplifier.

ELECTRICAL CHARACTERISTICS

Filament — Thoriated Tungsten (Quick-Heating)	
Voltage	6.0 volts
Current	3.3 amperes
Grid-Screen mu Factor	5.0
Transconductance (500 v. E_b, 400 v. Ec_2, 0 v. Ec_3, 150 ma. Ib_1)	4500 μmhos
Interelectrode Capacitances	
Grid-Plate	0.09 $\mu\mu$f
Input	7.5 $\mu\mu$f
Output	3.4 $\mu\mu$f

MECHANICAL CHARACTERISTICS

Base[1]	7-pin Septar, EIA E 7-2
Basing	See base diagram
Maximum Overall Dimensions	
Length	4.38 inches
Diameter	2.38 inches
Mounting Position — Vertical, base up or down	

[1] Fits Johnson No. 122-101 or 122-247 or National No. HX-29 sockets.

20 April 1965 Form 92C-111A

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

PL-6549

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

(Frequencies below 175 Mc.)	Class-C FM or CW	Class-C Plate Mod.	Class AB_1 Audio Ampl.	Class AB_2 Audio Ampl.	
D-C Plate Voltage	2000	2000	2000	2000	volts
D-C Screen-Grid Voltage	600	600	600	600	volts
D-C Suppressor-Grid Voltage	100	100	100	100	volts
D-C Plate Current	150	125	175	175	ma.
Plate Dissipation	75	50	75	75	watts
Screen-Grid Input	10	10	10	10	watts

TYPICAL OPERATION — Class-C CW or FM Amplifier

Frequencies below 175 Mc.

D-C Plate Voltage	600	750	1000	1500	2000	volts
D-C Screen-Grid Voltage	400	400	400	400	400	volts
D-C Suppressor-Grid Voltage	70	70	70	70	70	volts
D-C Control-Grid Voltage	—90	—90	—105	—115	—125	volts
D-C Plate Current	150	150	150	150	150	ma.
D-C Screen-Grid Current	18	17	16	14	12	ma.
D-C Suppressor-Grid Current	7	6.5	5.5	5	5	ma.
D-C Control-Grid Current	6	6	5	5	5	ma.
Peak R-F Grid Voltage (approx.)	130	125	140	155	165	volts
Driving Power (approx.)	0.75	0.75	0.70	0.75	0.80	watts
Screen-Grid Power Input	7.2	6.8	6.8	6.4	4.8	watts
Plate Power Input	90	112	150	225	300	watts
Plate Dissipation	30	38	40	45	50	watts
Plate Power Output	60	74	110	180	250	watts

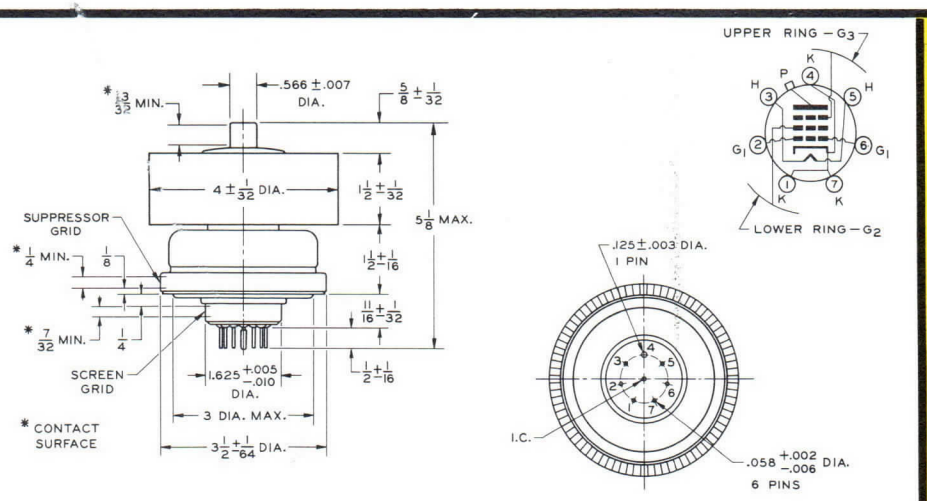
TYPICAL OPERATION — Class-AB_1 A.F. Power Amplifier or Modulator (Sine Wave, Two Tubes)

D-C Plate Voltage	600	1000	1500	2000	volts
D-C Screen-Grid Voltage	600	600	600	600	volts
D-C Suppressor-Grid Voltage	70	70	70	70	volts
D-C Control-Grid Voltage*	—100	—108	—115	—120	volts
Zero-Sig. D-C Plate Current	70	50	40	30	ma.
Max.-Sig. D-C Plate Current	350	320	240	210	ma.
Zero-Sig. D-C Screen-Grid Current	1.5	0.5	0.3	0.1	ma.
Max.-Sig. D-C Screen-Grid Current	28	20	14	9	ma.
Peak A-F Grid-to-Grid Voltage	195	200	180	170	volts
Plate-to-Plate Load Resistance	2550	5800	11,700	19,800	ohms
Max.-Sig. Plate Dissipation (per tube)	59	68	73	73	watts
Max.-Sig. Plate Power Output	92	185	220	275	watts

TYPICAL OPERATION — Class-AB_2 A.F. Power Amplifier or Modulator (Sine Wave, Two Tubes)

D-C Plate Voltage	600	1000	1500	2000	volts
D-C Screen-Grid Voltage	400	400	400	400	volts
D-C Suppressor-Grid Voltage	70	70	70	70	volts
D-C Control-Grid Voltage*	—65	—72	—78	—85	volts
Zero-Sig. D-C Plate Current	70	50	40	30	ma.
Max.-Sig. D-C Plate Current	350	350	285	225	ma.
Zero-Sig. D-C Screen-Grid Current	1.4	0.5	0.2	0.1	ma.
Max.-Sig. D-C Screen-Grid Current	40	34	18	10	ma.
Peak A-F Grid-to-Grid Voltage	210	230	190	180	volts
Driving Power (Max. Sig.)	2.3	1.8	0.9	0.05	watts
Plate-to-Plate Load Resistance	2700	5500	11,100	19,000	ohms
Max.-Sig. Plate Dissipation (per tube)	50	73	74	70	watts
Max.-Sig. Plate Power Output	110	205	280	325	watts

*Approximate value. Adjust to give stated value of zero-signal plate current.



PL-8295
(PL-172)
Beam Pentode

DESCRIPTION

The PL-8295/PL-172 is a forced-air cooled, 1000-watt plate dissipation power pentode featuring high power gain and good efficiency at relatively low plate voltages. This tube is particularly well suited for low-distortion Class-AB_1 linear r-f amplifier service, where a single tube will deliver over 1500 watts of useful power output. The excellent characteristics of the PL-8295/PL-172 also provide outstanding performance in Class-AB_2, Class-B, and Class-C service.

ELECTRICAL CHARACTERISTICS

Cathode — Coated Unipotential		
Heater Voltage	6.0	volts
Heater Current	8.2	amperes
Minimum Cathode Heating Time	3	minutes
Grid-Screen mu Factor	3.4	
Transconductance (1000 v. Eb, 500 v. Ec_2, 1 a. I_b)	23,000	μmhos
Interelectrode Capacitances		
Grid-Plate	0.09	$\mu\mu$f
Input	38	$\mu\mu$f
Output	18	$\mu\mu$f

MECHANICAL CHARACTERISTICS

Base	7-pin Septar,	EIA E 7-2
Base Connections	See base diagram	
Recommended Socket	PL-184, PL-184A	
Maximum Overall Dimensions		
Length	5.125	inches
Diameter	4.032	inches
Net Weight	3	pounds
Cooling		
Volume of air through cooler (at 1000 watts plate dissipation; 40°C max. incoming air temperature)	50	c.f.m., minimum
Pressure drop across cooler (at 50 c. f. m.)	0.15	in. water
Mounting Position	Any	

1 October 1964

Form 92C-171E

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

MOUNTING

The PL-8295/PL-172 may be mounted in any position. When the tube is mounted with the axis vertical, it should be supported by either the lower edge or the upper flat portion of the suppressor grid terminal ring, or by the anode cooler. When mounted with the axis horizontal, the tube should be supported by the anode cooler. The tube must not be supported by the glass or pins at the base.

Contact to the suppressor and screen grid contact surfaces should be made by spring contact material in at least three places around the periphery of each surface.

The base of the PL-8295/PL-172 fits a standard seven-pin Septar socket, such as the E. F. Johnson Co. type 122-247 or 122-248. The socket should be located so that the glass at the base of the tube does not contact the socket when the tube is seated in its support.

Special sockets having air-directing means, and contacts for all base pins and screen and suppressor grid terminals are available. The PL-184 socket has built-in by-pass capacitors for the screen grid and suppressor grid. The type PL-184A socket has a built-in by-pass capacitor for the screen grid, but grounded suppressor-grid contacts.

COOLING

Minimum anode cooling requirements for the PL-8295/PL-172, together with air flow vs. pressure drop data, are given by the graph below. A small amount of cooling air (approximately 5 c. f. m.) should be diverted over the base end of the tube from the anode cooling supply, either before or after entering the anode cooler, to limit the temperature of the base seals and the screen grid and suppressor grid contact surfaces to a maximum of 175° C.

The pressure drop graph below refers only to the drop through the cooler. If additional pressure losses occur in the air system between the blower and the cooler, such as might occur in a socket or air duct, these losses must be added to the figure taken from the curve to determine the static pressure which must be maintained at the blower.

OPERATION — GENERAL

Maximum ratings and typical operating conditions for the PL-8295/PL-172 are given in the accompanying tabular data.

Heater voltage for the tube should be maintained as closely as possible to the rated value of 6.0 volts. Heater voltage variations up to 10 per cent are permissible, but decreased tube life and variations in power output may occur with prolonged operation at voltages more than 5 per cent from the rated value.

Screen-grid input in excess of the maximum rating can cause permanent damage to the PL-8295/PL-172. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be arranged so that it is impossible to apply screen voltage without plate voltage. The use of a screen-grid overcurrent relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

In Class AB_1 or AB_2 applications, grid bias voltage for the tube must be obtained from a fixed bias supply. The internal resistance of the bias source should not exceed 5000 ohms in Class AB_1 applications or 2000 ohms in Class AB_2 applications. Either fixed bias or cathode bias, or a combination of the two, is recommended for Class C applications. Partial grid leak bias, in combination with fixed or cathode bias, or both, may be used in Class C application, if desired, provided the total resistance of the grid leak plus the bias source does not exceed 5000 ohms.

Excellent performance may be obtained from the PL-8295/PL-172 with the suppressor grid operated at cathode potential. For maximum efficiency at high power input at low plate voltages, a positive voltage of about 35 volts should be applied to the suppressor grid. The actual value of suppressor voltage is not critical, and voltages between 25 and 45 volts may be used with only minor differences in performance. The internal resistance of the suppressor-grid voltage supply should not exceed 3000 ohms.

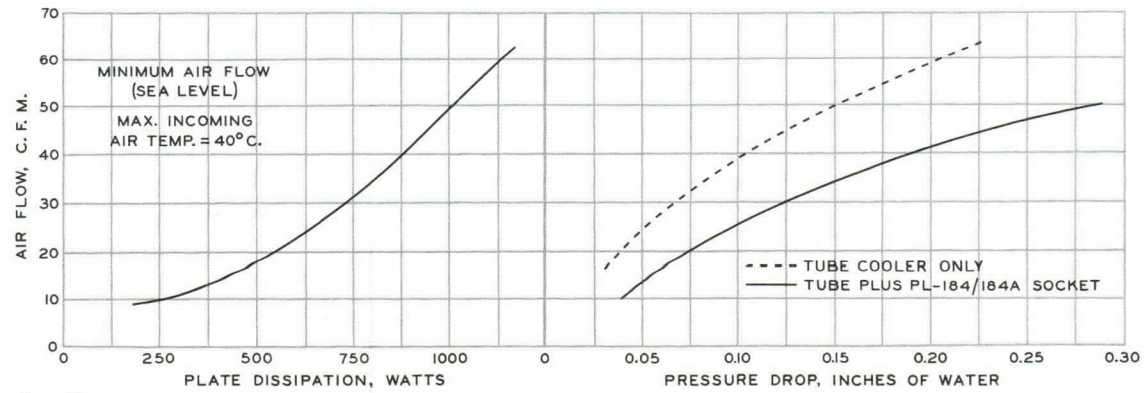
RADIO-FREQUENCY OPERATION

In most ordinary Class C applications, the PL-8295/PL-172 may be operated without neutralization, provided the suppressor and screen grids are effectively grounded for radio frequencies. In low-distortion Class AB_1 linear amplifier service, where reaction on the driver circuit must be entirely eliminated, it will usually be found advisable to neutralize the small feedback capacitance of the PL-8295/PL-172.

A metal chassis or equivalent means should be provided to separate the input and output circuits of an amplifier employing the PL-8295/PL-172. Reasonable precautions should be observed in regard to by-passing and shielding of the supply leads to prevent coupling between input and output through external circuits.

When it is desired to apply voltage to the suppressor grid of the tube, it is recommended that the suppressor grid by-pass capacitor, or capacitors, be located on the anode side of the chassis. The total suppressor-grid by-pass capacitance should be sufficient to result in a reactance of 3 ohms or less at the operating frequency. The d-c supply lead to the suppressor grid should either be located entirely on the anode side of the shielding, or fed through an effective r-f choke located well out of the field on the plate tank circuit and again by-passed before passing through the shielding into any compartment exposed to the control grid circuit.

For Class AB_1 linear amplifier service, the screen voltage for the PL-8295/PL-172 must be obtained from a well regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.



PL-8295/PL-172 AIR COOLING CHARACTERISTICS

MAXIMUM RATINGS

CCS (Continuous Commercial Service)

	Class-C CW or FM	*Class-AB_2 Audio or RF*	*Class-AB_1 Audio or RF*	
D-C Plate Voltage	3000	3000	3000	volts
D-C Screen-Grid Voltage	500	500	600	volts
D-C Suppressor-Grid Voltage	75	75	75	volts
D-C Control-Grid Voltage	−200			volts
D-C Plate Current	1000	800	800	ma.
D-C Control-Grid Current	10	10		ma.
Control-Grid Dissipation	5	5		watts
Screen-Grid Input	30	30	30	watts
Plate Dissipation	1000	1000	1000	watts

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[1]

Single-Sideband, Suppressed Carrier

D-C Plate Voltage	2000	2500	2500	3000	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Suppressor-Grid Voltage	35	0	35	35	volts
D-C Control-Grid Voltage[2]	−110	−115	−115	−115	volts
Zero-Signal D-C Plate Current	200	200	200	220	ma.
Zero-Signal D-C Screen Current	12	11	11	11	ma.
Maximum-Signal D-C Plate Current	800	800	800	800	ma.
Maximum-Signal D-C Screen Current	43	50	40	39	ma.
Maximum-Signal Peak R-F Grid Voltage	110	115	115	115	volts
Intermodulation Distortion Level[3]					
Third Order	−26	−27	−27	−27	db
Fifth Order	−50	−45	−41	−45	db
Maximum-Signal Power Input	1600	2000	2000	2400	watts
Maximum-Signal Useful Power Output[4]	1040	1140	1260	1590	watts

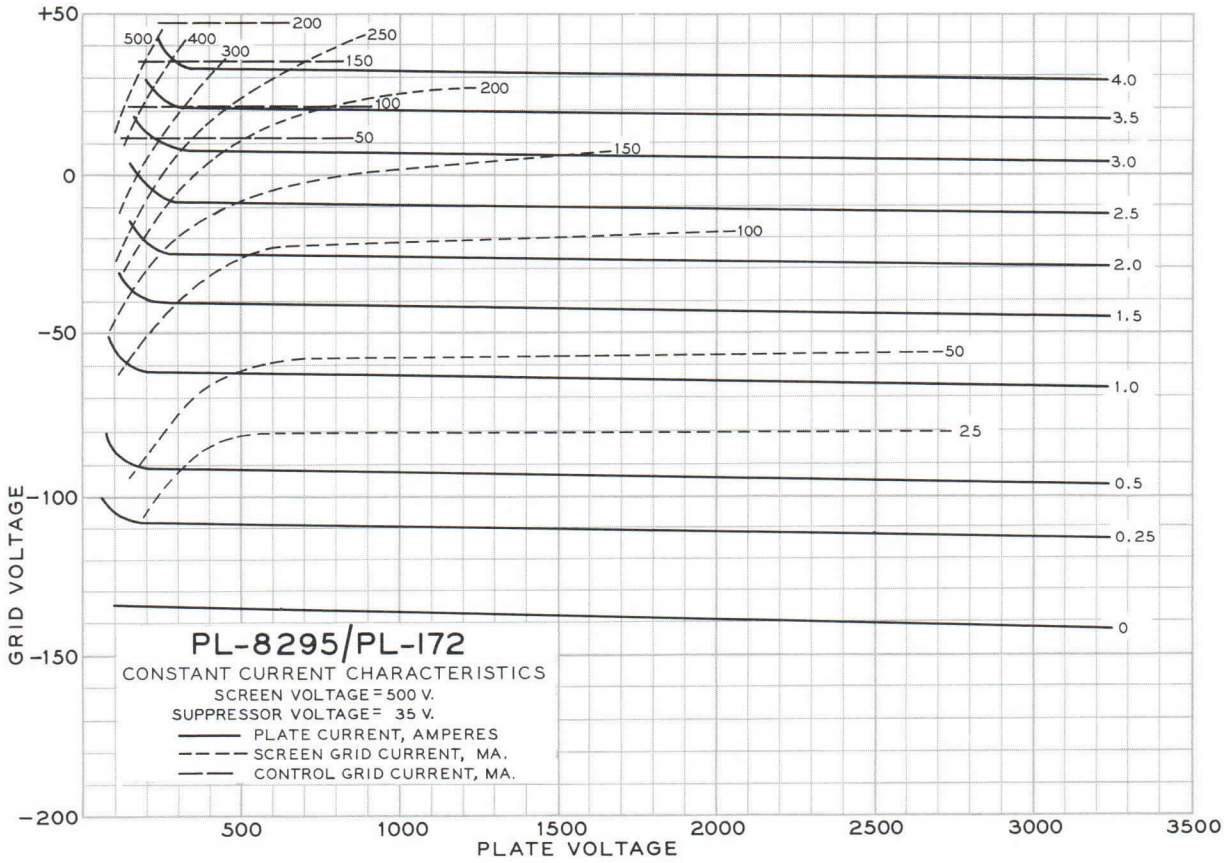
[1] D-C current values shown are for peak conditions, or for single-tone modulation at full signal.
[2] Approximate value; adjust to give stated zero-signal plate current.
[3] At maximum output. Referenced against one tone of a two equal-tone signal. No degenerative feedback.
[4] Single-tone or peak envelope power delivered to load from typical amplifier.

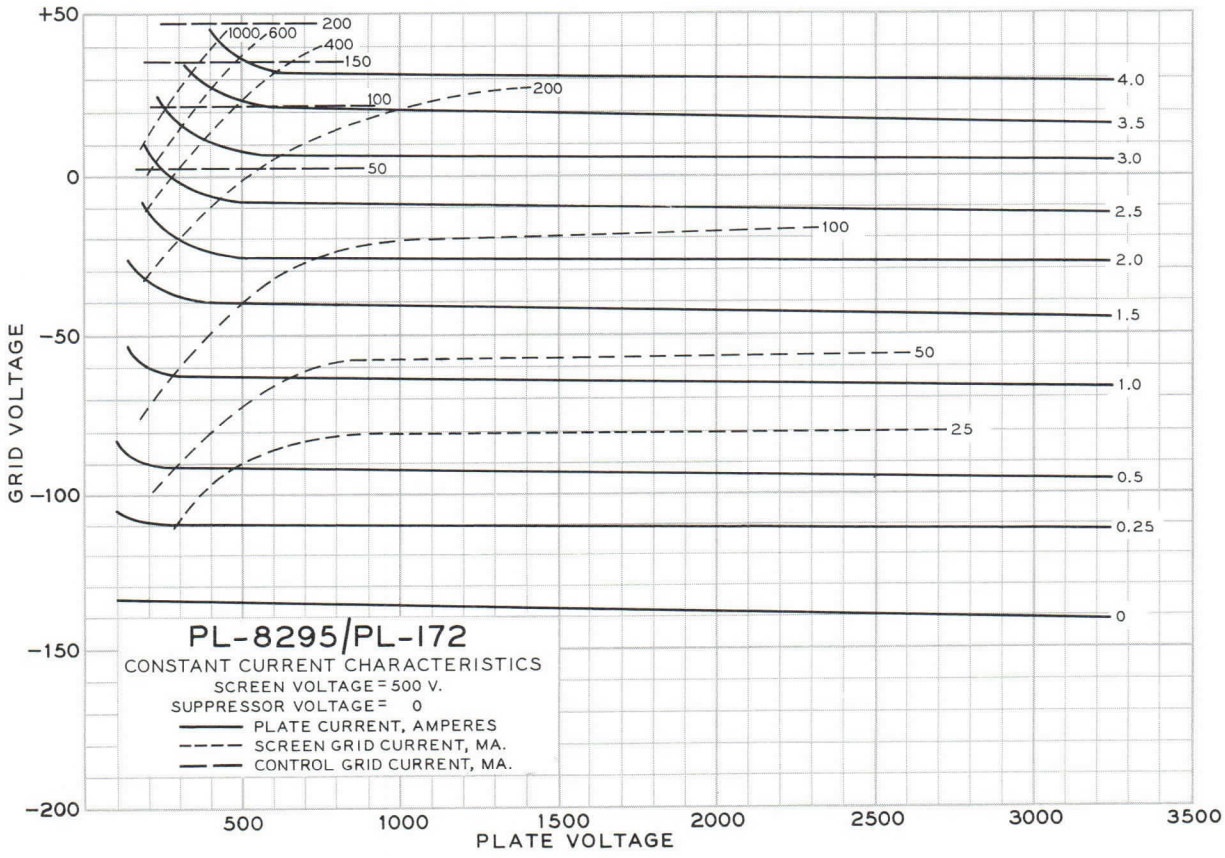
TYPICAL OPERATION — Class C C-W or FM Amplifier

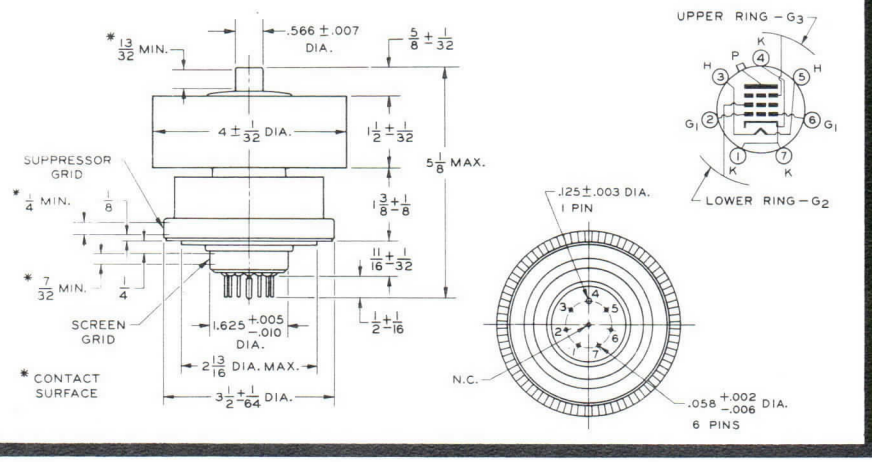
Grounded-Cathode Circuit

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen-Grid Voltage	500	500	500	volts
D-C Suppressor-Grid Voltage	35	35	35	volts
D-C Control-Grid Voltage	−175	−200	−200	volts
D-C Plate Current	850	840	820	ma.
D-C Screen-Grid Current	42	40	42	ma.
D-C Control-Grid Current	10	10	10	ma.
Peak R-F Grid Voltage (Approx.)	188	210	210	volts
Driving Power (Approx.)	1.9	2.1	2.1	watts
Plate Power Input	1700	2100	2460	watts
Useful Power Output[1]	1155	1440	1770	watts

[1] Actual power output delivered to load from typical amplifier.


+50
0
−50
−100
−150
−200
GRID VOLTAGE
500
1000
1500
2000
2500
3000
3500
PLATE VOLTAGE
500
400
300
200
250
150
200
100
50
150
100
50
25
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
0
PL-8295/PL-172
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 35 V.
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.


+50
0
−50
−100
−150
−200
GRID VOLTAGE
500
1000
1500
2000
2500
3000
3500
PLATE VOLTAGE
1000
600
200
400
150
100
200
50
100
50
25
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
0
PL-8295/PL-172
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.



PL-8295A

Ceramic Beam Pentode

DESCRIPTION

The PL-8295A is a forced-air cooled, 1000-watt plate dissipation beam pentode of ceramic construction, capable of high power gain and excellent efficiency at relatively low plate voltages. The tube requires considerably less cooling air than the PL-8295 beam pentode, which the PL-8295A may be used to replace.

This external-anode beam pentode is especially suited for low-distortion Class-AB_1 linear r-f amplifier service, where a single tube will deliver over 1500 watts of useful power output. The excellent characteristics of the PL-8295A also provide outstanding performance in Class-AB_2, Class-B, and Class-C service.

ELECTRICAL CHARACTERISTICS

Cathode — Coated Unipotential		
Heater Voltage	6.0	volts
Heater Current	8.2	amperes
Minimum Cathode Heating Time	3	minutes
Grid-Screen mu Factor	3.4	
Transconductance (1000 v. Eb, 500 v. Ec_2, 1 a. I_b)	23,000	μmhos
Interelectrode Capacitances		
Grid-Plate	0.09	μμf
Input	42	μμf
Output	21	μμf

MECHANICAL CHARACTERISTICS

Base	7-pin Septar,	EIA E 7-2
Base Connections		See base diagram
Maximum Overall Dimensions		
Length	5.125	inches
Diameter	4.032	inches
Net Weight	3	pounds
Cooling		
Volume of air through cooler (at 1000 watts plate dissipation; 40°C max. incoming air temperature)	25	c.f.m., minimum
Pressure drop across cooler (at 25 c. f. m.)	0.05	in. water
Mounting Position		Any

17 September 1962 Form 545

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-8295A

MOUNTING

The PL-8295A may be mounted in any position. When the tube is mounted with the axis vertical, it should be supported by either the lower edge or the upper flat portion of the suppressor grid terminal ring, or by the anode cooler. When mounted with the axis horizontal, the tube should be supported by the anode cooler.

Contact to the suppressor and screen grid contact surfaces should be made by spring contact material in at least three places around the periphery of each surface.

The base of the PL-8295A fits a standard seven-pin Septar socket, such as the E. F. Johnson Co. type 122-247 or 122-248. The socket should be located so that the ceramic wafer at the base of the tube does not contact the socket when the tube is seated in its support.

Special sockets having air-directing means, and contacts for all base pins and screen and suppressor grid terminals are available. The PL-184 socket has built-in by-pass capacitors for the screen grid and suppressor grid. The type PL-184A socket has a built-in by-pass capacitor for the screen grid, but grounded suppressor-grid contacts.

COOLING

Cooling air requirements for the PL-8295A tube cooler only, and the cooler plus a Penta PL-184 or PL-184A socket, are shown in the graph below. Any additional pressure drops in the air system between the tube cooler and Penta socket, if used, such as might occur in an air duct, must be added to the pressure drop figure taken from the chart to determine the static pressure which must be maintained at the blower.

A small amount of cooling air should be diverted over the base end of the tube from the anode cooling supply, either before or after entering the anode cooler, to limit the temperature of the base seals and screen grid and suppressor grid contact surfaces to a maximum of 250° C.

OPERATION — GENERAL

Maximum ratings and typical operating conditions for the PL-8295A are given in the accompanying tabular data.

Heater voltage for the tube should be maintained as closely as possible to the rated value of 6.0 volts. Heater voltage variations up to 10 per cent are permissible, but decreased tube life and variations in power output may occur with prolonged operation at voltages more than 5 per cent from the rated value.

Screen-grid input in excess of the maximum rating can cause permanent damage to the PL-8295A. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be arranged so that it is impossible to apply screen voltage without plate voltage. The use of a screen-grid over-current relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

In Class AB_1 or AB_2 applications, grid bias voltage for the tube must be obtained from a fixed bias supply. The internal resistance of the bias source should not exceed 5000 ohms in Class AB_1 applications or 2000 ohms in Class AB_2 applications. Either fixed bias or cathode bias, or a combination of the two, is recommended for Class C applications. Partial grid leak bias, in combination with fixed or cathode bias, or both, may be used in Class C application, if desired, provided the total resistance of the grid leak plus the bias source does not exceed 5000 ohms.

Excellent performance may be obtained from the PL-8295A with the suppressor grid operated at cathode potential. For maximum efficiency at high power input at low plate voltages, a positive voltage of about 35 volts should be applied to the suppressor grid. The actual value of suppressor voltage is not critical, and voltages between 25 and 45 volts may be used with only minor differences in performance. The internal resistance of the suppressor-grid voltage supply should not exceed 3000 ohms.

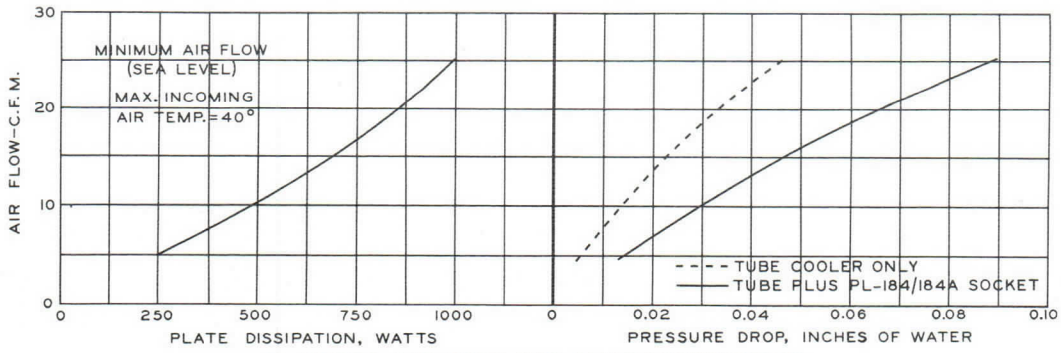
RADIO-FREQUENCY OPERATION

In most ordinary Class C applications, the PL-8295A may be operated without neutralization, provided the suppressor and screen grids are effectively grounded for radio frequencies. In low-distortion Class AB_1 linear amplifier service, where reaction on the driver circuit must be entirely eliminated, it will usually be found advisable to neutralize the small feedback capacitance of the PL-8295A.

A metal chassis or equivalent means should be provided to separate the input and output circuits of an amplifier employing the PL-8295A. Reasonable precautions should be observed in regard to by-passing and shielding of the supply leads to prevent coupling between input and output through external circuits.

When it is desired to apply voltage to the suppressor grid of the tube, it is recommended that the suppressor grid by-pass capacitor, or capacitors, be located on the anode side of the chassis. The total suppressor-grid by-pass capacitance should be sufficient to result in a reactance of 3 ohms or less at the operating frequency. The d-c supply lead to the suppressor grid should either be located entirely on the anode side of the shielding, or fed through an effective r-f choke located well out of the field on the plate tank circuit and again by-passed before passing through the shielding into any compartment exposed to the control grid circuit.

For Class AB_1 linear amplifier service, the screen voltage for the PL-8295A must be obtained from a well regulated source, to prevent excessive screen voltage variations due to the changes in screen current which occur between zero-signal and full-signal conditions.



PL-8295A AIR COOLING CHARACTERISTICS

PL-8295A

MAXIMUM RATINGS

CCS (Continuous Commercial Service)

	Class-C CW or FM	*Class-AB_2 Audio or RF*	*Class-AB_1 Audio or RF*	
D-C Plate Voltage	3000	3000	3000	volts
D-C Screen-Grid Volage	500	500	600	volts
D-C Suppressor-Grid Voltage	75	75	75	volts
D-C Control-Grid Voltage	−200			volts
D-C Plate Current	1000	800	800	ma.
D-C Control-Grid Current	10	10		ma.
Control-Grid Dissipation	5	5		watts
Screen-Grid Input	30	30	30	watts
Plate Dissipation	1000	1000	1000	watts

TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[1]

Single-Sideband, Suppressed Carrier

D-C Plate Voltage	2000	2500	2500	3000	volts
D-C Screen-Grid Voltage	500	500	500	500	volts
D-C Suppressor-Grid Voltage	35	0	35	35	volts
D-C Control-Grid Voltage[2]	−110	−115	−115	−115	volts
Zero-Signal D-C Plate Current	200	200	200	220	ma.
Zero-Signal D-C Screen Current	12	11	11	11	ma.
Maximum-Signal D-C Plate Current	800	800	800	800	ma.
Maximum-Signal D-C Screen Current	43	50	40	39	ma.
Maximum-Signal Peak R-F Grid Voltage	110	115	115	115	volts
Intermodulation Distortion Level[3]					
Third Order	−26	−27	−27	−27	db
Fifth Order	−50	−45	−41	−45	db
Maximum-Signal Power Input	1600	2000	2000	2400	watts
Maximum-Signal Useful Power Output[4]	1040	1140	1260	1590	watts

[1] D-C current values shown are for peak conditions, or for single-tone modulation at full signal.
[2] Approximate value; adjust to give stated zero-signal plate current.
[3] At maximum output. Referenced against one tone of two equal-tone signal. No degenerative feedback.
[4] Single-tone or peak envelope power delivered to load from typical amplifier.

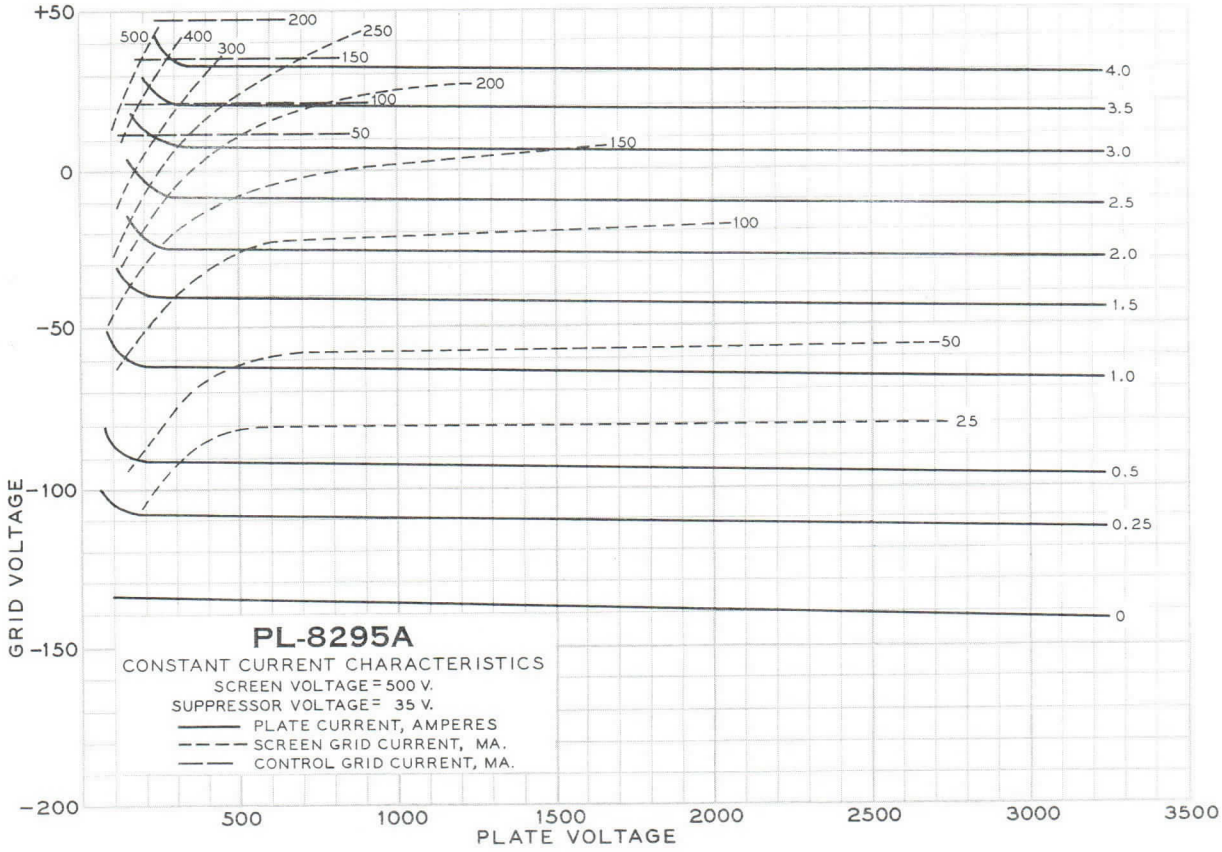
TYPICAL OPERATION — Class C C-W or FM Amplifier

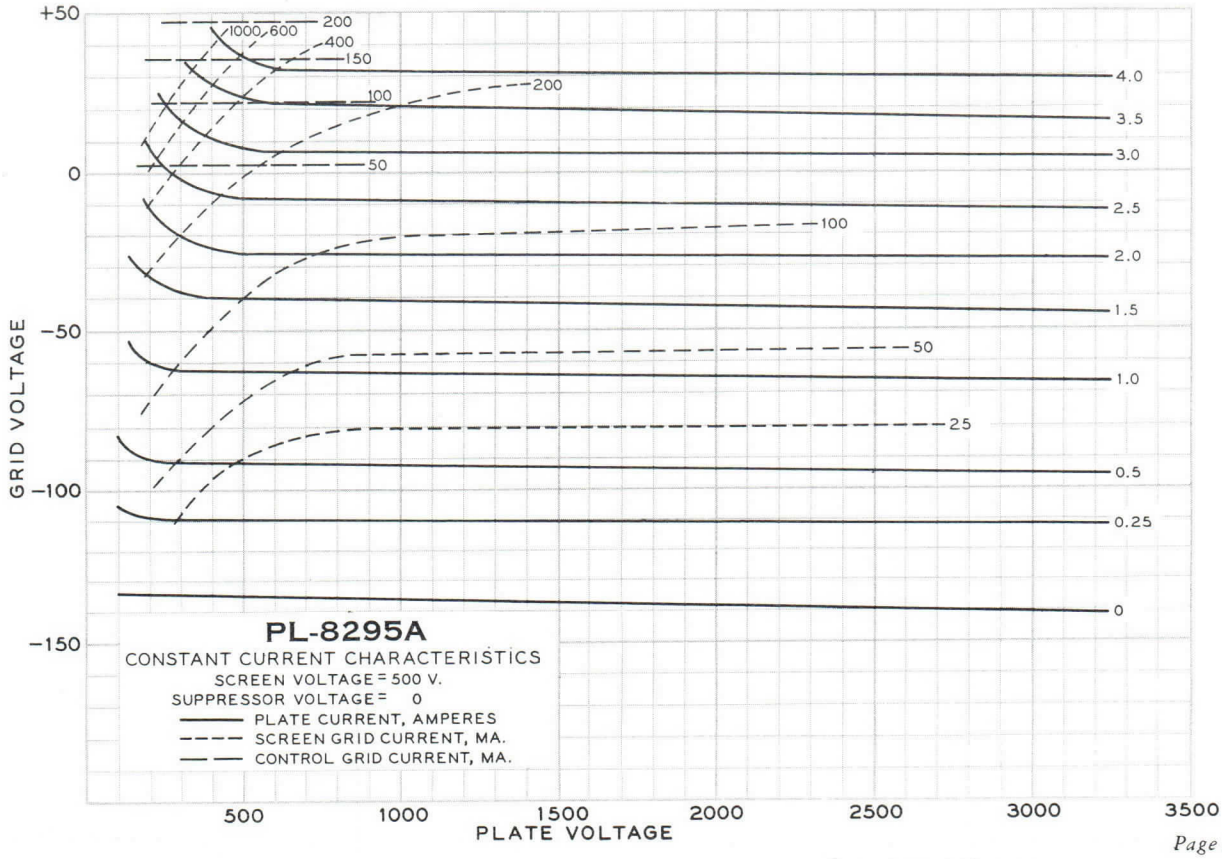
Grounded-Cathode Circuit

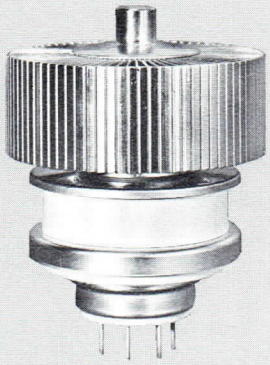
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen-Grid Voltage	500	500	500	volts
D-C Suppressor-Grid Voltage	35	35	35	volts
D-C Control-Grid Voltage	−175	−200	−200	volts
D-C Plate Current	850	840	820	ma.
D-C Screen-Grid Current	42	40	42	ma.
D-C Control-Grid Current	10	10	10	ma.
Peak R-F Grid Voltage (Approx.)	188	210	210	volts
Driving Power (Approx.)	1.9	2.1	2.1	watts
Plate Power Input	1700	2100	2460	watts
Useful Power Output[1]	1155	1440	1770	watts

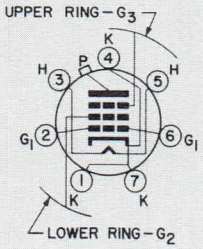
[1] Actual power output delivered to load from typical amplifier.

PL-8295A


+50
0
−50
−100
−150
−200
GRID VOLTAGE
500
1000
1500
2000
2500
3000
3500
PLATE VOLTAGE
200
250
500
400
300
150
200
100
50
150
100
50
25
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
0
PL-8295A
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 35 V.
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.


+50
0
−50
−100
−150
GRID VOLTAGE
500
1000
1500
2000
2500
3000
3500
PLATE VOLTAGE
200
1000
600
400
150
100
200
50
100
50
25
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
0
PL-8295A
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.





PL-8432

Ceramic Beam Pentode

DESCRIPTION

The PL-8432 is a forced-air cooled, 1000-watt plate dissipation ceramic-envelope beam pentode featuring compact construction. This tube is especially suited for low-distortion Class-AB_1 linear r-f amplifier use, where a single tube will deliver over 1500 watts of useful power output. The excellent characteristics of the PL-8432 also provide outstanding performance in Class-AB_2, and Class-B service.

ELECTRICAL CHARACTERISTICS

Cathode – Coated Unipotential		
Heater Voltage	6.0	volts
Heater Current	8.2	amperes
Minimum Cathode Heating Time	3	minutes
Grid-Screen mu Factor	3.4	
Transconductance (1000 v. Eb, 500 v. Ec_2, 1 a. I_b)	23,000	μmhos
Interelectrode Capacitances		
Grid-Plate	0.09	μμf
Input	42	μμf
Output	20	μμf

MECHANICAL CHARACTERISTICS

Base	7-pin Septar,	EIA E 7-2
Base Connections		See base diagram
Recommended Socket		PL-209A
Maximum Overall Dimensions		
Length	4.75	inches
Diameter	3.53	inches
Net Weight	2.5	pounds
Cooling		
Volume of air through cooler (at 1000 watts plate dissipation; 40°C max. incoming air temperature)	37	c.f.m., minimum
Pressure Drop (at 37 c. f. m.)		
Cooler only	0.10	in. water
Cooler plus PL-209A socket	0.18	in. water
Mounting Position		Any

19 October 1964

Form 92C-291B

THE PENTA LABORATORIES, INC.

A SUBSIDIARY OF RAYTHEON COMPANY

312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

PL-8432

MOUNTING

The PL-8432 may be mounted in any position. Support for the tube, when mounted with the axis vertical, should be by either the lower edge or upper flat portion of the suppressor-grid terminal ring, or by the anode cooler. For horizontal mounting, the PL-8432 should be supported by the anode cooler.

Spring contact material should be used to make contact with the suppressor and screen-grid contact surfaces. Contacts should be provided in at least three places around the periphery of each surface.

The PL-209A, a special socket which provides for the proper distribution of cooling air, is available. The socket includes contacts for all base pins and screen and suppressor-grid terminals. By-pass capacitors for the screen grid are included, and the suppressor-grid contacts are grounded to the frame of the socket.

A standard seven-pin Septar socket, such as the E. F. Johnson Co. type 122-247 or 122-248, will fit the base of the PL-8432. Support for the tube must be provided to make certain that the ceramic wafer at the base of the tube does not contact the socket.

COOLING

The graph below illustrates the cooling air requirements for the PL-8432 when installed in the PL-209A socket. Any additional pressure drops in the air system between the tube cooler and Penta socket, if used, such as might occur in an air duct, must be added to the pressure drop figure taken from the chart to determine the static pressure which must be maintained at the blower.

It is necessary to divert a small amount of cooling air from the anode cooling supply, either before or after entering the anode cooler, to limit the temperature of the base seals and screen-grid and suppressor-grid contact surfaces to a maximum of 250° C.

OPERATION — GENERAL

PL-8432 heater voltage should be held as closely as possible to the rated 6.0 volts. Although heater voltage variations of up to 10 per cent are permissible, decreased tube life and deviations in power output may result from prolonged operation at voltages more than five per cent from the rated value.

Permanent damage to the PL-8432 may result from screen-grid input in excess of the maximum rating. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be so arranged that screen-grid voltage cannot be applied without plate voltage. A screen-grid overcurrent relay should be employed to remove screen voltage immediately in the event of excessive screen current resulting from circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

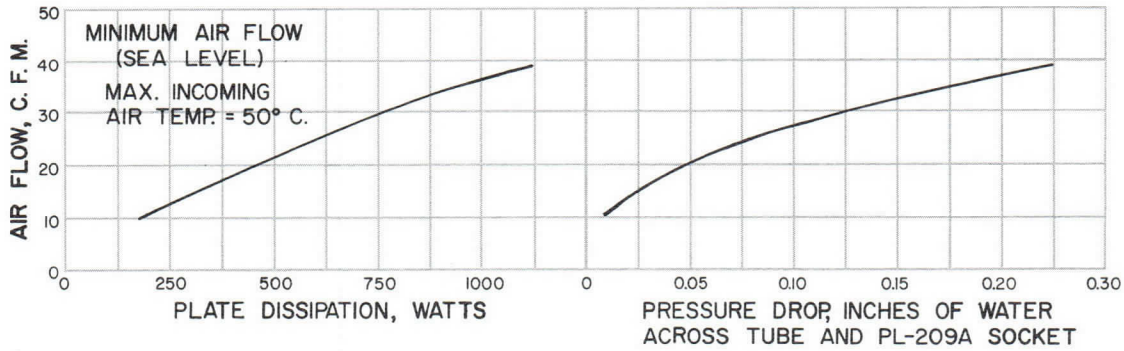
Grid bias voltage for the PL-8432 must be obtained from a fixed bias supply in Class-AB_1 or AB_2 applications. The total grid circuit resistance, including the internal resistance of the bias source, must not exceed 5000 ohms in Class-AB_1 applications or 2000 ohms in Class-AB_2 operation.

RADIO-FREQUENCY OPERATION

In low distortion Class-AB_1 linear amplifier service, where reaction on the driver circuit must be entirely eliminated, it will usually be found advisable to neutralize the small feedback capacitance of the PL-8432.

The input and output circuits of an amplifier using the PL-8432 should be separated by a metal chassis or equivalent shield. Care should be used in by-passing and shielding of the supply leads to prevent coupling between the input and output through external circuits.

When operating the PL-8432 as a Class-AB_1 linear amplifier, it is important that the screen voltage for the tube be obtained from a well-regulated source, to avoid excessive screen voltage variations caused by the changes in screen current which occur between zero-signal and full-signal conditions.

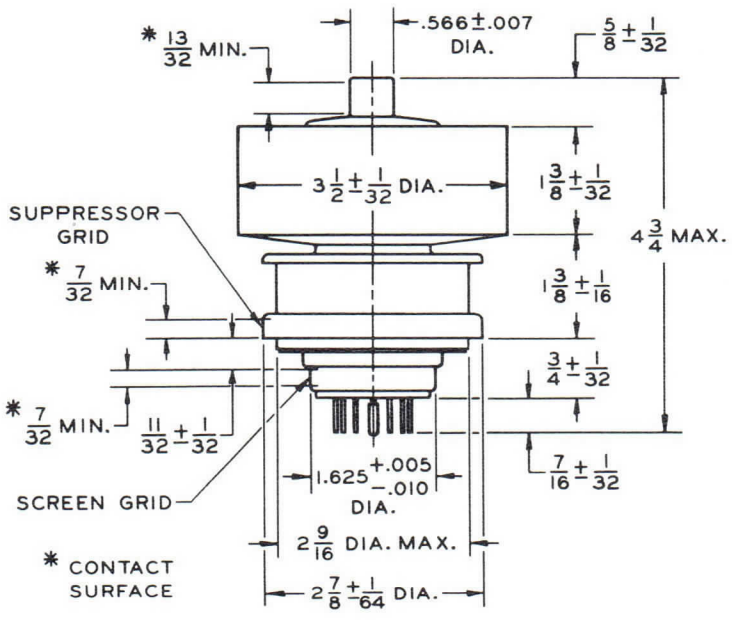


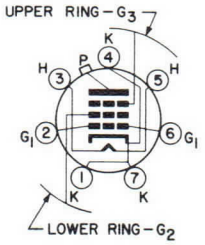
MAXIMUM RATINGS CCS (Continuous Commercial Service)	*Class-C* *CW or FM*	*Class-AB_2* *Audio or RF*	*Class-AB_1* *Audio or RF*	
D-C Plate Voltage	3000	3000	3000	volts
D-C Screen-Grid Voltage	500	500	600	volts
D-C Suppressor-Grid Voltage	75	75	75	volts
D-C Control-Grid Voltage	−200			volts
D-C Plate Current	1000	800	800	ma.
D-C Control-Grid Current	10	10		ma.
Control-Grid Dissipation	5	5		watts
Screen-Grid Input	30	30	30	watts
Plate Dissipation	1000	1000	1000	watts

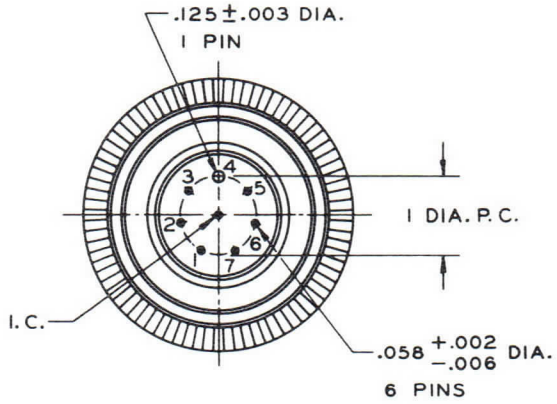
TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier[1]
Single-Sideband, Suppressed Carrier; Grounded-Cathode Circuit

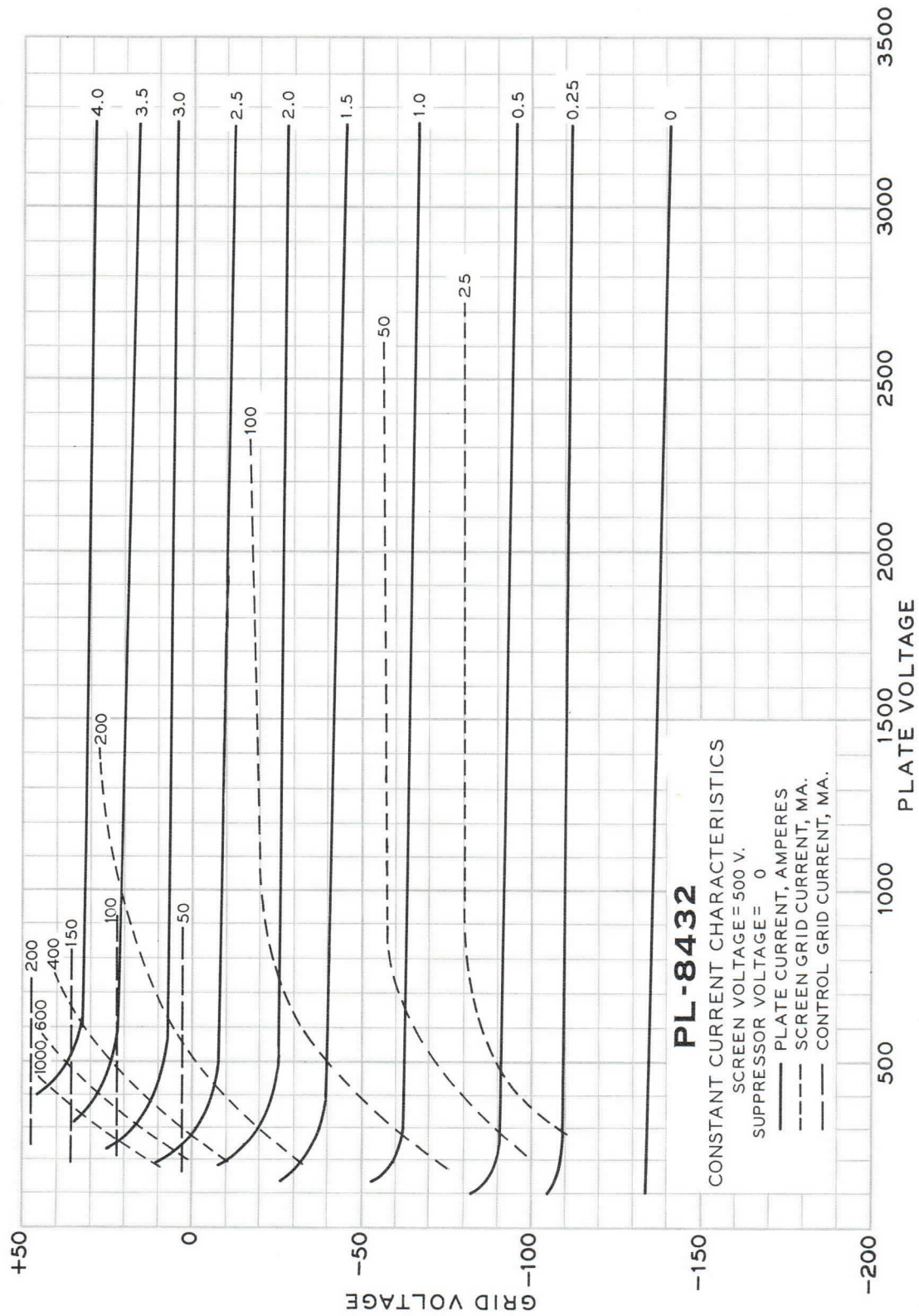
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen-Grid Voltage	500	500	500	volts
D-C Suppressor-Grid Voltage	0	0	0	volts
D-C Control-Grid Voltage[2]	−110	−112	−115	volts
Zero-Signal D-C Plate Current	200	200	200	ma.
Zero-Signal D-C Screen Current	6	4	3	ma.
Maximum-Signal D-C Plate Current	760	780	800	ma.
Maximum-Signal D-C Screen Current	60	55	52	ma.
Maximum-Signal Peak R-F Grid Voltage	110	112	115	volts
Intermodulation Distortion Level[3]				
Third Order	−26	−27	−27	db
Fifth Order	−50	−45	−45	db
Maximum-Signal Power Input	1520	1950	2400	watts
Maximum-Signal Useful Power Output[4]	1030	1280	1540	watts

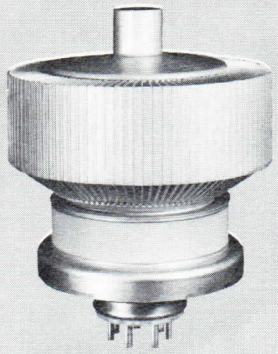
[1] D-C current values shown are for peak conditions, or for single-tone modulation at full signal.
[2] Approximate value; adjust to give stated zero-signal plate current.
[3] At maximum output. Referenced against one tone of two equal-tone signals. No degenerative feedback.
[4] Single-tone or peak envelope power delivered to load from typical amplifier.

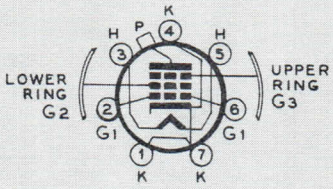







PL-8432
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 V.
SUPPRESSOR VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.
GRID VOLTAGE
PLATE VOLTAGE
+50
0
−50
−100
−150
−200
500
1000
1500
2000
2500
3000
3500
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.25
0
200
100
50
25
1000, 600
400
150





PL-8576/ PL-264

Beam Pentode

DESCRIPTION

The Penta PL-8576/PL-264 is a ceramic beam pentode having an exceptionally low input capacitance for its power-handling capability. The tube is especially suited for use in broad-band linear amplifiers, but will also provide outstanding performance in other Class-AB_1 amplifier applications.

ELECTRICAL CHARACTERISTICS

Cathode – Coated Unipotential	
Heater Voltage	6.0 volts
Heater Current	17 amperes
Minimum Cathode Heating Time	5 minutes
Transconductance (1500 v. Eb, 750 v. Ec_2, 2 a. Ib)	37,000 μmhos
Interelectrode Capacitances	
Grounded-Cathode Circuit Configuration	
Grid-Plate	0.14 μμfd
Input	54 μμfd
Output	31 μμfd
Grounded-Cathode Circuit Configuration, Tube in PL-265A Socket	
Grid-Plate	0.16 μμfd
Input	57 μμfd
Output	33 μμfd

MECHANICAL CHARACTERISTICS

Base	Special 7-pin
Base Connections	See Base Diagram
Recommended Socket	PL-265A
Maximum Overall Dimensions	
Length	5.7 inches
Diameter	4.4 inches
Net Weight	4.8 pounds

Cooling*

Plate Dissipation (Watts)	*Air Flow (c.f.m.)*	*Pressure Drop (Inches of Water)*
2000	67	0.43
3000	108	0.95

*At sea level, 50° C. maximum incoming air temperature. Pressure drop includes drop across PL-265A socket.

Mounting Position . . . . . Axis vertical, base up or down

25 May 1964

Form 92C-341A

PENTA LABORATORIES, INC.

312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-8576/PL-264

MOUNTING

The PL-8576/PL-264 may be mounted in any position. When the tube is mounted with the axis vertical, it should be supported by either the lower edge or the upper flat portion of the suppressor-grid terminal ring, or by the anode cooler. When mounted with the axis horizontal, the tube should be supported by the anode cooler.

Contact to the suppressor and screen-grid contact surfaces should be made by spring contact material in at least three places around the periphery of each surface.

The base of the tube fits a standard giant seven-pin ceramic socket, such as the E. F. Johnson Co. No. 122-237. The socket should be so located that the ceramic at the tube base does not contact the socket when the tube is seated in its support.

The PL-265A, a special socket having air-directing provisions and contacts for all base pins and suppressor and screen-grid terminals, is available. The PL-265A socket has built-in screen-grid by-pass capacitors, and the suppressor-grid contacts are grounded to the socket frame.

COOLING

Cooling air requirements for the PL-8576/PL-264 when used with the PL-265A socket, are shown in the graph below. Any additional pressure drops in the air system between the blower and socket, such as might occur in an air duct, must be added to the pressure drop figure taken from the chart to determine the static pressure which must be maintained at the blower.

Sufficient cooling air should be diverted over the base end of the tube from the anode cooling supply, either before or after entering the anode cooler, to limit the temperature of the base seals and screen-grid and suppressor-grid contact surfaces to a maximum of 250° C.

OPERATION — GENERAL

Heater voltage for the tube should be maintained as closely as possible to the rated value of 6.0 volts. Variations in heater voltage of up to 10 per cent are permissible, but decreased tube life and variations in power output may occur with prolonged operation at voltages of more than five per cent from the rated value.

Permanent damage to the tube can be caused by screen-grid input in excess of the maximum rating. If screen voltage is obtained from a power supply separate from the plate voltage supply, the circuit should be so arranged that it is impossible to apply screen voltage without plate voltage. The use of a screen-grid overcurrent relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit maladjustment, grid bias failure, or accidental removal of plate circuit loading.

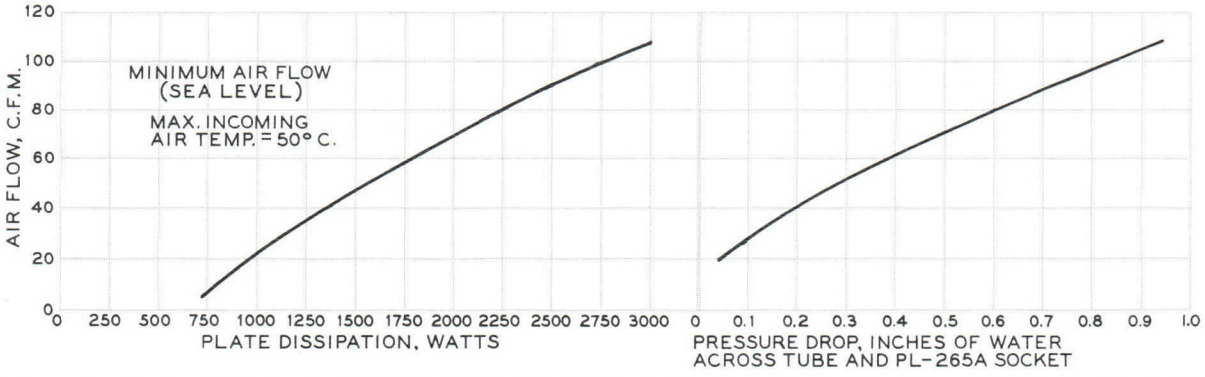
Grid-bias voltage must be obtained from a fixed bias supply in Class-AB_1 or AB_2 applications. The internal resistance of the bias source should not exceed 2500 ohms.

RADIO-FREQUENCY OPERATION

In low distortion Class-AB_1 linear amplifier service, where reaction on the driver circuit must be entirely eliminated, it will usually be found advisable to neutralize the small feedback capacitance of the PL-8576/PL-264.

A metal chassis or equivalent means should be provided to separate the input and output circuits of an amplifier using the PL-8576/PL-264. Reasonable precautions should be observed in regard to by-passing and shielding of the supply leads to prevent coupling between input and output through external circuits.

For Class-AB_1 linear amplifier service, the screen voltage for the tube must be obtained from a well-regulated source, to prevent excessive screen voltage variations due to changes in screen current which occur between zero-signal and full-signal conditions.



MAXIMUM RATINGS

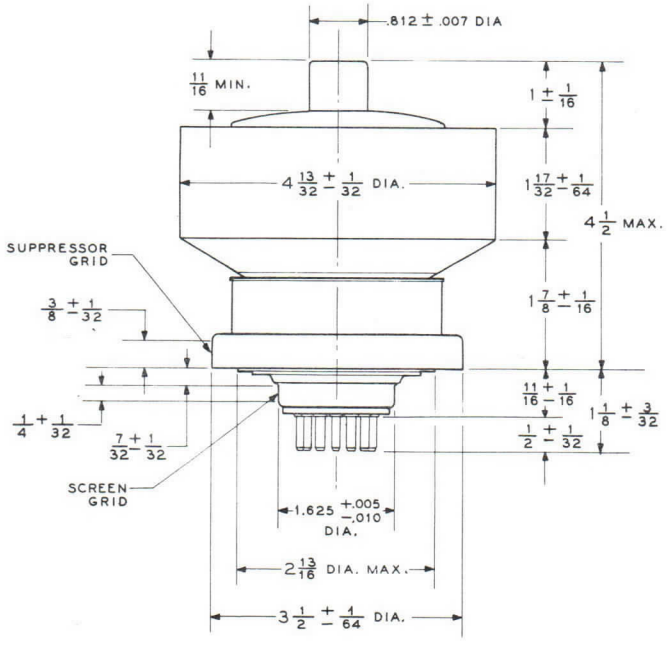
CCS (Continuous Commercial Service)

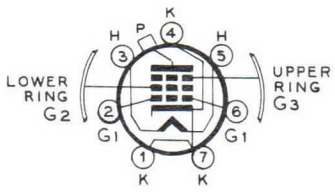
D-C Plate Voltage	5000 volts
D-C Screen-Grid Voltage	750 volts
D-C Suppressor-Grid Voltage	100 volts
D-C Control-Grid Voltage	−250 volts
D-C Plate Current	2.0 amperes
Screen-Grid Input	50 watts
Plate Dissipation	3000 watts

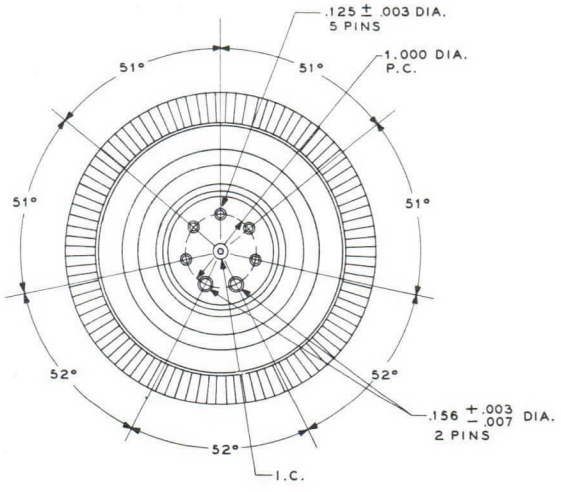
TYPICAL OPERATION — Class AB_1 Linear R-F Amplifier
Single-Sideband, Suppressed Carrier; Grounded-Cathode Circuit

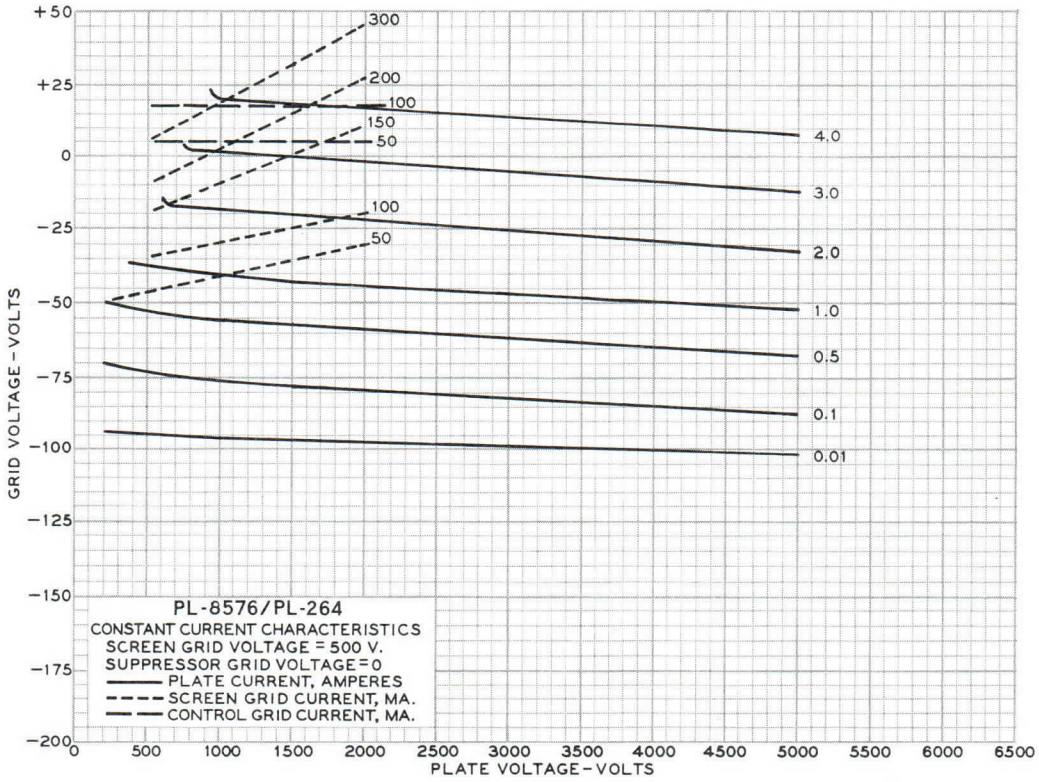
D-C Plate Voltage	3000	4000	4000	5000	5000	volts
D-C Screen-Grid Voltage	750	650	750	650	750	volts
D-C Suppressor-Grid Voltage	0	0	0	0	0	
D-C Control-Grid Voltage[1]	−105	−88	−107	−92	−110	volts
Zero-Signal D-C Plate Current	400	400	400	400	400	ma.
Maximum-Signal D-C Plate Current, Single Tone	*	1.21	*	1.33	*	amperes
Maximum-Signal D-C Plate Current, Two Tone	1.03	0.87	1.04	0.90	1.06	amperes
Zero-Signal D-C Screen-Grid Current	16	10	13	8	11	ma.
Maximum-Signal D-C Screen-Grid Current, Single Tone	*	75	*	70	*	ma.
Maximum-Signal D-C Screen-Grid Current, Two Tone	57	38	45	33	36	ma.
Maximum-Signal Peak R-F Control-Grid Voltage	105	88	107	92	110	volts
Intermodulation Distortion Level[2] Third Order Products	−29	−33	−29	−30	−29	db
Maximum-Signal Useful Power Output[3]	2950	2900	4050	4100	5400	watts

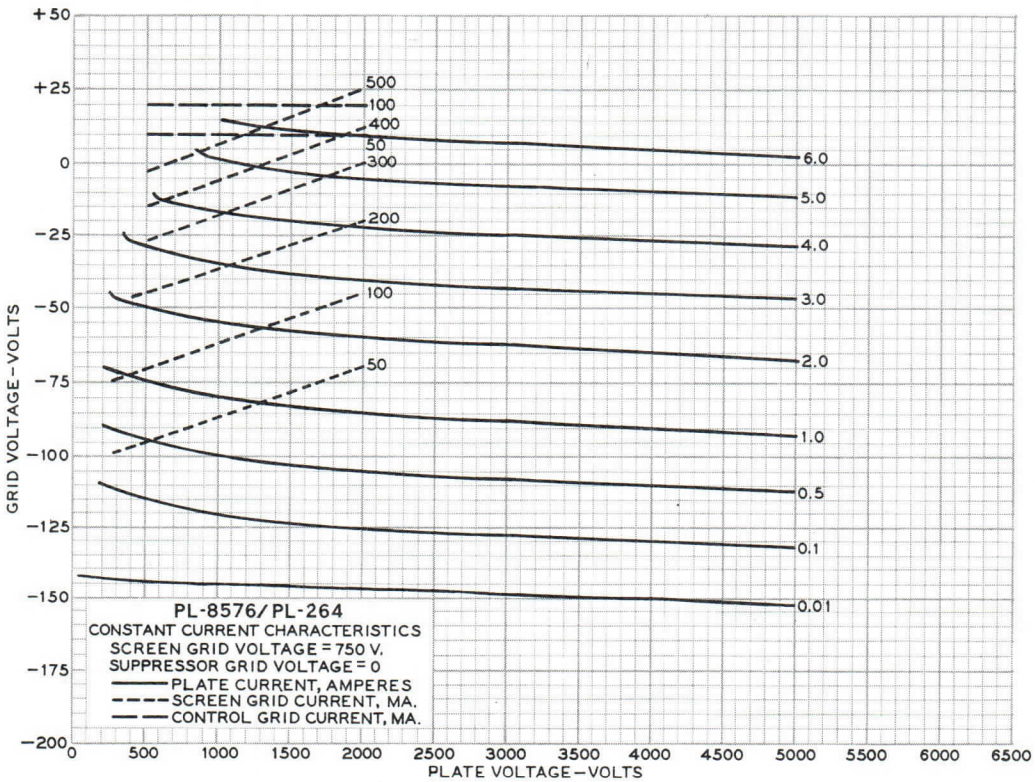
*Single-tone operation not permissible under conditions shown because screen-grid input exceeds maximum rating.
[1]Approximate value; adjust to give stated zero-signal plate current.
[2]At maximum output. Referenced against one tone of two equal-tone signal. No degenerative feedback. Fifth and higher-order distortion products more than 45 db below one tone.
[3]Single-tone or peak envelope power delivered to load from typical amplifier.

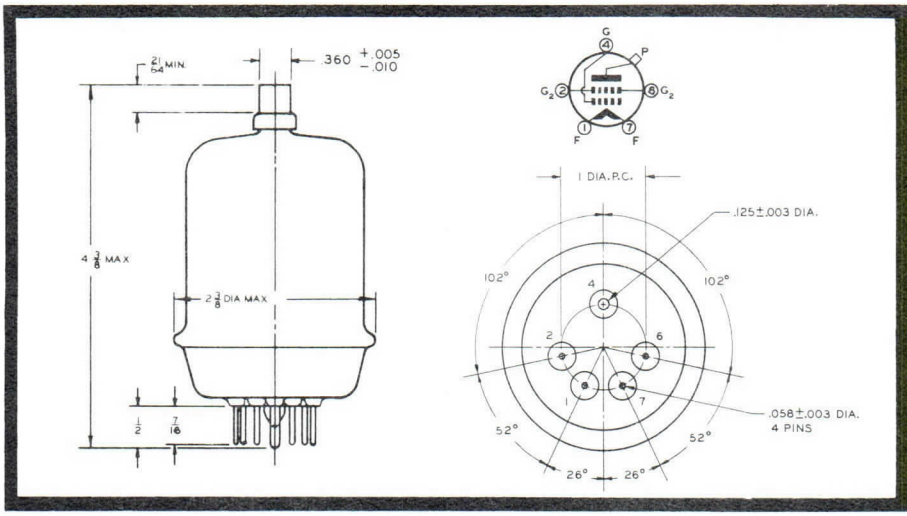







+50
+25
0
−25
−50
−75
−100
−125
−150
−175
−200
GRID VOLTAGE – VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
PLATE VOLTAGE – VOLTS
300
200
100
150
50
100
50
4.0
3.0
2.0
1.0
0.5
0.1
0.01
PL-8576/PL-264
CONSTANT CURRENT CHARACTERISTICS
SCREEN GRID VOLTAGE = 500 V.
SUPPRESSOR GRID VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.


+50
+25
0
−25
−50
−75
−100
−125
−150
−175
−200
GRID VOLTAGE – VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
PLATE VOLTAGE – VOLTS
500
100
400
50
300
200
100
50
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
0.01
PL-8576/PL-264
CONSTANT CURRENT CHARACTERISTICS
SCREEN GRID VOLTAGE = 750 V.
SUPPRESSOR GRID VOLTAGE = 0
PLATE CURRENT, AMPERES
SCREEN GRID CURRENT, MA.
CONTROL GRID CURRENT, MA.



PL-8165/ 4-65A

Power Tetrode

The PL-8165/4-65A is a 65-watt power tetrode suitable for use as an r-f power amplifier and oscillator, and as an a-f power amplifier and modulator. Because of its compact size and quick-heating thoriated-tungsten filament, the PL-8165/4-65A is especially useful in mobile communications equipment. The tube can be operated at full input at frequencies up to 150 Mc.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	6.0 volts
Current	3.5 amperes
Grid-Screen Amplification Factor	5
Interelectrode Capacitances	
Grid-Plate	.08 μμfd.
Input	7.5 μμfd.
Output	2.2 μμfd.
Transconductance (500 v. Eb, 125 ma. Ib, 250 v. Ec2)	4000 μmhos

MECHANICAL CHARACTERISTICS

Base[1]	5-pin Septar
Maximum Overall Dimensions	
Length	4.38 inches
Diameter	2.38 inches
Mounting Position	Vertical, base up or down

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class C CW or FM	Class C Telephony	
D-C Plate Voltage	3000	2500	max. volts
D-C Screen-Grid Voltage	600	400	max. volts
D-C Plate Current	150	120	max. ma.
Screen-Grid Input	10	10	max. watts
Plate Dissipation	65	45	max. watts

[1] Fits E. F. Johnson Co. No. 122-101 or 122-247 sockets.

27 January 1964

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-8165/4-65A

TYPICAL OPERATION — Class-C CW or FM Amplifier

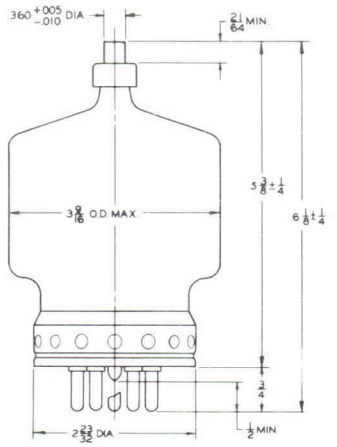
Grounded Cathode Circuit

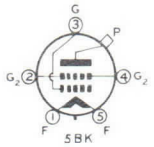
D-C Plate Voltage	1000	1500	2000	3000	volts
D-C Screen-Grid Voltage	250	250	250	250	volts
D-C Control-Grid Voltage	-80	-85	-90	-100	volts
D-C Plate Current	150	150	140	115	ma.
D-C Screen-Grid Current	40	40	40	22	ma.
D-C Control-Grid Current	17	18	11	10	ma.
Peak R-F Grid Voltage (approx.)	175	180	190	170	volts
Driving Power (approx.)	3.0	3.2	2.1	1.7	watts
Plate Power Input	150	225	280	345	watts
Plate Dissipation	55	60	65	65	watts
Plate Power Output	95	165	215	280	watts

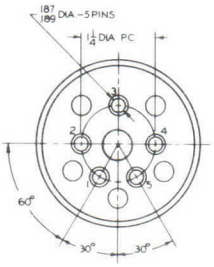
TYPICAL OPERATION — Class-C Amplitude-Modulated Amplifier, Carrier Conditions

Grounded-Cathode Circuit

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen-Grid Voltage	250	250	250	250	volts
D-C Control-Grid Voltage	-125	-125	-130	-135	volts
D-C Plate Current	120	120	120	110	ma.
D-C Screen-Grid Current	40	40	40	25	ma.
D-C Control-Grid Current	16	16	16	12	ma.
Peak R-F Grid Voltage (approx.)	220	220	225	215	volts
Driving Power (approx.)	3.5	3.5	3.6	2.6	watts
Plate Power Input	120	180	240	275	watts
Plate Dissipation	30	40	45	45	watts
Plate Power Output	90	140	195	230	watts







PL-8438/ 4-400A

Power Tetrode

The Penta PL-8438/4-400A is a power tetrode with a maximum plate dissipation rating of 400 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 Penta ribbed-plate construction utilized in the PL-8438/4-400A provides a large effective plate radiating area, with minimum plate, screen-grid, and control-grid temperatures.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage (± 5 per cent)	5.0 volts
Current	14.5 amperes
Grid-Screen mu factor	5.1
Transconductance (2500 v. Eb, 500 v. Ec_2, 100 ma. 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[1]	EIA A5-97
Basing	EIA Type 5BK
Maximum Overall Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Mounting Position	Vertical, base up or down
Net Weight	9.0 Ounces

---

1 Recommended Socket -- Johnson 122-275, operated in conjunction with the PL-C1 glass chimney with socket cut-out as shown on page 3.

1 June 1964 Form 92C-61D

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

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-8438/4-400A 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 a standard tube socket is mounted in a special cut-out, in conjunction with a Penta PL-C1 air-control glass chimney. Proper dimensions for the socket cut-out to provide correct air distribution to the various portions of the tube are given on page 3 of this data sheet. Alternatively, a commercially available air-distribution type socket may be used with the PL-8438/4-400A.

When used with a socket cut-out as illustrated on page 3 and the PL-C1 chimney, the PL-8438/4-400A 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. air flow will be obtained. Air at the proper pressure and quantity may be obtained from a small centrifugal blower rated at about 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 the 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 is required, however.

RADIO-FREQUENCY OPERATION

The PL-8438/4-400A is especially 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 effect of screen-lead inductance may be eliminated for a specified frequency of operation through the use of a variable capacitor as the screen-lead by-pass. 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 $\mu\mu$f. normally will be found adequate for operation in the 100-Mc region.

Under normal operating conditions the PL-8438/4-400A 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-8438/4-400A makes it well suited for use as an audio-frequency power amplifier or modulator in push-pull Class-AB_1 or Class-AB_2 service. In these classes of operation a pair of the tubes can give relatively high audio-frequency power output with low driving power and low harmonic distortion.

Under Class-AB_2 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 normally will prove adequate. Grid-bias voltage may be obtained from batteries or from a power supply having a low resistance bleeder.

Under Class-AB_1 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. However, the effective grid-circuit resistance per tube must not exceed 250,000 ohms.

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	350	275	350	350	ma.
Plate Dissipation	400	270	400	400	watts
Screen Dissipation	35	35	35	35	watts
Grid Dissipation	10	10	10	10	watts

PL-8438/4-400A

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	350	350	350	ma.
D-C Screen Current	46	46	42	ma.
D-C Grid Current	18	18	19	ma.
Plate Dissipation	235	250	300	watts
Screen Dissipation	23	23	21	watts
Grid Dissipation	1.8	1.8	1.8	watts
Peak R-F Grid Voltage (approx.)	300	320	320	volts
Driving Power (at 20 Mc.)	5.5	5.9	6.0	watts
Plate Power Input	875	1050	1400	watts
Plate Power Output	640	800	1100	watts

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

TYPICAL OPERATION—Class AB_1 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	190	160	120	ma.
Max.-Signal D-C Plate Current	635	610	585	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)	370	400	400	watts
Max.-Signal Plate Power Output	850	1100	1550	watts

TYPICAL OPERATION—Class C Amplitude-Modulated Amplifier, Carrier Conditions

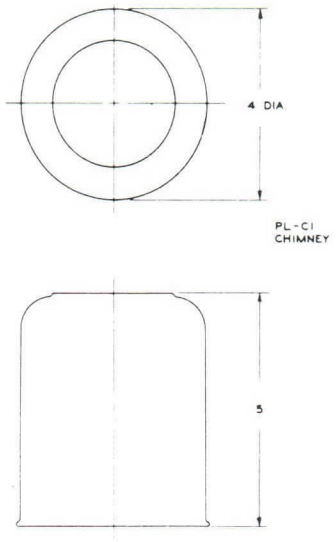
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	−220	−220	−220	volts
D-C Plate Current	275	275	275	ma.
D-C Screen Current	30	28	26	ma.
D-C Grid Current	12	12	12	ma.
Plate Dissipation	170	180	195	watts
Screen Dissipation	15	14	13	watts
Grid Dissipation	1.1	1.1	1.1	watts
Peak A-F Screen Voltage	350	350	350	volts
Peak R-F Grid Voltage (approx.)	290	290	290	volts
Driving Power (approx.)	3.5	3.5	3.5	watts
Plate Power Input	550	688	825	watts
Plate Power Output	380	508	630	watts

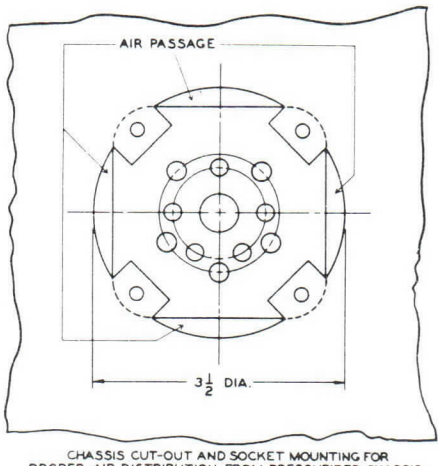
(Frequencies below 75 Mc.)

TYPICAL OPERATION—Class AB_2 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	volts
Zero-Signal D-C Plate Current	190	160	120	ma.
Max.-Signal D-C Plate Current	700	700	640	ma.
Zero-Signal D-C Screen Current	0	0	0	ma.
Max.-Signal D-C Screen Current	50	40	32	ma.
Plate-to-Plate Load Resistance	7200	9000	14,000	ohms
Peak A-F Grid-to-Grid Signal	265	280	280	volts
Average Driving Power (Max. signal)	4.3	4.5	3.5	watts
Peak Driving Power (Max. signal)	9	10	8	watts
Max-Signal Plate Dissipation (per tube)	320	400	400	watts
Max-Signal Plate Power Output	1100	1380	1750	watts

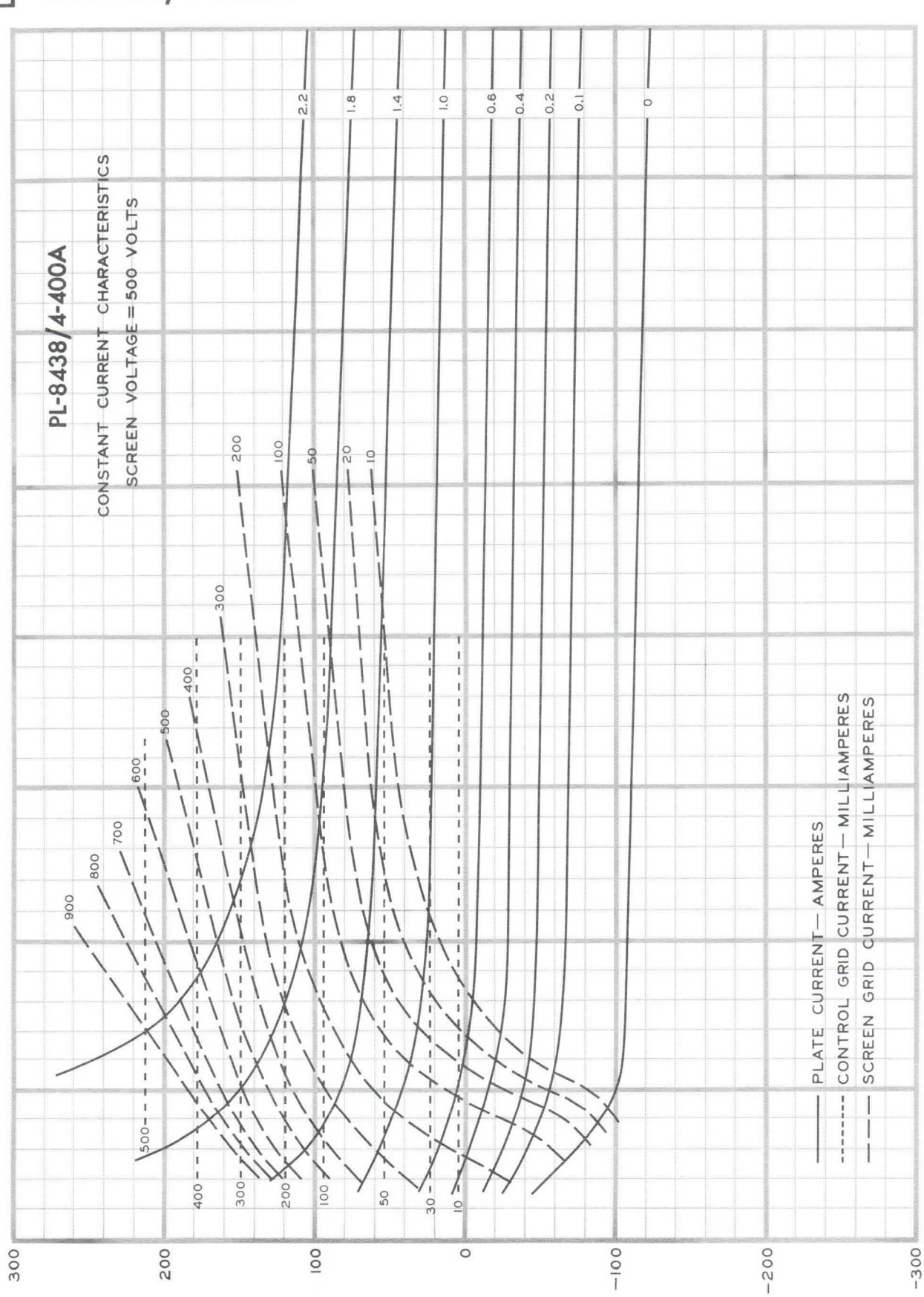
*Note: Approximate values. Adjust to give the stated value of zero-signal plate current.

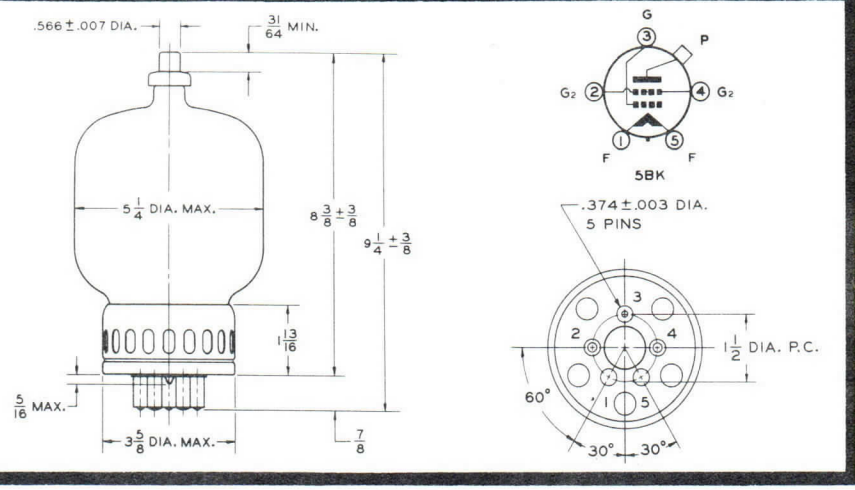




CHASSIS CUT-OUT AND SOCKET MOUNTING FOR PROPER AIR DISTRIBUTION FROM PRESSURIZED CHASSIS (JOHNSON NO. 122-275 SOCKET)

PL-8438/4-400A





PL-8166/ 4-1000A

Power Tetrode

The PL-8166/4-1000A is a beam power tetrode with a plate dissipation rating of 1000 watts. It is suitable for use as an r-f power amplifier and oscillator, and as an a-f amplifier and modulator. The PL-8166/4-1000A can be used at frequencies up to 110 Mc. Cooling of the tube is achieved by radiation from the plate and by circulation of forced-air through the base and around the envelope.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	7.5 volts
Current	21 amperes
Grid-Screen Amplification Factor	7
Interelectrode Capacitances	
Grid-Plate	0.25 μμfd.
Input	28.0 μμfd.
Output	8.1 μμfd.
Transconductance (2500 v Eb, 300 ma. Ib, 500 v. Ec2)	10,000 μmhos

MECHANICAL CHARACTERISTICS

Base	5-pin metal shell (see drawing)
Maximum Overall Dimensions	
Length	9.63 inches
Diameter	5.25 inches
Mounting Position	Vertical, base up or down

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class C CW or FM	Class C Telephony	
D-C Plate Voltage	6000	5000	max. volts
D-C Screen-Grid Voltage	1000	1000	max. volts
D-C Plate Current	700	600	max. ma.
Screen-Grid Input	75	75	max. watts
Plate Dissipation	1000	670	max. watts

27 January 1964

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-8166/4-1000A

TYPICAL OPERATION — Class-C CW or FM Amplifier

Grounded-Cathode Circuit

(Frequencies up to 30 Mc.)

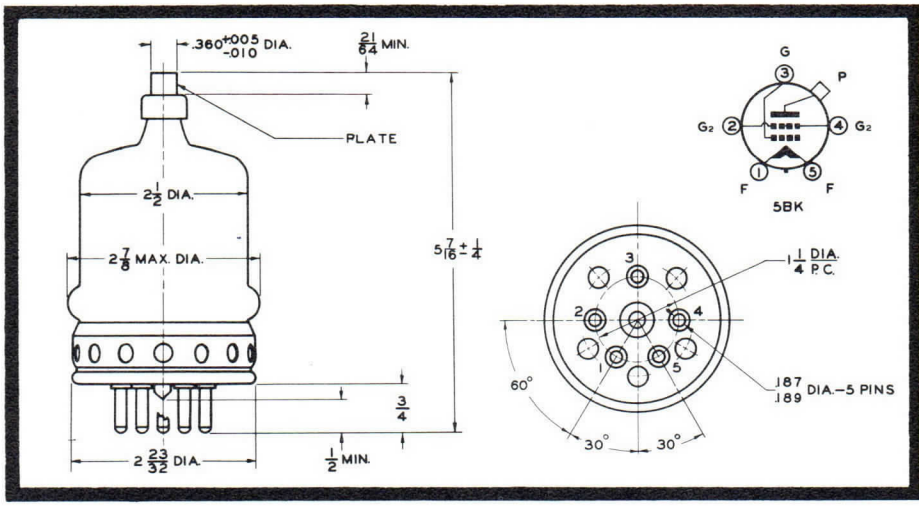
D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Screen-Grid Voltage	500	500	500	500	volts
D-C Control-Grid Voltage	-150	-150	-200	-200	volts
D-C Plate Current	700	700	700	700	ma.
D-C Screen-Grid Current	146	137	147	140	ma.
D-C Control-Grid Current	38	39	45	42	ma.
Peak R-F Grid Voltage (approx.)	290	290	355	350	volts
Driving Power (approx.)	11	12	16	15	watts
Plate Power Input	2100	2800	3500	4200	watts
Plate Dissipation	670	700	690	800	watts
Plate Power Output	1430	2100	2810	3400	watts

TYPICAL OPERATION — Class-C Amplitude-Modulated Amplifier, Carrier Conditions

Grounded Cathode Circuit

(Frequencies up to 30 Mc.)

D-C Plate Voltage	3000	4000	5000	5500	volts
D-C Screen-Grid Voltage	500	500	500	500	volts
D-C Control-Grid Voltage	-200	-200	-200	-200	volts
D-C Plate Current	600	600	600	600	ma.
D-C Screen-Grid Current	145	132	130	105	ma.
D-C Control-Grid Current	36	33	33	28	ma.
Peak R-F Grid Voltage (approx.)	340	335	335	325	volts
Driving Power (approx.)	12	11	11	9	watts
Plate Power Input	1800	2400	3000	3300	watts
Plate Dissipation	410	490	560	670	watts
Plate Power Output	1390	1910	2440	2630	watts



PL-4D21

Power Tetrode

The Penta PL-4D21 is a power tetrode with a maximum plate dissipation rating of 125 watts. Cooling for normal operation with a radiator-type plate connector is by radiation and by convective air flow through the base and alongside the envelope. Forced cooling of the envelope and the radiator-type connector by a small fan or blower is required for normal operation on frequencies above 30 Mc. and for operation under maximum ICAS ratings at all frequencies. Forced cooling of the seals at the base is required when free circulation of air through the base is prevented by shielding or other obstruction.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage (± 5 per cent)	5.0 volts
Current	6.5 amperes
Grid-Screen mu factor	5.9
Transconductance (2500 v. E_b, 400 v. E_{c2}, 50 ma. I_b)	2500 μmhos
Interelectrode Capacitances	
Grid-plate	0.05 μμf.
Input	10.8 μμf.
Output	3.1 μμf.
Maximum Frequency for Full Ratings	120 Mc.

MECHANICAL CHARACTERISTICS

Base[1]	5-pin, metal shell
Basing	EIA type 5BK
Maximum Overall Dimensions	
Length	5.69 inches
Diameter	2.82 inches
Net Weight	6.5 ounces
Mounting Position	Vertical, base up or down

1 Recommended socket -- E.F. Johnson No. 122-275.

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-4D21

OPERATION

The PL-4D21 is especially suited for use as a radio-frequency power amplifier. The compact construction and low interelectrode capacities permit operation at full ratings for continuous service at frequencies as high as 120 Mc. Operation at reduced ratings may be attained at frequencies as high as 240 Mc. The PL-4D21 may also be used as an audio-frequency power amplifier and modulator.

Under normal operating conditions the PL-4D21 requires an unusually small amount of driving power for a specified value of plate power output. 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.

Maximum ratings and typical operating conditions are given for ICAS (Intermittent Commercial and Amateur Service) operation in addition to the standard CCS (Continuous Commercial Service) ratings. ICAS ratings and operating conditions may be used for those classes of intermittent service on frequencies below 30 Mc. where the number of plate-power hours is materially less than the hours of filament operation.

MAXIMUM RATINGS—CCS (Continuous Commercial Service)

Frequencies up to 120 Mc.	Class C FM or C.W.	Plate Mod. Class C	Class AB_1 Audio Ampl.	Class AB_2 Audio Ampl.
D-C Plate Volts	3000	2500	3000	3000 volts
D-C Screen Volts	400	400	600	400 volts
D-C Grid Bias	—500	—500		volts
D-C Plate Current	225	200	225	225 ma.
Plate Dissipation	125	85	125	125 watts
Screen Dissipation	20	20	20	20 watts
Grid Dissipation	5	5		watts

MAXIMUM RATINGS—ICAS (Intermittent Commercial and Amateur Service)

Frequencies up to 30 Mc.	Class C FM or C.W.	Plate Mod. Class C	Class AB_2 Audio Ampl.
D-C Plate Voltage	4000	3200	3200 volts
D-C Screen Voltage	400	400	400 volts
D-C Grid Bias	—500	—500	volts
D-C Plate Current	225	200	250 ma.
Plate Dissipation	125	100	125 watts
Screen Dissipation	20	20	20 watts
Grid Dissipation	5	5	watts

TYPICAL OPERATION—Class C C-W or FM Amplifier

	CCS—Frequencies below 120 Mc.			*ICAS—Below 30 Mc.*
D-C Plate Voltage	2000	2500	3000	4000 volts
D-C Screen Voltage	350	350	350	350 volts
D-C Grid Voltage	−100	−150	−150	−350 volts
D-C Plate Current	200	200	167	156 ma.
D-C Screen Current	50	40	30	16 ma.
D-C Grid Current	12	12	9	8 ma.
Plate Dissipation	125	125	125	125 watts
Screen Dissipation	18	14	10.5	5.6 watts
Grid Dissipation	1.6	2.0	1.2	1.0 watts
Peak R-F Grid Voltage (Approx.)	230	320	280	480 volts
Driving Power (Approx.)	2.8	3.8	2.5	3.8 watts
Plate Power Input	400	500	500	625 watts
Plate Power Output	275	375	375	500 watts

TYPICAL OPERATION—Class C Amplitude-Modulated Amplifier, Carrier Conditions

	CCS—Frequencies below 120 Mc.		*ICAS—Below 30 Mc.*
D-C Plate Voltage	2000	2500	3200 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage	−220	−210	−335 volts
D-C Plate Current	150	152	156 ma.
D-C Screen Current	33	30	21 ma.
D-C Grid Current	10	9	8.5 ma.
Plate Dissipation	75	80	100 watts
Screen Dissipation	11.5	10.5	7.5 watts
Grid Dissipation	1.6	1.4	1.1 watts
Peak A-F Screen Voltage	210	210	240 volts
Peak R-F Grid Voltage (Approx.)	375	360	465 volts
Driving Power (Approx.)	3.8	3.3	4.0 watts
Plate Power Input	300	380	500 watts
Plate Power Output	225	300	400 watts

TYPICAL OPERATION—Class AB_1 A-F Power Amplifier or Modulator (Sine wave, two tubes)

D-C Plate Voltage	1500	2000	2500 volts
D-C Screen Voltage	600	600	600 volts
D-C Grid Voltage	−90	−94	−96 volts
Zero-Sig. D-C Plate Current	60	50	50 ma.
Max.-Sig. D-C Plate Current	222	240	232 ma.
Zero-Sig. D-C Screen Current	−1.0	−0.5	−0.3 ma
Max.-Sig. D-C Screen Current	17	6.4	8.5 ma.
Plate-to-Plate Load Resistance	10,200	13,400	20,300 ohms
Peak A-F Grid-to-Grid Signal	180	188	192 volts
Driving Power	0	0	0 watts
Max.-Sig. Plate Diss. (per tube)	87.5	125	125 watts
Max.-Sig. Plate Power Output	158	230	330 watts
Total Harmonic Distortion	5	2	2.6 per cent

TYPICAL OPERATION—Class AB_2 A-F Power Amplifier or Modulator (Sine wave, two tubes)

	CCS			*ICAS*
D-C Plate Voltage	1500	2000	2500	3000* volts
D-C Screen Voltage	350	350	350	350 volts
D-C Grid Voltage	−41	−45	−43	−50 volts
Zero-Sig. D-C Plate Current	87	72	93	61 ma.
Max.-Sig. D-C Plate Current	400	300	260	280 ma.
Zero-Sig. D-C Screen Current	0	0	0	0 ma.
Max.-Sig. D-C Screen Current	34	14	16	9 ma.
Plate-to-Plate Load Resistance	7200	13,600	22,200	22,700 ohms
Peak A-f Grid-to-Grid Signal	282	210	178	188 volts
Average Driving Power (Max. Sig.)	2.5	1.4	1.0	0.85 watts
Peak Driving Power (Max. Sig)	5.2	3.1	2.4	1.8 watts
Max.-Sig. Plate Diss. (per tube)	125	125	122	148* watts
Max.-Sig. Plate Power Output	350	350	400	550 watts
Total Harmonic Distortion	2.5	1.0	2.2	2.6 pct.

*Note—This set of operating conditions is for voice work of an intermittent nature and cannot be used at full signal for testing with a sine wave. In any event, average plate dissipation with normal voice modulation must not exceed 125 watts per tube.

PL-4D21

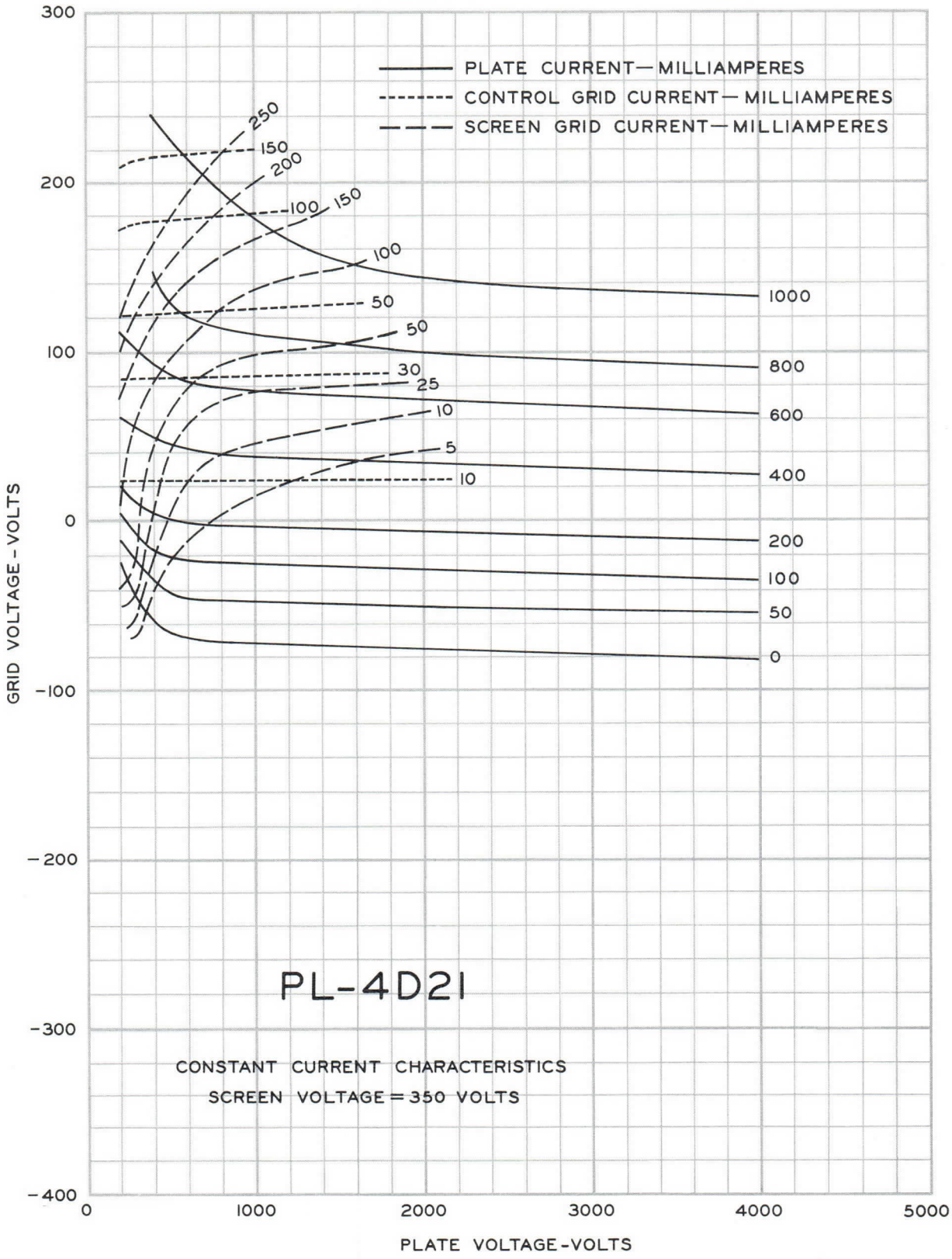
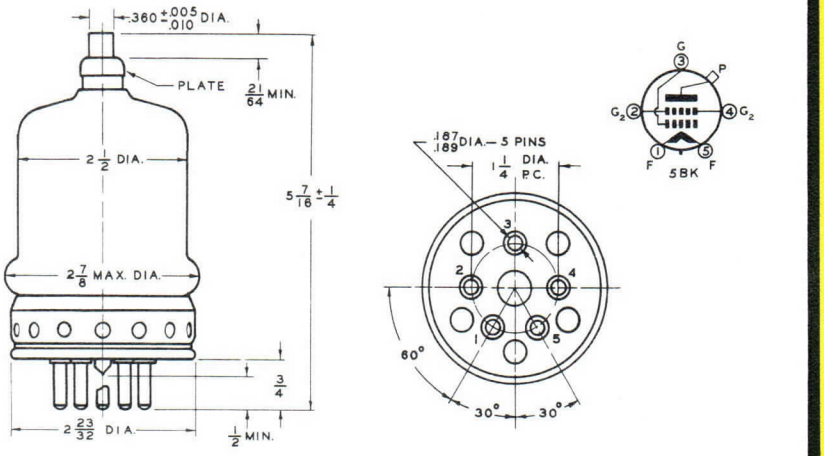


PLATE CURRENT—MILLIAMPERES
CONTROL GRID CURRENT—MILLIAMPERES
SCREEN GRID CURRENT—MILLIAMPERES
250
150
200
100
150
100
50
50
30
25
10
5
10
1000
800
600
400
200
100
50
0
300
200
100
0
-100
-200
-300
-400
0
1000
2000
3000
4000
5000
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - VOLTS
PL-4D21
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 350 VOLTS



PL-4D21A

Power Tetrode

The PL-4D21A is a 175-watt dissipation radiation-cooled power tetrode unilaterally interchangable with the 4D21/4-125A. The PL-4D21A may be substituted for the 4D21/4-125A in all applications without circuit changes. Because of the increased plate radiating area made possible by the unique Penta ribbed design, direct substitution of the PL-4D21A will result in cooler tube operation. Where circuits allow increased input, and where a small amount of air cooling can be supplied, substitution of the PL-4D21A in equipment designed for the 4D21/4-125A will allow a substantial increase in useful power output.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes
Grid-Screen mu Factor	5.9
Transconductance (2500 v. Eb, 400 v. Ec_2, 70 ma. Ib)	3050 μmhos
Interelectrode Capacitances	
Grid-Plate	0.05 $\mu\mu$f
Input	10.8 $\mu\mu$f
Output	3.3 $\mu\mu$f

MECHANICAL CHARACTERISTICS

Base	5-pin, metal shell
Basing	EIA type 5 BK
Mounting Position	Vertical, base up or down
Maximum Overall Dimensions	
Length	5.69 inches
Diameter	2.82 inches
Net Weight	6.5 ounces

MAXIMUM RATINGS (Continuous Commercial Service)

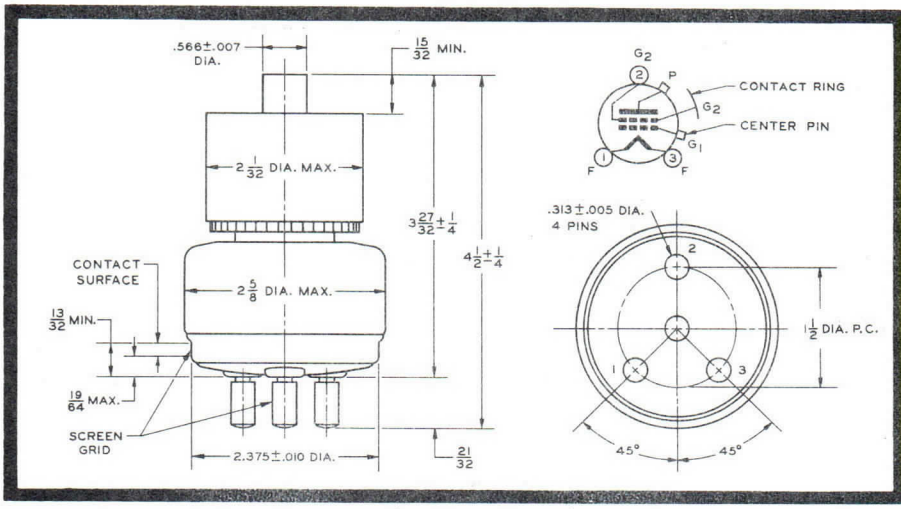
	Class C FM or CW	Class C Plate Mod[2]	Class AB_1 Audio	Class AB_2 Audio	
D-C Plate Voltage	3000	2500	3000	3000	volts max.
D-C Screen Voltage	400	400	600	400	volts max.
D-C Grid Voltage	-500	-500	-500	-500	volts max.
D-C Plate Current	225	200	225	225	ma. max.
Plate Dissipation[1]	175	115	175	175	watts max.
Screen Dissipation	20	20	20	20	watts max.
Grid Dissipation	5	5	5	5	watts max.

1 Base and envelope cooling by normal convection is adequate for plate dissipation up to 125 watts. When plate dissipation exceeds 125 watts, forced air cooling of both base and envelope are required. When cooling is required, 5 c.f.m. of cooling air should be passed through the base, and small fan delivering 50-100 c.f.m. of free air should be directed at the upper portion of the tube envelope. Envelope cooling is adequate when plate seal and envelope temperatures do not exceed 200° C.

2 Carrier conditions.

Form No. 508R-1
31 March 1960

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA



PL-4X500A

Power Tetrode

The PL-4X500A is an external-anode tetrode suitable for use as an RF amplifier and oscillator. The maximum plate dissipation rating for the tube is 500 watts. Because of its small size and low-inductance leads, the PL-4X500A can be operated efficiently over a large portion of the VHF region.

COOLING

A minimum air-flow of 40 cubic feet per minute must be passed through the anode cooler when the PL-4X500A is operated at full rated plate dissipation. At the specified rate of air flow the pressure drop across the cooler equals 1.4 inches of water. Forced-air cooling for the base and screen seals must also be provided. The temperature of the seals and the core of the anode cooler must not exceed 150° C. All cooling air must be applied before the application of filament voltage and must continue for three minutes after removal of power from the filament.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	13.5 amperes
Grid-Screen Amplification Factor	6.2
Interelectrode Capacitances	
Grid-Plate	0.05 μμf
Input	12.8 μμf
Output	5.6 μμf
Transconductance (2500 v. Eb, 200 ma. Ib, 500 v. Ec2)	5200 μmhos
Maximum Frequency for Full Ratings	120 Mc.

MECHANICAL CHARACTERISTICS

Base	Special; see drawing
Maximum Overall Dimensions	
Length	4.75 inches
Diameter	2.63 inches
Net Weight	1.2 pounds
Mounting Position	Vertical, base up or down

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-4X500A

MAXIMUM RATINGS — CCS (Continuous Commercial Service)

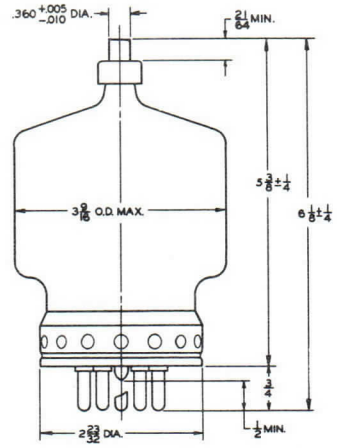
	Class-C CW or FM	Class-B TV Service	
D-C Plate Voltage	4000	3000	max. volts
D-C Screen-Grid Voltage	500	500	max. volts
D-C Plate Current	350	350	max. ma.
Screen-Grid Input	30	30	max. watts
Plate Dissipation	500	500	max. watts

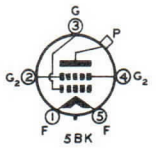
TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit

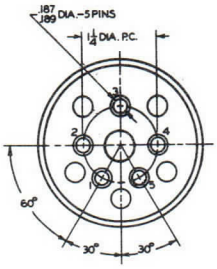
D-C Plate Voltage	2500	3000	4000	volts
D-C Screen-Grid Voltage	500	500	500	volts
D-C Control-Grid Voltage	-150	-150	-150	volts
D-C Plate Current	310	310	315	ma.
D-C Screen-Grid Current	26	24	22	ma.
D-C Control-Grid Current	15	16	16	ma.
Peak R-F Grid Voltage (approx.)	230	230	230	volts
Driving Power (approx.)	5	5	5	watts
Plate Power Input	775	930	1260	watts
Plate Dissipation	300	330	425	watts
Plate Power Output	475	600	835	watts

TYPICAL OPERATION — Class C C-W or FM Amplifier
Grounded-Cathode Circuit; Two Tubes in Push-Pull at 110 Mc.

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen-Grid Voltage	500	500	500	volts
D-C Control-Grid Voltage	-250	-250	-250	volts
D-C Plate Current	690	600	625	ma.
D-C Screen-Grid Current	100	95	80	ma.
D-C Control-Grid Current	40	45	35	ma.
Driving Power (approx.)	20	18	25	watts
Power Output (approx.)	1300	1320	1850	watts







PL-5D22

(4-250A)

Power Tetrode

The Penta PL-5D22/4-250A is a power tetrode with a maximum plate dissipation rating of 250 watts. Cooling for normal operation is by radiation and by forced air cooling of five cubic feet per minute through the base. A radiator-type plate connector must be used for all classes of service at all frequencies. Forced cooling of the envelope and of the radiator-type plate connector, in addition to forced cooling of the base, is required for normal operation at frequencies above 30 Mc.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage (± 5 per cent)	5.0 volts
Current	14.5 amperes
Grid-Screen mu factor	5.1
Transconductance (2500 v. E_b, 500 v. E_{c2}, 100 ma. I_b)	4000 μmhos
Interelectrode Capacitances	
Grid-Plate	0.12 μμf.
Input	12.7 μμf.
Output	4.5 μμf.
Maximum Frequency for Full Ratings	75 Mc.

MECHANICAL CHARACTERISTICS

Base[1]	EIA A5-97
Basing	EIA Type 5BK
Maximum Overall Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Mounting Position	Vertical, base up or down
Net Weight	8.0 ounces

---

1 Fits E. F. Johnson Co. No. 122-275 socket.

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-5D22

COOLING

Forced-air cooling of the base and base seals of the PL-5D22/4-250A is required for all classes of operation. Such cooling normally is provided through use of a tube socket having holes which align with the holes in the tube base, and with a small fan or blower to pressurize the chassis upon which the tube is mounted. Alternatively, when an open chassis is used, a small fan or blower may be used with the outlet air stream directed at the tube socket. A minimum air flow of five cubic feet per minute through the base of the tube is required during the period that filament power is applied.

Adequate cooling of the envelope and plate seal for operation at frequencies below 30 Mc. can be obtained by convective air flow. Above 30 Mc. the air stream from a small fan or blower directed at the upper portion of the envelope normally will provide adequate cooling. In any event, the temperature of the plate cap should not be permitted to exceed 170°C for any class of continuous service.

RADIO-FREQUENCY OPERATION

The PL-5D22/4-250A is especially 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 75 Mc. Operation at reduced ratings may be attained at frequencies as high as 120 Mc.

Under normal operating conditions, the PL-5D22/4-250A requires an unusually small amount of driving power for a specified value of plate power output. The high power sensitivity of the type 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-5D22/4-250A makes it well suited for use as an audio-frequency power amplifier or modulator in push-pull Class AB_1 or Class AB_2 service. In these classes of operation a pair of PL-5D22/4-250A's can give relatively high audio-frequency power output with low driving power and low harmonic distortion. Under Class AB_2 operating condition 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 normally will prove adequate. Grid bias voltage may be obtained from batteries or from a supply having a bleeder resistor of 250 ohms or less.

Under Class AB_1 operating conditions, the d-c screen voltage must be obtained from a supply having good regulation, but the internal impedance of the bias supply is not of critical importance. However, the effective grid circuit resistance per tube should not exceed 250,000 ohms.

MAXIMUM RATINGS—C C S (Continuous Commercial Service)

(Frequencies below 75 Mc.)	Class C FM or C.W.	Plate Mod. Class C	Class AB_1 Audio Ampl.	Class AB_2 Audio Ampl.	
D-C Plate Voltage	4000	3200	4000	4000	volts
D-C Screen Voltage	600	600	600	600	volts
D-C Grid Bias	—500	—500			volts
D-C Plate Current	350	275	350	350	ma.
Plate Dissipation	250	165	250	250	watts
Screen Dissipation	35	35	35	35	watts
Grid Dissipation	10	10	10	10	watts

PL-5D22

TYPICAL OPERATION—Class C C-W 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	—150	—175	—225 volts
D-C Plate Current	300	333	313 ma.
D-C Screen Current	60	60	45 ma.
D-C Grid Current	9	9	9 ma.
Plate Dissipation	175	225	250 watts
Screen Dissipation	30	30	30 watts
Grid Dissipation	0.3	0.6	0.5 watts
Peak R-F Grid Voltage (approx.)	220	260	300 volts
Driving Power (approx.)	1.7	2.2	2.5 watts
Plate Power Input	750	1000	1250 watts
Plate Power Output	575	775	1000 watts

TYPICAL OPERATION—Class C Amplitude-Modulated Amplifier, Carrier Conditions

Frequencies below 75 Mc.

D-C Plate Voltage	2500	3000	volts
D-C Screen Voltage	400	400	volts
D-C Grid Voltage	—200	—310	volts
D-C Plate Current	200	225	ma.
D-C Screen Current	30	30	ma.
D-C Grid Current	9	9	ma.
Plate Dissipation	125	165	watts
Screen Dissipation	12	12	watts
Grid Dissipation	1.8	2.7	watts
Peak A-F Screen Voltage	350	350	volts
Peak R-F Grid Voltage (approx.)	250	360	volts
Driving Power (approx.)	2.1	3.1	watts
Plate Power Input	500	675	watts
Plate Power Output	375	510	watts

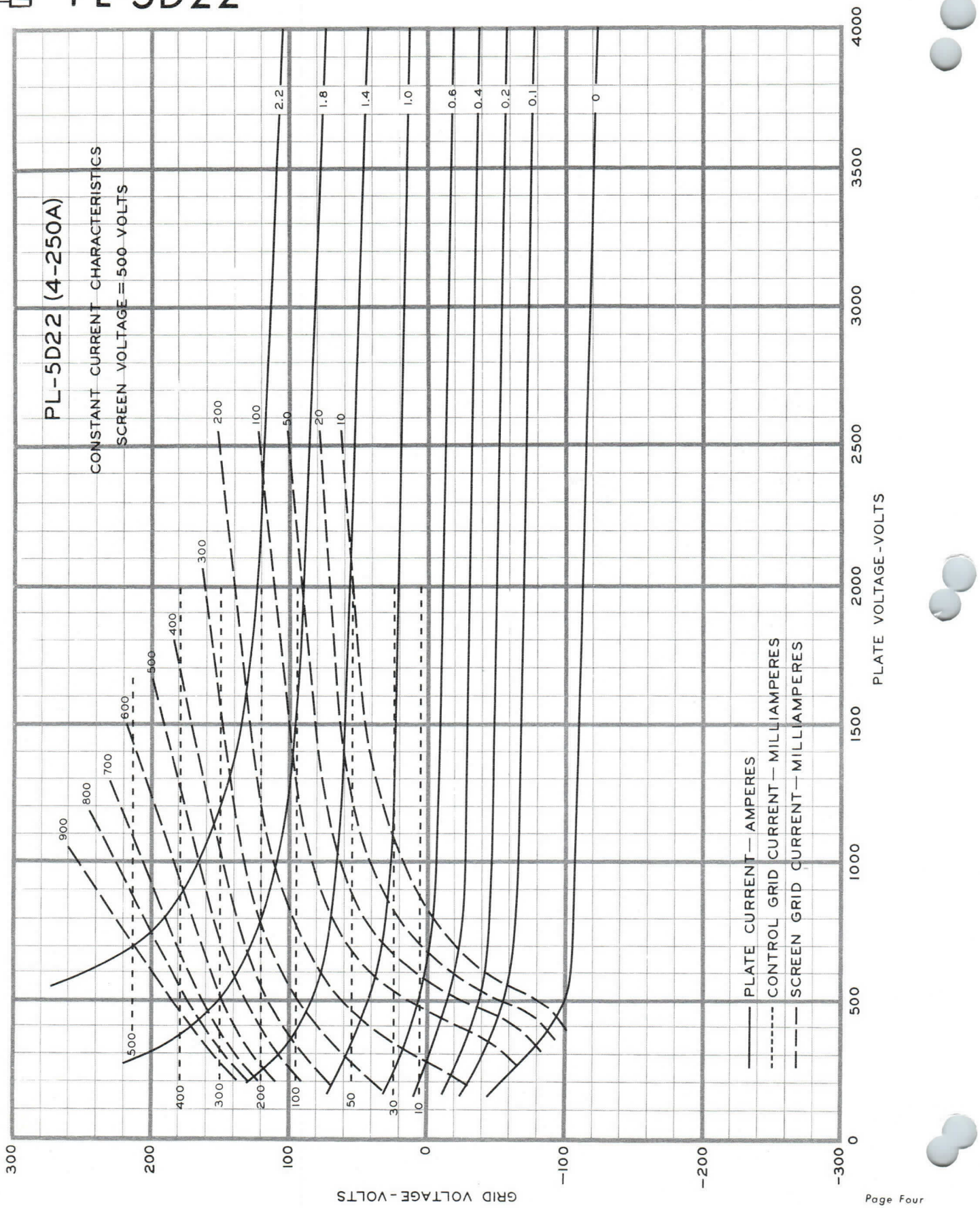
TYPICAL OPERATION—Class AB_1 A-F Power Amplifier or Modulator (Sine Wave, Two Tubes)

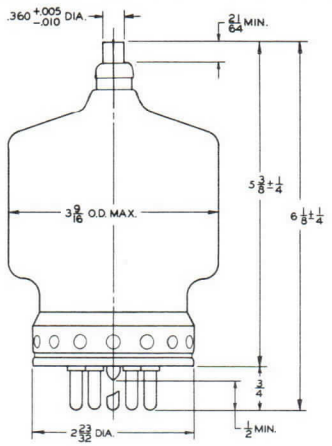
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage	—105	—110	—115	volts
Zero-Sig. D-C Plate Current	110	120	120	ma.
Max.-Sig. D-C Plate Current	405	430	416	ma.
Zero-Sig. D-C Screen Current	—0.3	—0.3	—0.3	ma.
Max.-Sig. D-C Screen Current	22	13	11	ma.
Plate-to-Plate Load Resistance	9170	11,400	15,000	ohms
Peak A-F Grid-to-Grid Signal	175	180	186	volts
Driving Power	0	0	0	watts
Max.-Sig. Plate Dissipation (per tube)	175	225	250	watts
Max.-Sig. Plate Power Output	460	625	750	watts
Total Harmonic Distortion	2.5	2	2.5	pct.

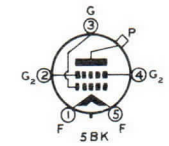
TYPICAL OPERATION—Class AB_2 A-F Power Amplifier or Modulator (Sine Wave, Two Tubes)

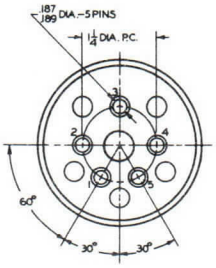
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	300	300	300	volts
D-C Grid Voltage	—48	—51	—53	volts
Zero-Sig. D-C Plate Current	120	120	123	ma.
Max.-Sig. D-C Plate Current	510	500	475	ma.
Zero-Sig. D-C Screen Current	0	0	0	ma.
Max.-Sig. D-C Screen Current	26	23	33	ma.
Plate-to-Plate Load Resistance	8000	11,000	16,000	ohms
Peak A-F Grid-to-Grid Signal	200	200	200	volts
Average Driving Power (Max. Sig.)	2.3	2.1	1.9	watts
Peak Driving Power (Max. Sig.)	5.5	4.8	4.6	watts
Max.-Sig. Plate Dissipation (per tube)	185	205	190	watts
Max.-Sig. Plate Power Output	650	840	1045	watts
Total Harmonic Distortion	4	4	4.6	pct.

PL-5D22


PL-5D22 (4-250A)
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT — AMPERES
CONTROL GRID CURRENT — MILLIAMPERES
SCREEN GRID CURRENT — MILLIAMPERES
PLATE VOLTAGE - VOLTS
GRID VOLTAGE - VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
300
200
100
0
-100
-200
-300
2.2
1.8
1.4
1.0
0.6
0.4
0.2
0.1
0
900
800
700
600
500
400
300
200
100
50
20
10
500
400
300
200
100
50
30
10







PL-6775

Power Tetrode

The PL-6775 is a ruggedized version of the 4-400A power tetrode, for which it can be used as a replacement without circuit modification. The tube may be operated in any position, and will withstand high levels of shock and vibration. The PL-6775 features a one-piece, low-loss plate cap and seal which will not loosen or easily break off.

The maximum plate dissipation rating of the PL-6775 is 400 watts. It is cooled by radiation from the plate and by forced air through the base, along the envelope, and over the plate seal. A large effective plate radiating area is provided through use of the unique Penta ribbed-plate construction.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage (± 5 per cent)	5.0 volts
Current	14.5 amperes
Grid-Screen mu factor	5.1
Transconductance (2500 v. Eb, 500 v. Ec_2, 100 ma. 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[1]	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

[1] Recommended Socket -- Johnson 122-275, operated in conjunction with the PL-C1 glass chimney with socket cut-out as shown on page 3.

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

PL-6775

COOLING

A total quantity of 15 cubic feet per minute of cooling air, properly distributed to the base, envelope, and plate seal area, is required for all classes of operation when the PL-6775 is operated at or near the maximum plate dissipation rating. The required cooling air is most conveniently provided by means of a pressurized chassis upon which a standard tube socket is mounted in a special cut-out, as shown on page three, in conjunction with a Penta PL-C1 air-control glass chimney. Alternatively, a commercial air-distribution type socket may be used with the PL-6775.

When used with the socket cut-out shown on page three, and with the PL-C1 chimney, the PL-6775 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 which pressure the required 15 cfm air flow will be obtained. A small centrifugal blower rated at about 100 cfm of free air will provide the proper pressure and quantity of cooling air. Cooling is adequate when the base seal temperatures do not exceed 200° C and the plate seal temperature does not exceed 225° C.

In applications where the plate dissipation does not exceed 250 watts, and where operation is below 30 Mc., the PL-6775 may be operated without forced envelope or plate seal cooling but with an air flow of five cubic feet per minute through the base alone.

RADIO-FREQUENCY OPERATION

The PL-6775 is especially 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 is not normally required 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 effect of screen-lead inductance may be eliminated for a specified frequency of operation through the use of a variable capacitor as the screen-lead by-pass. The capacitor is tuned for minimum feedback of energy from the plate circuit back to the grid circuit. A variable capacitor with a maximum capacitance of 50 $\mu\mu$fd normally will be found adequate for operation in the 100 Mc. region.

An unusually small amount of driving power is required by the PL-6775 under normal operating conditions. The high power sensitivity of the tube permits a reduction in the power requirements imposed on 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-6775 makes it well suited for use as an audio-frequency power amplifier or modulator in push-pull Class AB_1 or Class AB_2 service. In these classes of operation a pair of PL-6775s can give relatively high audio-frequency power output with low driving power and low harmonic distortion.

GRID-VOLTAGE REGULATION

When the PL-6775 is used as a Class AB_1 or AB_2 amplifier, screen voltage should be obtained from a well-regulated source. If a separate screen-grid power supply is used, the supply should be shunted by a resistance of 25,000 ohms or less, to prevent screen-voltage "runaway" in case of negative screen-grid current. This limitation regarding maximum screen-to-ground resistance applies to either unregulated supplies or supplies containing a series-tube regulator, since the latter may be ineffective when the net current flowing in the supply circuit becomes negative.

In Class AB_2 operation, the control-grid bias source should have good regulation, to prevent bias variations during periods of grid-current flow. Bias regulation is not of significant importance under Class AB_1 operating conditions, but grid-circuit resistance should not exceed 250,000 ohms per tube.

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	350	275	350	350	ma.
Plate Dissipation	400	270	400	400	watts
Screen Dissipation	35	35	35	35	watts
Grid Dissipation	10	10	10	10	watts

PL-6775

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	350	350	350	ma.
D-C Screen Current	46	46	42	ma.
D-C Grid Current	18	18	19	ma.
Plate Dissipation	235	250	300	watts
Screen Dissipation	23	23	21	watts
Grid Dissipation	1.8	1.8	1.8	watts
Peak R-F Grid Voltage (approx.)	300	320	320	volts
Driving Power (at 20 Mc.)	5.5	5.9	6.0	watts
Plate Power Input	875	1050	1400	watts
Plate Power Output	640	800	1100	watts

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

TYPICAL OPERATION—Class AB_1 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	190	160	120	ma.
Max.-Signal D-C Plate Current	635	610	585	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)	370	400	400	watts
Max.-Signal Plate Power Output	850	1100	1550	watts

TYPICAL OPERATION—Class C. Amplitude-Modulated Amplifier, Carrier Conditions

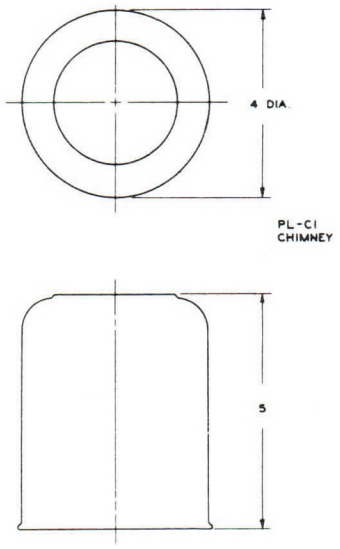
D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—220	—220	—220	volts
D-C Plate Current	275	275	275	ma.
D-C Screen Current	30	28	26	ma.
D-C Grid Current	12	12	12	ma.
Plate Dissipation	170	180	195	watts
Screen Dissipation	15	14	13	watts
Grid Dissipation	1.1	1.1	1.1	watts
Peak A-F Screen Voltage	350	350	350	volts
Peak R-F Grid Voltage (approx.)	290	290	290	volts
Driving Power (approx.)	3.5	3.5	3.5	watts
Plate Power Input	550	688	825	watts
Plate Power Output	380	508	630	watts

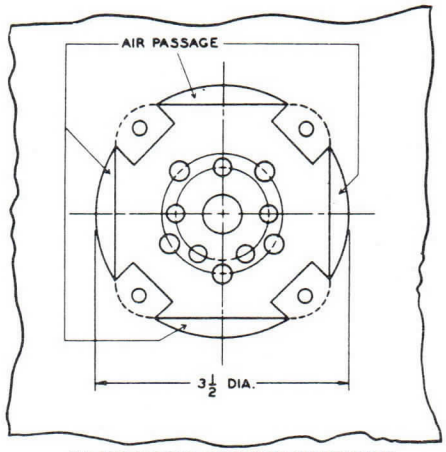
(Frequencies below 75 Mc.)

TYPICAL OPERATION—Class AB_2 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	volts
Zero-Signal D-C Plate Current	190	160	120	ma.
Max.-Signal D-C Plate Current	700	700	640	ma.
Zero-Signal D-C Screen Current	0	0	0	ma.
Plate-to-Plate Load Resistance	7200	9000	14,000	ohms
Peak A-F Grid-to-Grid Signal	265	280	280	volts
Average Driving Power (Max. signal)	4.3	4.5	3.5	watts
Peak Driving Power (Max. signal)	9	10	8	watts
Max-Signal Plate Dissipation (per tube)	320	400	400	watts
Max-Signal Plate Power Output	1100	1380	1750	watts

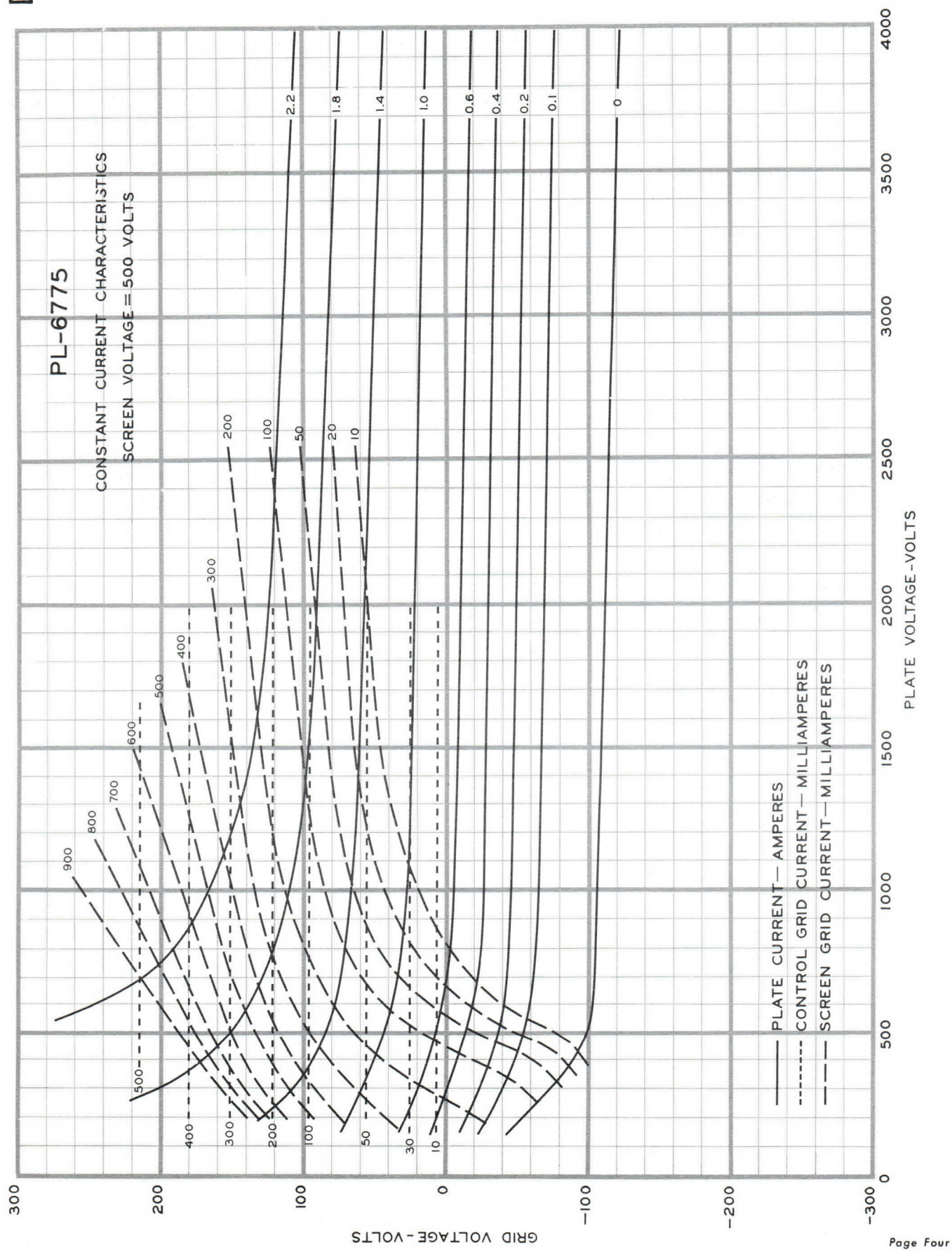
*Note: Approximate values. Adjust to give the stated value of zero-signal plate current.

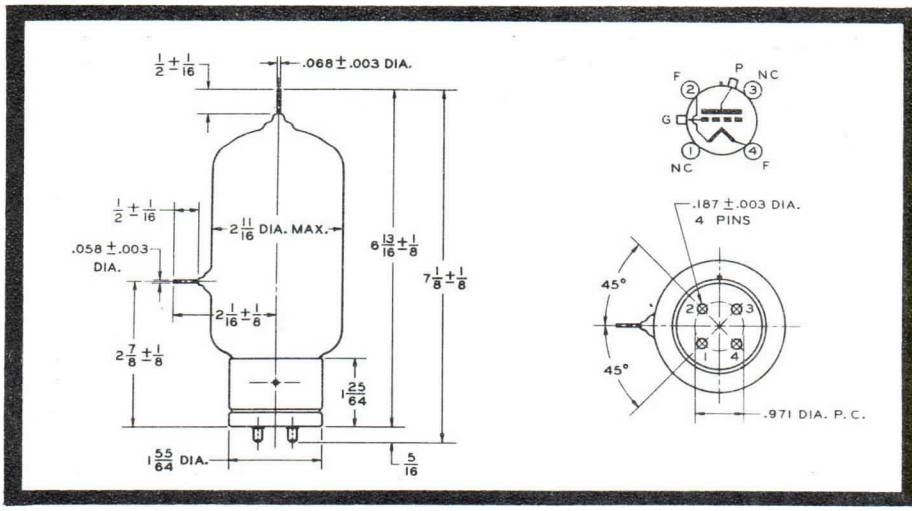




CHASSIS CUT-OUT AND SOCKET MOUNTING FOR PROPER AIR DISTRIBUTION FROM PRESSURIZED CHASSIS (JOHNSON NO. 122-275 SOCKET)

PL-6775


PL-6775
CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE VOLTAGE - VOLTS
GRID VOLTAGE - VOLTS
PLATE CURRENT — AMPERES
CONTROL GRID CURRENT — MILLIAMPERES
SCREEN GRID CURRENT — MILLIAMPERES
0
500
1000
1500
2000
2500
3000
3500
4000
300
200
100
0
-100
-200
-300
2.2
1.8
1.4
1.0
0.6
0.4
0.2
0.1
0
900
800
700
600
500
400
300
200
100
50
20
10
500
400
300
200
100
50
30
10



PL-254W

Power Triode

The PL-254W is a 100-watt radiation-cooled triode suitable for use as an r-f power amplifier, frequency multiplier or oscillator, and as an a-f power amplifier and modulator. The tube is widely used in base-station communications equipment, and will deliver up to 400 watts when operated at maximum ratings as a Class-C CW or FM amplifier. Internal geometry of the PL-254W is such that it is exceptionally efficient in VHF operation.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	7.5 amperes
Amplification Factor	25
Interelectrode Capacitances	
Grid-Plate	2.5 μμf
Input	3.4 μμf
Output	0.43 μμf
Transconductance (E_b = 2500 v., I_b = 40 ma.)	2000 μmhos

MECHANICAL CHARACTERISTICS

Base[1]	Jumbo 4-pin, JETEC A4-29
Maximum Overall Dimensions	
Length	7.13 inches
Diameter	2.69 inches
Net Weight (average)	6.0 ounces
Mounting Position	Vertical, base up or down

MAXIMUM RATINGS — C C S (Continuous Commercial Service)

	Class C CW or FM	Class C Telephony	
D-C Plate Voltage	4000	3000	max. volts
D-C Plate Current	225	180	max. ma.
D-C Grid Current	60	60	max. ma.
Plate Dissipation	100	85	max. watts

1 Fits E. F. Johnson Co. No. 123-211 socket.

Form 92C-271A

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

20 April 1965

PL-254W

TYPICAL OPERATION — Class-C CW or FM Amplifier

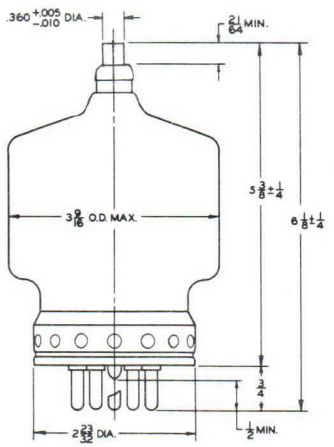
Grounded-Cathode Circuit

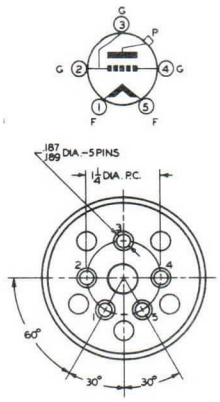
D-C Plate Voltage	1000	2000	3000	4000	volts
D-C Plate Current	225	215	165	125	ma.
D-C Grid Voltage	-195	-230	-245	-260	volts
D-C Grid Current	60	55	40	30	ma.
Peak R-F Grid Voltage (approx.)	480	500	480	450	volts
Driving Power (approx.)	25	25	18	12	watts
Plate Power Input	225	430	500	500	watts
Plate Dissipation	80	100	100	100	watts
Plate Power Output	125	330	400	400	watts

TYPICAL OPERATION — Class-C Amplitude-Modulated Amplifier, Carrier Conditions

Grounded-Cathode Circuit

D-C Plate Voltage	1000	2000	2500	3000	volts
D-C Plate Current	180	180	168	140	ma.
D-C Grid Voltage	-315	-355	-360	-355	volts
D-C Grid Current	45	45	40	35	ma.
Peak R-F Grid Voltage (approx.)	580	620	610	580	volts
Driving Power (approx.)	23	25	23	19	watts
Plate Power Input	180	360	420	420	watts
Plate Dissipation	65	85	85	85	watts
Plate Power Output	115	275	335	335	watts





PL-6569

Power Triode

The PL-6569 is a 250-watt plate dissipation high-mu power triode designed especially for grounded-grid r-f amplifier service, but also capable of good performance in other applications. Because of its high amplification factor and high perveance, the PL-6569 will give power gains as high as ten as a grounded-grid amplifier. Effective shielding is provided within the PL-6569, and neutralization is not required in ordinary grounded-grid applications.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten
- Voltage - 5.0 volts
- Current - 14.5 amperes

Amplification Factor - - - - - - - - - - - - - - - - - - 45

Transconductance (E_b=2000 v, I_b=125 ma.) - - - - - - - - 4500 μmhos

Interelectrode Capacitances
- Grid-Filament (Input)- - - - - - - - - - - - - - - 7.6 μμf
- Grid-Plate (Output) - - - - - - - - - - - - - - - 3.7 μμf
- Plate-Filament (Feedback) - - - - - - - - - - - - 0.10 μμf

MECHANICAL CHARACTERISTICS

Base[1] - Giant 5-pin, Metal Shell

Basing - See base diagram

Maximum Overall Dimensions
- Length - 6.38 inches
- Diameter - 3.56 inches

Net Weight - 8 ounces

Mounting Position - - - - - - - - - - - - Vertical, base up or down

---

1 Fits E. F. Johnson Co. No. 122-275 socket.

1 February 1965 Form 92C121D

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

PL-6569

COOLING

Forced-air cooling of the base and seals of the PL-6569 is required for all classes of operation. Such cooling normally is provided through use of a tube socket having holes which align with the holes in the tube base, and with a small fan or blower to pressurize the chassis upon which the tube is mounted. Alternatively, when an open chassis is used, a small fan or blower may be used with the outlet air stream directed at the tube socket. A minimum air flow of five cubic feet per minute through the base of the tube is required during the period that filament power is applied.

Adequate cooling of the envelope and plate seal for operation at frequencies below 30 Mc. can be obtained by convective air flow. Above 30 Mc. the air stream from a small fan or blower directed at the upper portion of the envelope will normally provide adequate cooling. In any event, the temperature of the plate cap should not be permitted to exceed 170° C for any class of continuous service.

RADIO-FREQUENCY OPERATION

The PL-6569 is especially suited for use as a grounded-grid radio-frequency amplifier. The compact construction and low plate-to-filament capacitance make neutralization unnecessary in ordinary grounded-grid applications.

For every value of plate voltage, there is an optimum value of zero-signal plate current at which maximum linearity and minimum third-order intermodulation distortion will be realized. The PL-6569 can be operated over a wide range of plate voltages with excellent linearity by means of properly adjusting the bias voltage to obtain the correct zero-signal plate current. Zero-signal plate current values for typical plate voltages are given in the tabular data.

A typical grounded-grid amplifier circuit is shown in Figure 3. The grid is by-passed to ground, and supplied only with d-c bias voltage. Radio-frequency excitation is applied between filament and ground, and output is taken from the plate-to-ground circuit. The excitation circuit and the output circuit are in series, via the tube, and a portion of the output power "fed through" from the driving circuit is related to the ratio of tube excitation voltage to output voltage. The fed-through power is minimized by using a tube with a high amplification factor, so that minimum r-f grid voltage is required. A further improvement in the power gain of a grounded-grid amplifier is obtained by using the highest possible plate voltage, since the ratio of r-f output to excitation voltage is thereby increased.

In addition to the fed-through power, the r-f driving source must supply power for normal grid-driving purposes. This power is dissipated in the bias supply and at the grid of the tube, and does not appear in the output circuit. The power lost is ordinarily on the order of one-fiftieth of the output power.

During the portion of the radio-frequency cycle in which plate current flows, heavy demands are made upon the driving source for the grounded-grid amplifier to supply r-f cathode current. This current may be four to six times the average plate current, and unless adequate energy storage (Q) is provided in the driving circuit, distortion of individual cycles of the r-f driving wave can occur, with a consequent serious lowering of efficiency.

It is recommended that the tuned circuit driving the PL-6569 have a loaded Q of at least five, to minimize driving-wave distortion. Figure 1 shows the minimum amount of grid-cathode tank circuit capacitance required for proper Q at frequencies in the 2-to-60 Mc. region. Additional capacitance up to two or three times the recommended minimum may be used, if desired. The input circuit inductance should be selected to resonate at the operating frequency with the capacitance in use.

Where a pi-network coupling circuit is used to feed the PL-6569 from a low-impedance line, as shown in the circuit of Figure 3, the capacitance at the tube end of the network should be equal to or greater than the recommended minimum shown in Figure 1. The average input impedance of the PL-6569 is given by:

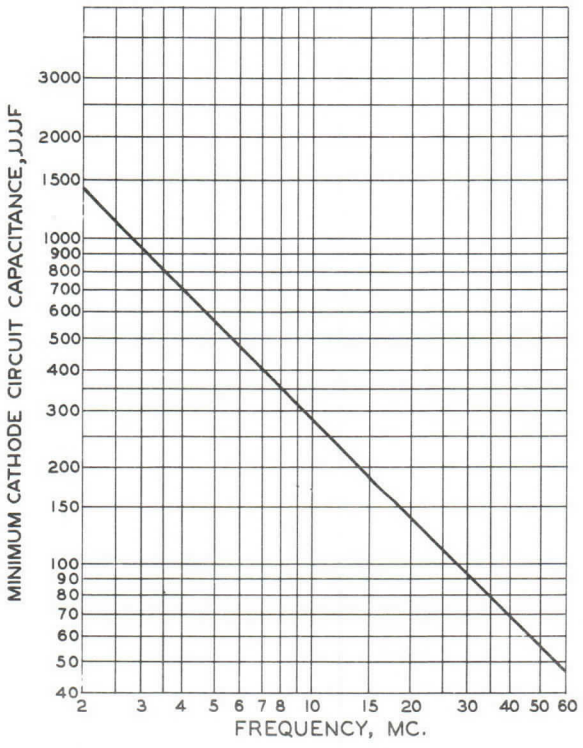


FIG. 1

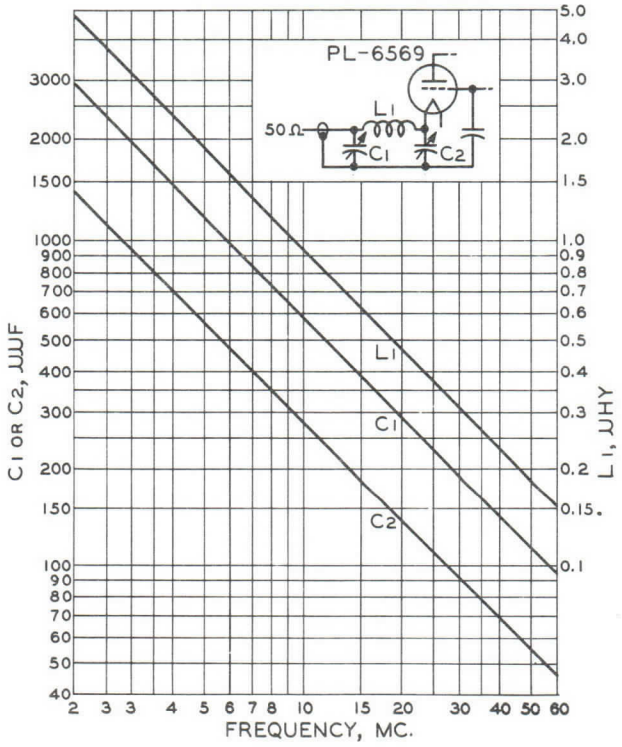


FIG. 2

PL-6569

$$Zin = \frac{(\text{peak r-f driving power})^2}{2 \times \text{driving power}},$$

and this value should be used in calculating the inductance and input-end capacitance of the pi-network driving circuit. Values for the peak r-f driving voltage and driving power for a number of operating conditions will be found in the tabular data. For practical purposes, the input impedance of the PL-6569 may be taken as 300 ohms in most applications.

Figure 2 shows suggested pi-network capacitance and inductance values for a network feeding the PL-6569 from a 50-ohm non-resonant line.

The grid of the PL-6569 terminates in three base pins. The corresponding three socket terminals should be connected together with a low-inductance connection, and by-passed to chassis with a short low-inductance lead and a low-inductance capacitor. Multiple by-pass capacitors may be used if desired, but will not ordinarily be found necessary.

Filament power for the PL-6569 should be supplied through suitable filament chokes, as indicated in Figure 3. The reactance of the chokes should be several times the input impedance of the amplifier and wound with wire of sufficient size to carry the filament current. It may be found necessary to employ a filament transformer delivering more than the rated filament voltage, to compensate for the voltage drop across the chokes. Examples of commercially-available filament chokes are the Barker and Williamson FC-15 (15 amperes) and FC-30 (30 amperes). The current requirements for filament chokes may be reduced by placing them in the primary of the filament transformer, and isolating the transformer from ground.[1]

When the PL-6569 is used as a grounded-grid linear amplifier of modulated power, the loading presented to the driving source makes additional "swamping" unnecessary. Typical operating conditions for the PL-6569 as an amplifier of single-sideband, suppressed carrier power are given in the tabular data. The typical operating conditions shown are for continuously applied sinusoidal modulation. Increased output without excessive plate dissipation may be obtained with intermittent modulation having a high ratio of peak-to-average power, such as normal speech. In such cases, increased plate circuit loading and increased drive should be used. The average plate dissipation should not be allowed to exceed 250 watts, except momentarily during adjustment procedures.

[1] See "Notes on Grounded-Grid RF Power Amplifiers" (Pucket), QST, December 1954, pg. 36, or 1962 A.R.R.L. Handbook, pg. 165.

MAXIMUM RATINGS — CCS (Continuous Commercial Service)

	Class-C FM or CW	*Class-C Plate Mod.*	*Class-B R-F or Audio*	
D-C Plate Voltage	4000	3200	4000	volts
D-C Plate Current	300	250	300	ma.
D-C Grid Current	120	120	120	ma.
Plate Dissipation	250	165	250	watts

TYPICAL OPERATION — Class C C-W or FM Amplifier

Grounded-Grid Circuit

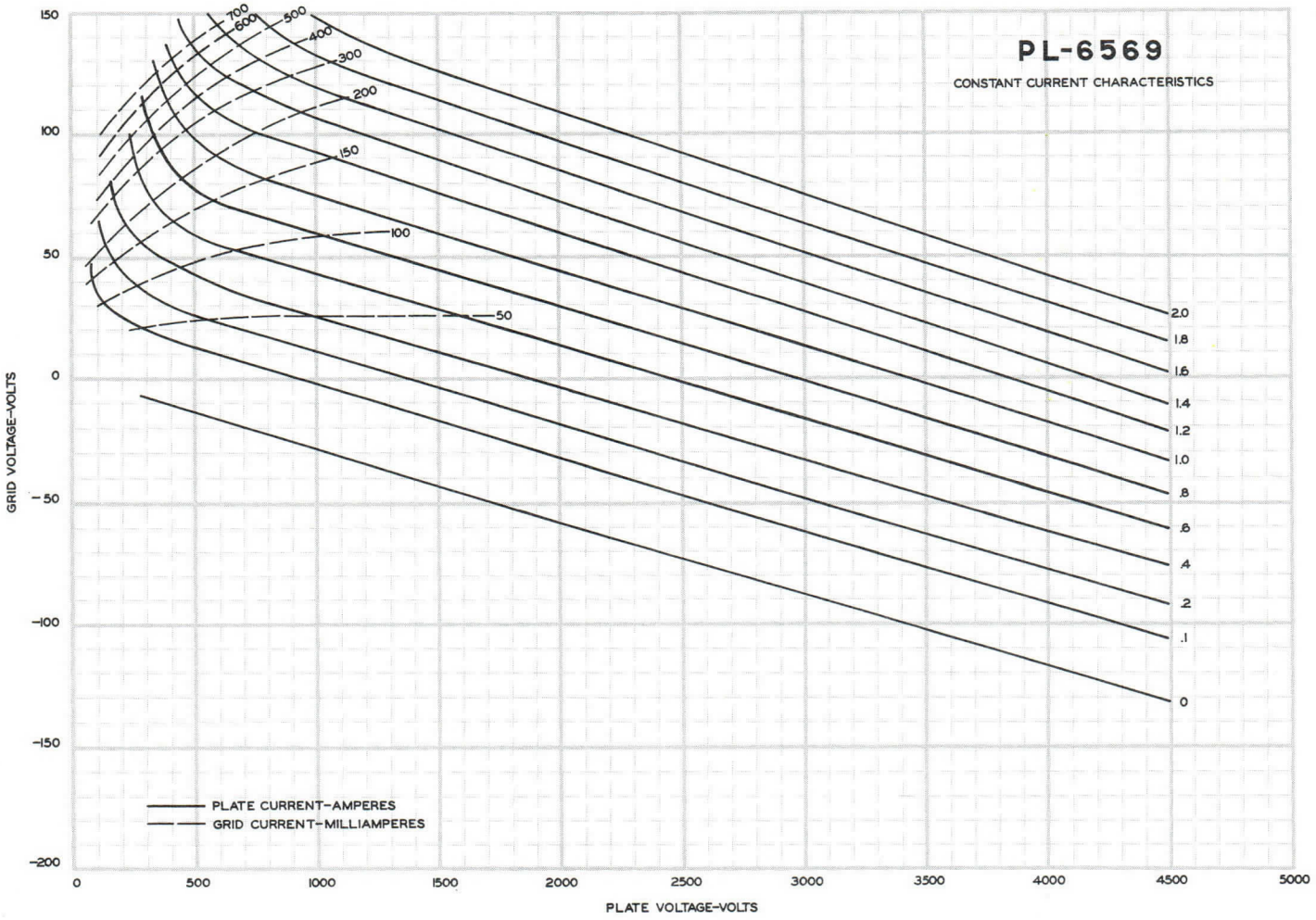
D-C Plate Voltage	2500	3000	3500	4000 volts
D-C Grid Voltage	-70	-95	-110	-120 volts
D-C Plate Current	300	300	285	250 ma.
D-C Grid Current	85	110	90	50 ma.
Peak R-F Driving Voltage	190	225	240	230 volts
Driving Power (approx.)[1]	75	85	85	70 watts
Plate Power Input	750	900	1000	1000 watts
Plate Dissipation	250	250	250	235 watts
Power Output	555	710	805	820 watts

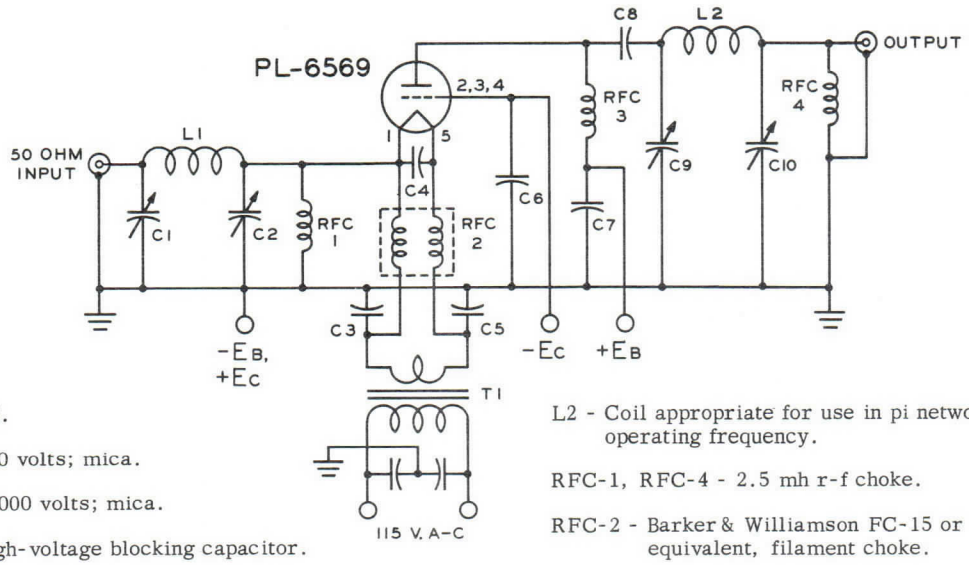
TYPICAL OPERATION — Class B Linear R-F Amplifier

Single-Sideband, Suppressed Carrier; Grounded-Grid Circuit

D-C Plate Voltage	2500	3000	3500	4000 volts
D-C Grid Voltage[2]	-60	-75	-90	-105 volts
Zero-Sig. D-C Plate Current	40	35	30	24 ma.
Max.-Sig. D-C Plate Current[3]	300	265	270	250 ma.
Max.-Sig. D-C Grid Current[3]	80	50	68	42 ma.
Max.-Sig. Peak R-F Driving Voltage[3]	180	170	220	205 volts
Max.-Sig. Driving Power (approx.)[1, 3]	70	60	75	60 watts
Max.-Sig. Plate Power Input[3]	750	800	945	1000 watts
Max.-Sig. Plate Dissipation[3]	250	250	250	250 watts
Max.-Sig. Power Output[3]	550	600	760	800 watts

[1] Includes bias loss, grid dissipation, and feed-through power.
[2] Approximate value -- adjust to give stated zero-signal plate current.
[3] Max.-Sig. values for peak conditions, or for single-tone modulation at full signal.





C1, C2 - See Figure 2.

C3, C5 - .01 μfd., 500 volts; mica.

C4, C6 - .002 μfd., 1000 volts; mica.

C7, C8 - .002 μfd. high-voltage blocking capacitor.

C9, C10 - Capacitors appropriate for use in pi network at desired operating frequency.

L1 - See Figure 2.

L2 - Coil appropriate for use in pi network at desired operating frequency.

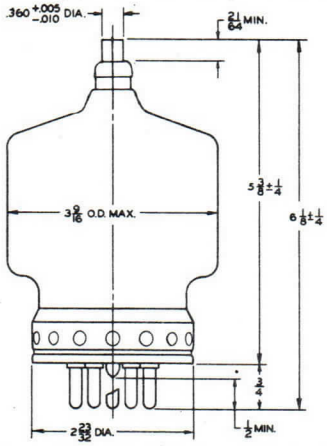
RFC-1, RFC-4 - 2.5 mh r-f choke.

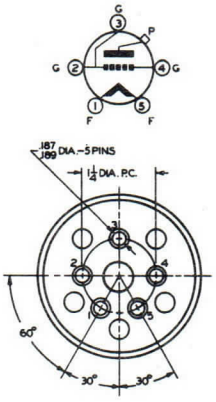
RFC-2 - Barker & Williamson FC-15 or FC-30, or equivalent, filament choke.

RFC-3 - 225 μh., 800 ma. r-f choke (National R-175A)

T-1 - Filament transformer (output voltage to be selected after determining voltage drop across filament choke).

Figure 3.





PL-6580

Power Triode

The PL-6580 is a 400-watt plate dissipation high-mu power triode designed especially for grounded-grid r-f amplifier service, but also capable of good performance in other applications. Because of its high amplification factor and high perveance, the PL-6580 will give power gains as high as ten as a grounded-grid amplifier. Effective shielding is provided within the PL-6580, and neutralization is not required in ordinary grounded-grid applications.

ELECTRICAL CHARACTERISTICS

Filament -- Thoriated Tungsten
- Voltage - 5.0 volts
- Current - 14.5 amperes

Amplification Factor - - - - - - - - - - - - - - - - - - - 45

Transconductance (E_b=2000 v, I_b=200 ma.) - - - - - - - - 6500 μmhos

Interelectrode Capacitances
- Grid-Filament (Input) - - - - - - - - - - - - - - - 7.6 μμf
- Grid-Plate (Output) - - - - - - - - - - - - - - - - 3.9 μμf
- Plate-Filament (Feedback) - - - - - - - - - - - - 0.10 μμf

MECHANICAL CHARACTERISTICS

Base - Giant 5-pin, Metal Shell

Basing - See base diagram

Maximum Overall Dimensions
- Length - 6.38 inches
- Diameter - 3.56 inches

Net Weight - 8 ounces

Mounting Position -- Vertical, base up or down

Recommended socket -- E. F. Johnson Co. No. 122-275, in conjunction with the PL-C1 glass chimney and socket cut-out as shown on page 4.

1 February 1965

Form 92C-131E

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

PL-6580

COOLING

Forced air cooling of the seals at the base end of the PL-6580 is required in all classes of service. A flow of 5 c.f.m. of cooling air should be passed through the base. Where the plate dissipation exceeds 250 watts, envelope cooling is also required. Adequate envelope cooling at 400 watts plate dissipation requires 15 c.f.m. of cooling air past the envelope and across the plate seal. Proper distribution of cooling air may be obtained by the use of a type PL-C1 glass chimney, with chassis cut out as shown on page 4.

RADIO-FREQUENCY OPERATION

The PL-6580 is especially suited for use as a grounded-grid radio-frequency amplifier. The compact construction and low plate-to-filament capacitance make neutralization unnecessary in ordinary grounded-grid applications.

For every value of plate voltage, there is an optimum value of zero-signal plate current at which maximum linearity and minimum third-order intermodulation distortion will be realized. The PL-6580 can be operated over a wide range of plate voltages with excellent linearity by means of properly adjusting the bias voltage to obtain the correct zero-signal plate current. Zero-signal plate current values for typical plate voltages are given in the tabular data.

A typical grounded-grid amplifier circuit is shown in Figure 3. The grid is by-passed to ground, and supplied only with d-c bias voltage. Radio-frequency excitation is applied between filament and ground, and output is taken from the plate-to-ground circuit. The excitation circuit and the output circuit are in series, via the tube, and a portion of the output power "fed through" from the driving circuit is related to the ratio of tube excitation voltage to output voltage. The fed-through power is minimized by using a tube with a high amplification factor, so that minimum r-f grid voltage is required. A further improvement in the power gain of a grounded-grid amplifier is obtained by using the highest possible plate voltage, since the ratio of r-f output to excitation voltage is thereby increased.

In addition to the fed-through power, the r-f driving source must supply power for normal grid-driving purposes. This power is dissipated in the bias supply and at the grid of the tube, and does not appear in the output circuit. The power lost is ordinarily on the order of one-fiftieth of the output power.

During the portion of the radio-frequency cycle in which plate current flows, heavy demands are made upon the driving source for the grounded-grid amplifier to supply r-f cathode current. This current may be four to six times the average plate current, and unless adequate energy storage (Q) is provided in the driving circuit, distortion of individual cycles of the r-f driving wave can occur, with a consequent serious lowering of efficiency.

It is recommended that the tuned circuit driving the PL-6580 have a loaded Q of at least five, to minimize driving-wave distortion. Figure 1 shows the minimum amount of grid-cathode tank circuit capacitance required for proper Q at frequencies in the 2-to-60 Mc. region. Additional capacitance up to two or three times the recommended minimum may be used, if desired. The input circuit inductance should be selected to resonate at the operating frequency with the capacitance in use.

Where a pi-network coupling circuit is used to feed the PL-6580 from a low-impedance line, as shown in the circuit of Figure 3, the capacitance at the tube end of the network should be equal to or greater than the recommended minimum shown in Figure 1. The average input impedance of the PL-6580 is given by:

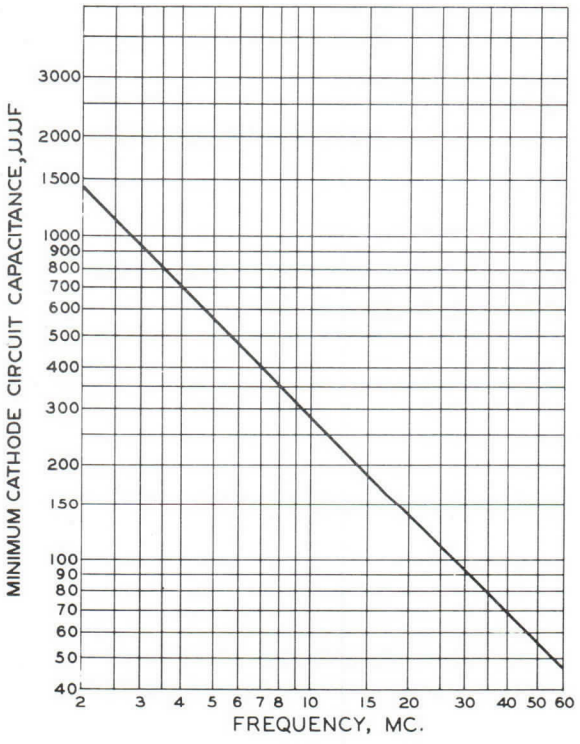


FIG. 1

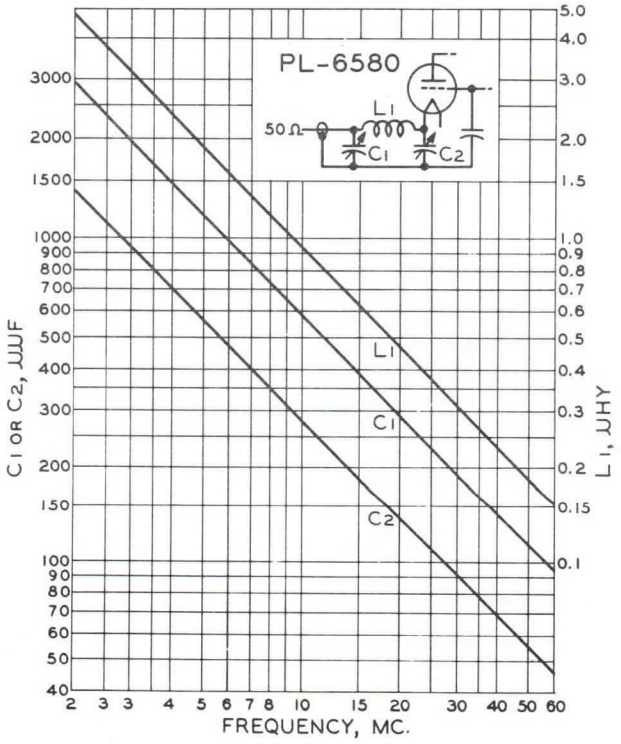


FIG. 2

$$Zin = \frac{(\text{peak r-f driving power})^2}{2 \times \text{driving power}},$$

and this value should be used in calculating the inductance and input-end capacitance of the pi-network driving circuit. Values for the peak r-f driving voltage and driving power for a number of operating conditions will be found in the tabular data. For practical purposes, the input impedance of the PL-658C may be taken as 300 ohms in most applications.

Figure 2 shows suggested pi-network capacitance and inductance values for a network feeding the PL-6580 from a 50-ohm non-resonant line.

The grid of the PL-6580 terminates in three base pins. The corresponding three socket terminals should be connected together with a low-inductance connection, and by-passed to chassis with a short low-inductance lead and a low-inductance capacitor. Multiple by-pass capacitors may be used if desired, but will not ordinarily be found necessary.

Filament power for the PL-6580 should be supplied through suitable filament chokes, as indicated in Figure 3. The reactance of the chokes should be several times the input impedance of the amplifier and wound with wire of sufficient size to carry the filament current. It may be found necessary to employ a filament transformer delivering more than the rated filament voltage, to compensate for the voltage drop across the chokes. Examples of commercially-available filament chokes are the Barker and Williamson FC-15 (15 amperes) and FC-30 (30 amperes). The current requirements for filament chokes may be reduced by placing them in the primary of the filament transformer, and isolating the transformer from ground.[1]

When the PL-6580 is used as a grounded-grid linear amplifier of modulated power, the loading presented to the driving source makes additional "swamping" unnecessary Typical operating conditions for the PL-6580 as an amplifier of single-sideband, suppressed carrier power are given in the tabular data. The typical operating conditions shown are for continuously applied sinusoidal modulation. Increased output without excessive plate dissipation may be obtained with intermittent modulation having a high ratio of peak-to-average power, such as normal speech. In such cases, increased plate circuit loading and increased drive should be used. The average plate dissipation should not be allowed to exceed 400 watts, except momentarily during adjustment procedures.

[1] See "Notes on Grounded-Grid RF Power Amplifiers" (Pucket), QST, December 1954, pg. 36, or 1962 A.R.R.L. Handbook, pg. 165.

MAXIMUM RATINGS — CCS (Continuous Commercial Service)

	Class-C FM or CW	*Class-C Plate Mod.*	*Class-B R-F or Audio*	
D-C Plate Voltage	4000	3200	4000	volts
D-C Plate Current	350	275	350	ma.
D-C Grid Current	120	120	120	ma.
Plate Dissipation	400	270	400	watts

TYPICAL OPERATION — Class C C-W or FM Amplifier

(Grounded-Grid Circuit)

D-C Plate Voltage	2500	3000	4000	volts
D-C Grid Voltage	-70	-90	-110	volts
D-C Plate Current	350	350	350	ma.
D-C Grid Current	95	82	92	ma.
Peak R-F Driving Voltage	210	215	265	volts
Driving Power (approx.)[1]	85	87	105	watts
Plate Power Input	875	1050	1400	watts
Plate Dissipation	280	375	400	watts
Power Output	660	745	1080	watts

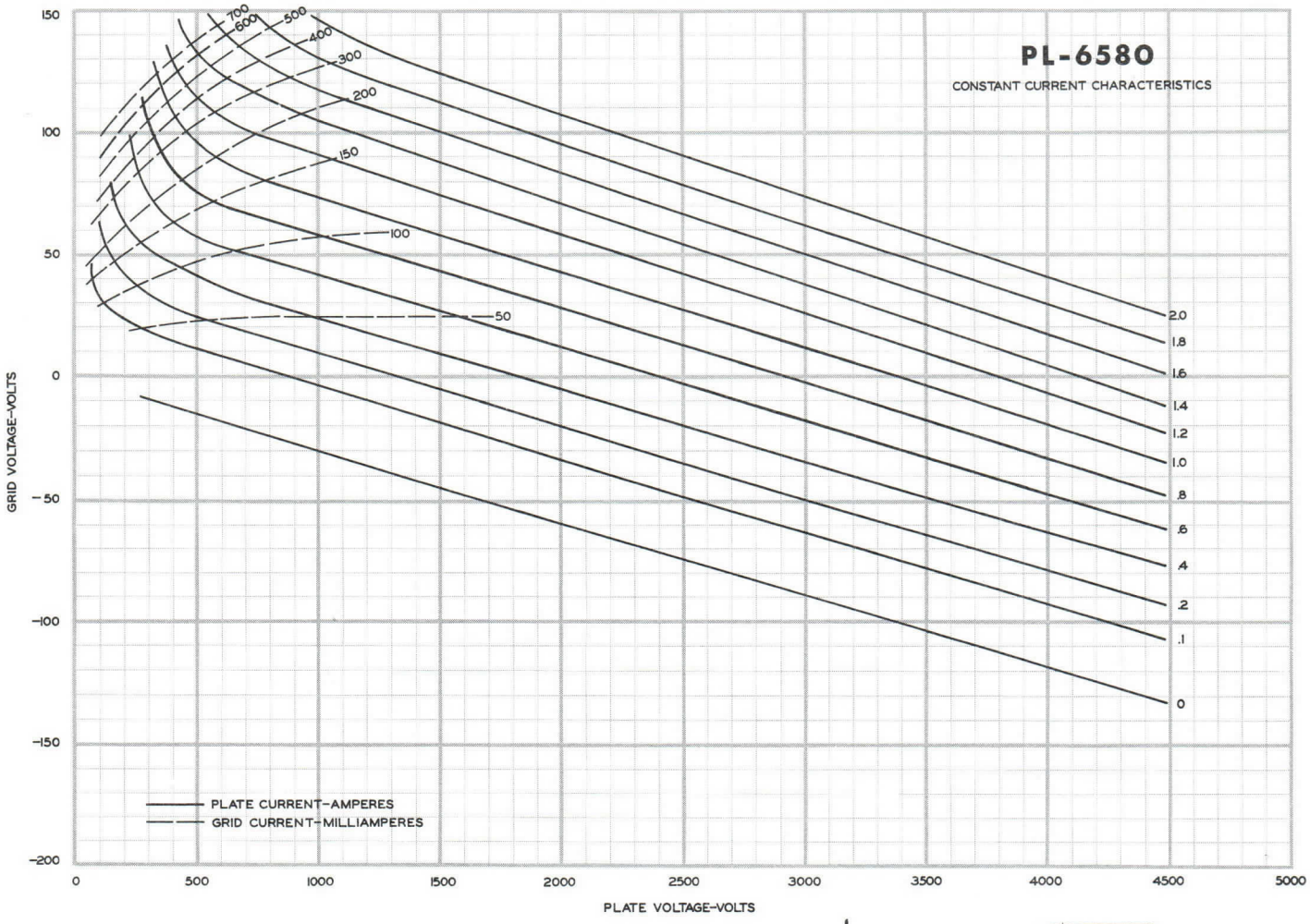
TYPICAL OPERATION — Class B Linear R-F Amplifier

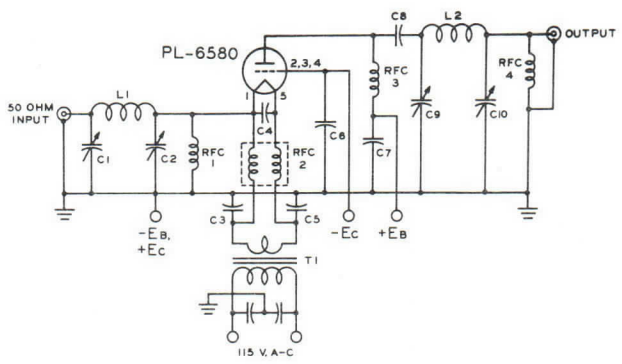
Single-Sideband, Suppressed Carrier; Grounded-Grid Circuit

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Grid Voltage[2]	-50	-70	-85	-100	volts
Zero-Sig. D-C Plate Current	60	50	45	40	ma.
Max.-Sig. D-C Plate Current[3]	350	335	300	300	ma.
Max.-Sig. D-C Grid Current[3]	95	80	65	65	ma.
Max.-Sig. Peak R-F Driving Voltage[3]	195	205	210	230	volts
Max.-Sig. Driving Power (approx.)[1, 3]	75	73	68	72	watts
Max.-Sig. Plate Power Input[3]	875	1000	1050	1200	watts
Max.-Sig. Plate Dissipation[3]	320	335	335	350	watts
Max.-Sig. Power Output[3]	610	720	765	910	watts

1 Includes bias loss, grid dissipation, and feed-through power.
2 Approximate value -- adjust to give stated zero-signal plate current.
3 Max.-Sig. values for peak conditions, or for single-tone modulation at full signal.

PL-6580





C1, C2 - See Figure 2.

C3, C5 - .01 μfd., 500 volts; mica.

C4, C6 - .002 μfd., 1000 volts; mica.

C7, C8 - .002 μfd. high-voltage blocking capacitor.

C9, C10 - Capacitors appropriate for use in pi network at desired operating frequency.

L1 - See Figure 2.

L2 - Coil appropriate for use in pi network at desired operating frequency.

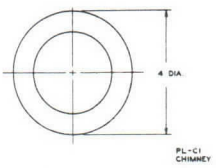
RFC-1, RFC-4 - 2.5 mh r-f choke.

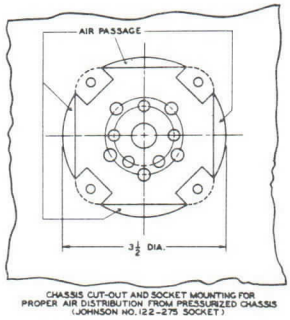
RFC-2 - Barker & Williamson FC-15 or FC-30, or equivalent, filament choke.

RFC-3 - 225 μh., 800 ma. r-f choke (National R-175A)

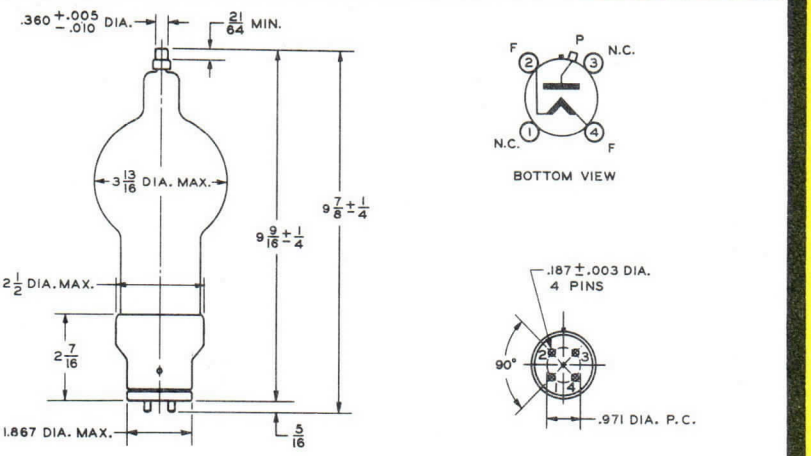
T-1 - Filament transformer (output voltage to be selected after determining voltage drop across filament choke).

Figure 3





CHASSIS CUT-OUT AND SOCKET MOUNTING FOR PROPER AIR DISTRIBUTION FROM PRESSURIZED CHASSIS (JOHNSON NO. 122-275 SOCKET)



PL-250R
High-Vacuum Rectifier

DESCRIPTION

The PL-250R is a high-vacuum diode rectifier utilizing an instant-heating thoriated-tungsten filament. The tube is suitable for use as a high-voltage rectifier, clipping diode, and charging diode. The PL-250R does not normally require the use of forced air for adequate cooling.

MECHANICAL CHARACTERISTICS

Base[1]	Jumbo 4-pin, JETEC A4-29
Maximum Overall Dimensions	
Length	9.82 inches
Diameter	3.82 inches
Net Weight (average)	10 ounces
Mounting Position	Vertical, base up or down

ELECTRICAL CHARACTERISTICS

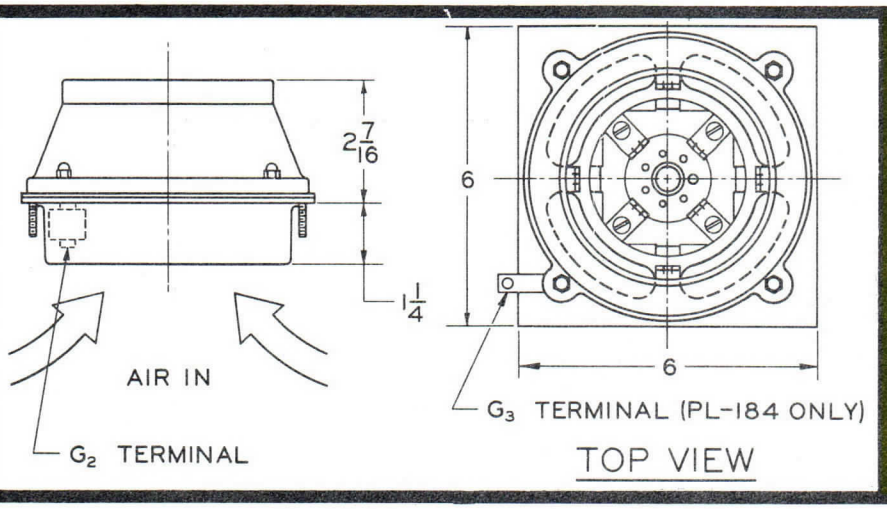
Filament -- Thoriated Tungsten	
Voltage	5.0 volts
Current	10.5 amperes

MAXIMUM RATINGS – CCS (Continuous Commercial Service)

Peak Inverse Plate Voltage	60,000 max. volts
Plate Dissipation	150 max. watts
D-C Plate Current	250 max. ma.
Peak Plate Current	2.5 max. amperes

1 Fits E. F. Johnson Co. No. 123-211 socket.

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA



PL-184 and PL-184A

Sockets for PL-8295 (PL-172) and PL-8295A

The PL-184 and PL-184A sockets provide electrical connections and air-flow directing means for the PL-8295(PL-172) and PL-8295A beam pentodes. The socket includes contact provisions for all base pins and the screen-grid and suppressor-grid ring terminals.

Proper use of the socket requires that it be mounted in an aperature in a pressurized chamber, such as a chassis. The drawing on the opposite side of this sheet gives dimensions of the chassis cut-out necessary to accomodate the socket. Proper cooling of the PL-8295(PL-172) will be obtained with a static pressure within the chassis equal to 0.28 inches of water. A static pressure of 0.09 inches of water is required for cooling of the PL-8295A. Suitable precautions should be taken to ascertain that cooling air is delivered uniformly to the bottom of the socket, to prevent non-uniform air flow through the socket and tube.

Radio-frequency by-pass capacitors for the screen grid are built into the PL-184 and PL-184A sockets. The PL-184 also has a built-in suppressor grid radio-frequency by-pass capacitor. The suppressor grid contacts are grounded on the PL-184A socket.

ELECTRICAL DATA

	PL-184	PL-184A
Screen-grid By-Pass Capacitance	2000 μμfd.	2000 μμfd.
Suppressor-grid By-Pass Capacitance	2500 μμfd.*	grounded

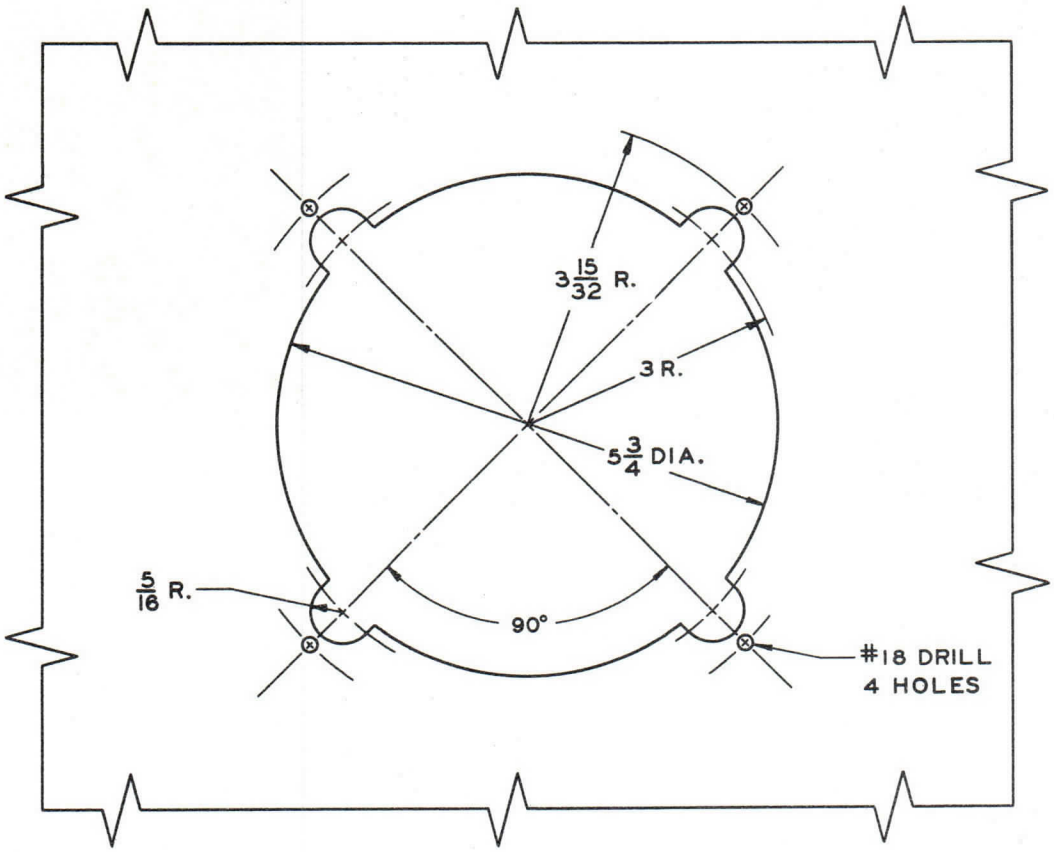
MECHANICAL DATA

Maximum Overall Dimensions	6 x 6 x 3-11/16 inches
Weight	2 pounds

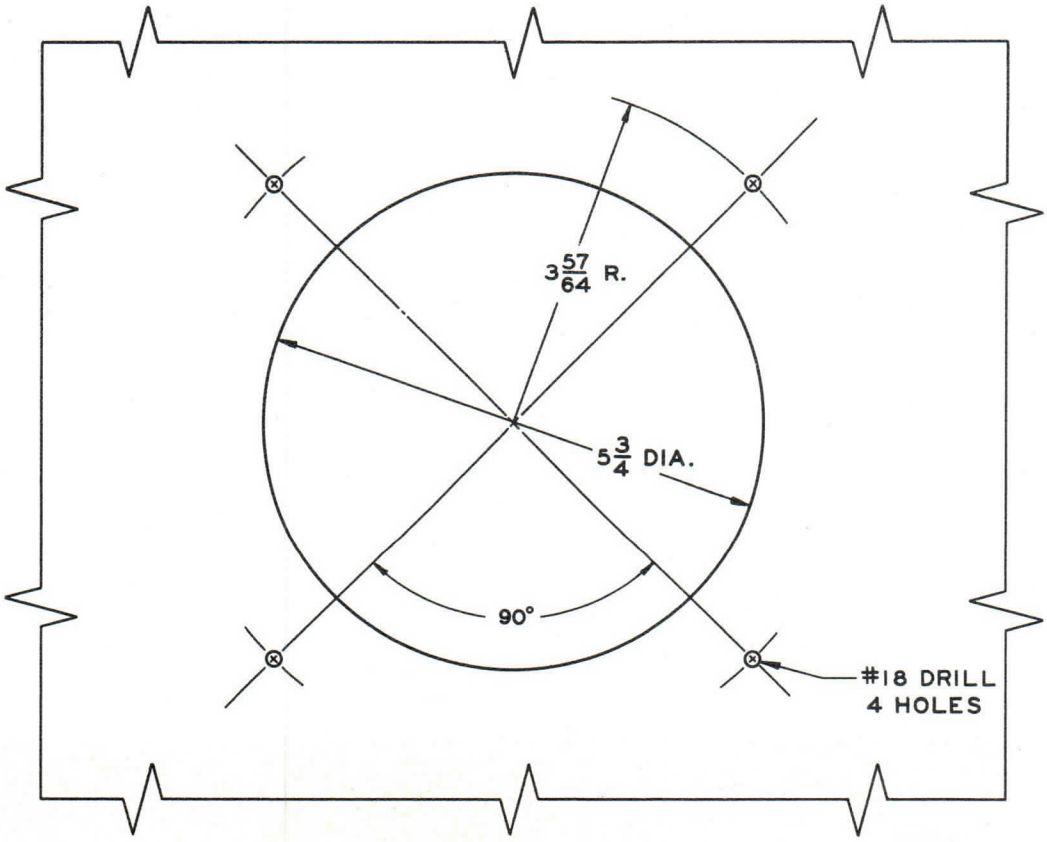
*Supplementary suppressor-grid by-pass capacitance, by means of fixed mica capacitor, desirable at frequencies below 30 Mc.

1 December 1962 Form 518R-5

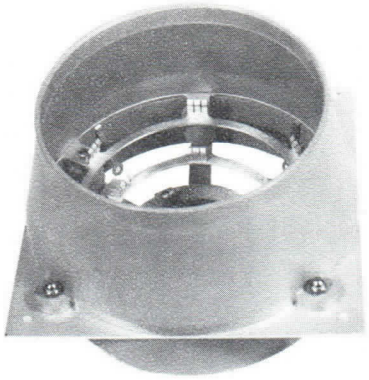
PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

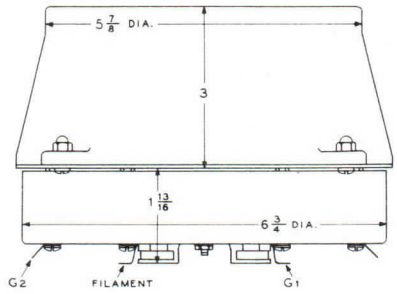


CHASSIS CUTOUT FOR PL-184



CHASSIS CUTOUT FOR PL-184A





PL-205A
Socket

Socket for Penta PL-195 Beam Pentode

DESCRIPTION

The PL-205A socket, for use with the Penta PL-195 beam pentode, provides all necessary electrical connections and assures the proper flow of cooling air. The socket includes contacts for all base pins and for the control-grid, screen-grid, and suppressor-grid ring terminals.

The socket should be mounted in an aperture in a pressurezed chamber, such as a chassis. The dimensions of the chassis cut-out necessary to accommodate the PL-205A socket are given on the opposite side of this sheet. Cooling air must be delivered uniformly to the bottom of the socket, to insure the uniform flow of air through the socket and the tube cooler.

Cooling requirements* for the PL-195 are as follows:

Plate Dissipation (Watts)	Air Flow (c.f.m.)	Pressure (Inches of Water)
3000	70	0.26
4000	110	0.45

*(At sea level, 50° C. maximum incoming air temperature. Pressure drop includes drop across PL-205A socket.)

Radio-frequency by-pass capacitors for the screen-grid are built into the PL-205A socket. The suppressor grid contacts are grounded to the frame of the socket.

ELECTRICAL DATA

Screen-Grid By-Pass Capacitance - - - - - - - - - - - 4000 μμfd.

MECHANICAL DATA

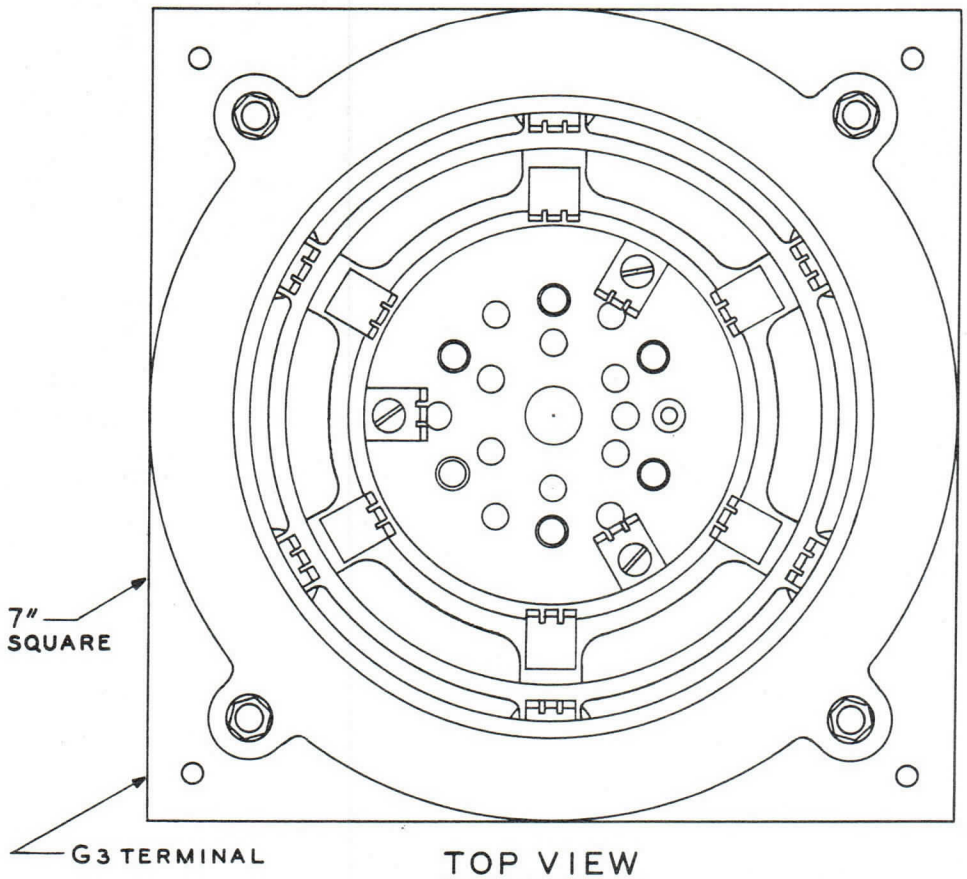
Maximum Overall Dimensions - - - - - - - 7 x 7 x 4-13/16 inches

Weight - 3 pounds

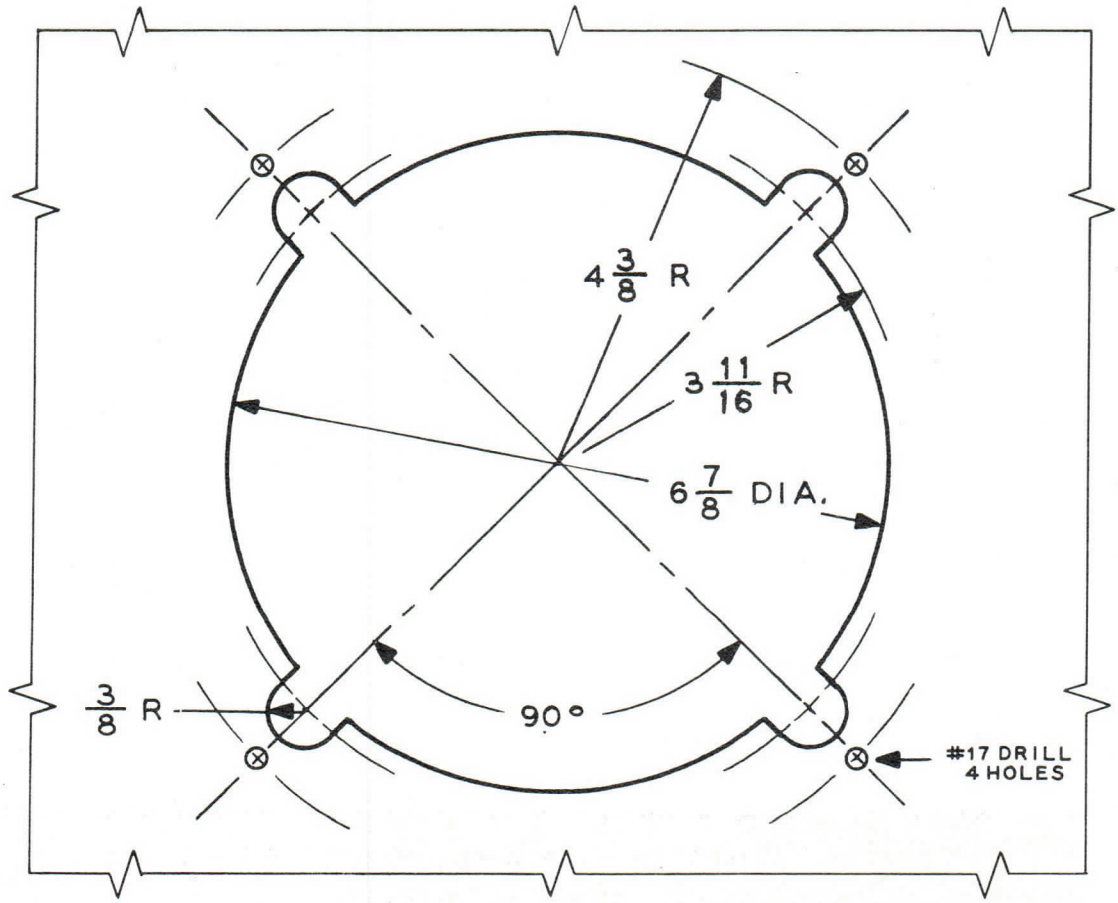
THE PENTA LABORATORIES, INC.

A SUBSIDIARY OF RAYTHEON COMPANY

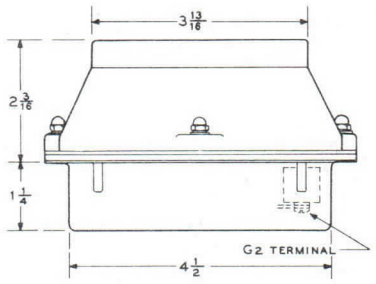
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102



TOP VIEW



CHASSIS CUTOUT FOR PL-205A



PL-209A
Socket

Socket for Penta PL-8432 Beam Pentode

DESCRIPTION

Electrical connections and air-flow directing means for the PL-8432 ceramic beam pentode are provided by the PL-209A socket. Included in the socket are contact provisions for all base pins and the screen-grid and suppressor-grid ring terminals.

Proper use of the socket requires that it be mounted in an aperture in a pressurized chamber, such as a chassis. The drawing on the opposite side of this sheet gives dimensions of the chassis cut-out necessary to accommodate the socket.

When installed in the PL-209A socket, proper cooling of the PL-8432, at 1000 watts plate dissipation and with a maximum incoming air temperature of 40° C., will be obtained with 37 c.f.m. of air at a pressure drop of 0.18 inches of water column. Suitable precautions must be taken to assure that the cooling air is delivered uniformly to the bottom of the socket, to insure the uniform flow of air through the socket and the tube cooler.

Radio-frequency by-pass capacitors are built into the PL-209A socket. The suppressor grid contacts are grounded to the frame of the socket.

ELECTRICAL DATA

Screen-Grid By-Pass Capacitance - - - - - 2000 μμfd.

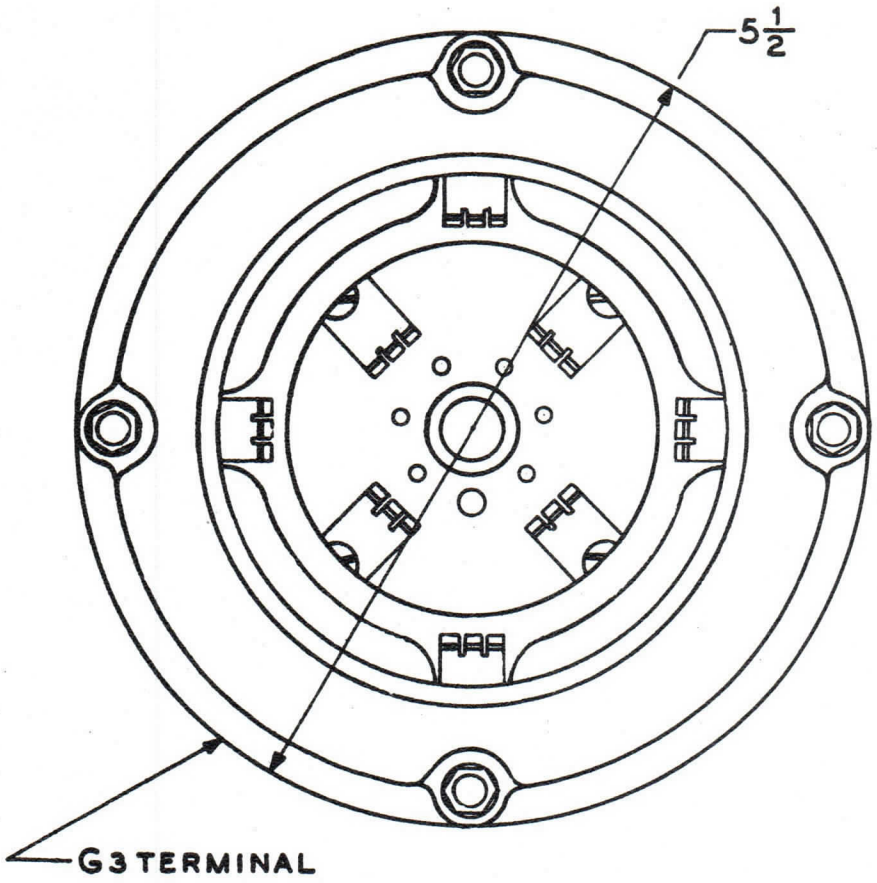
MECHANICAL DATA

Maximum Overall Dimensions - 6 in. dia. x 3-7/16 inches

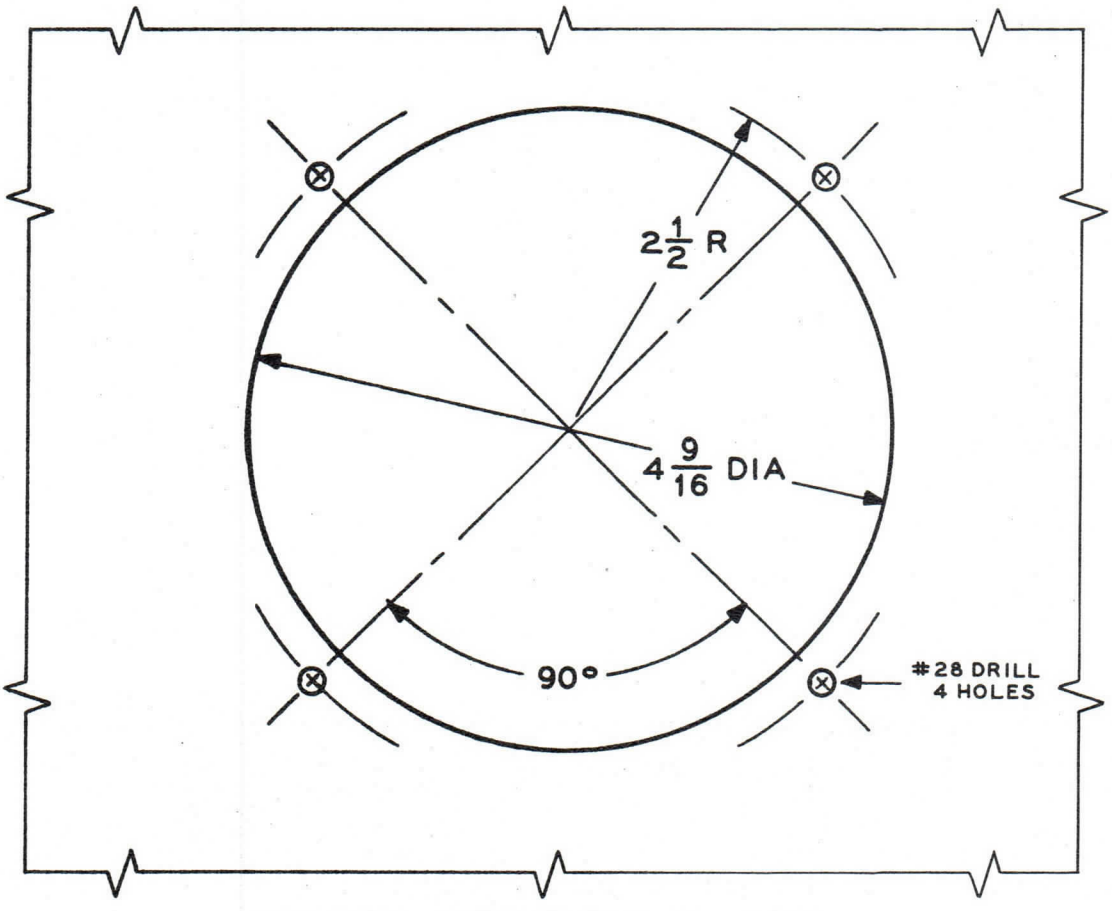
Weight - 1-1/2 pounds

THE PENTA LABORATORIES, INC.
A SUBSIDIARY OF RAYTHEON COMPANY
312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

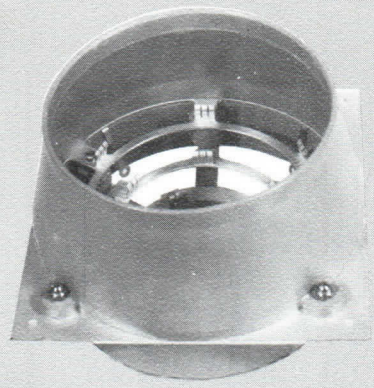
PL-209A

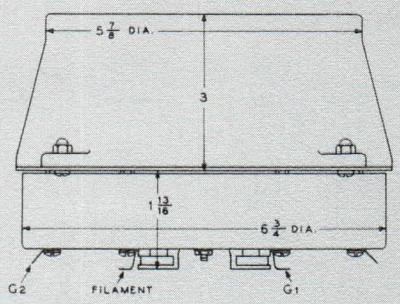


TOP VIEW



CHASSIS CUTOUT FOR PL-209A





PL-261A
Socket

Socket for PL-210 Beam Pentode

DESCRIPTION

The PL-261A socket provides all necessary electrical connections and assures the proper flow of cooling air for the Penta PL-210 beam pentode. Contacts are included for all base pins and the control-grid, screen-grid, and suppressor-grid ring terminals.

Proper use of the socket requires that it be mounted in an aperture in a pressurized chamber, such as a chassis. The drawing on the opposite side of this sheet provides the dimensions of the chassis cut-out necessary to accommodate the PL-261A socket. It is essential that the cooling air be delivered uniformly to the bottom of the socket, to insure proper flow of air through the socket and tube cooler.

Cooling requirements* for the PL-210 are as follows:

Plate Dissipation (Watts)	*Air Flow (c.f.m.)*	*Pressure (Inches of Water)*
3000	85	0.28
5000	170	0.95

*(At sea level, 50° C. maximum incoming air temperature. Pressure drop includes drop across PL-261A socket.)

Radio-frequency by-pass capacitors for the screen grid are built into the PL-261A socket. The suppressor grid contacts are grounded to the frame of the socket.

ELECTRICAL DATA

Screen-Grid By-Pass Capacitance . . . . . 4000 $\mu\mu$fd

MECHANICAL DATA

Maximum Overall Dimensions . . . . . 7 x 7 x 4 13/16 inches

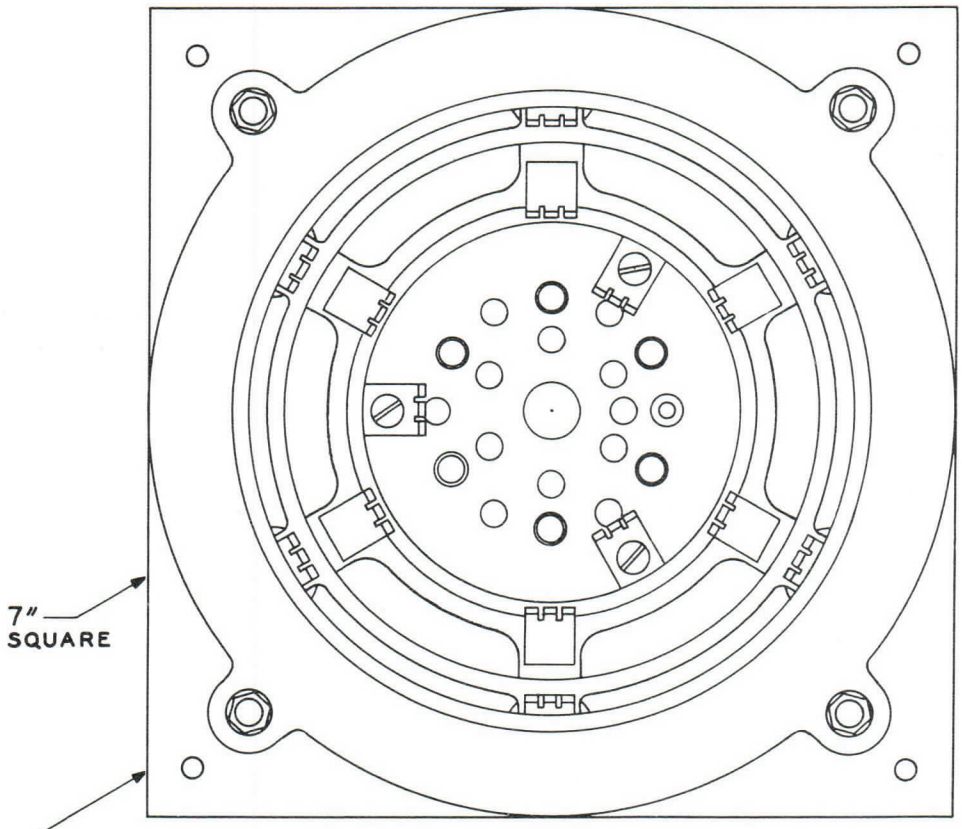
Weight . . . . . 3 pounds

THE PENTA LABORATORIES, INC.

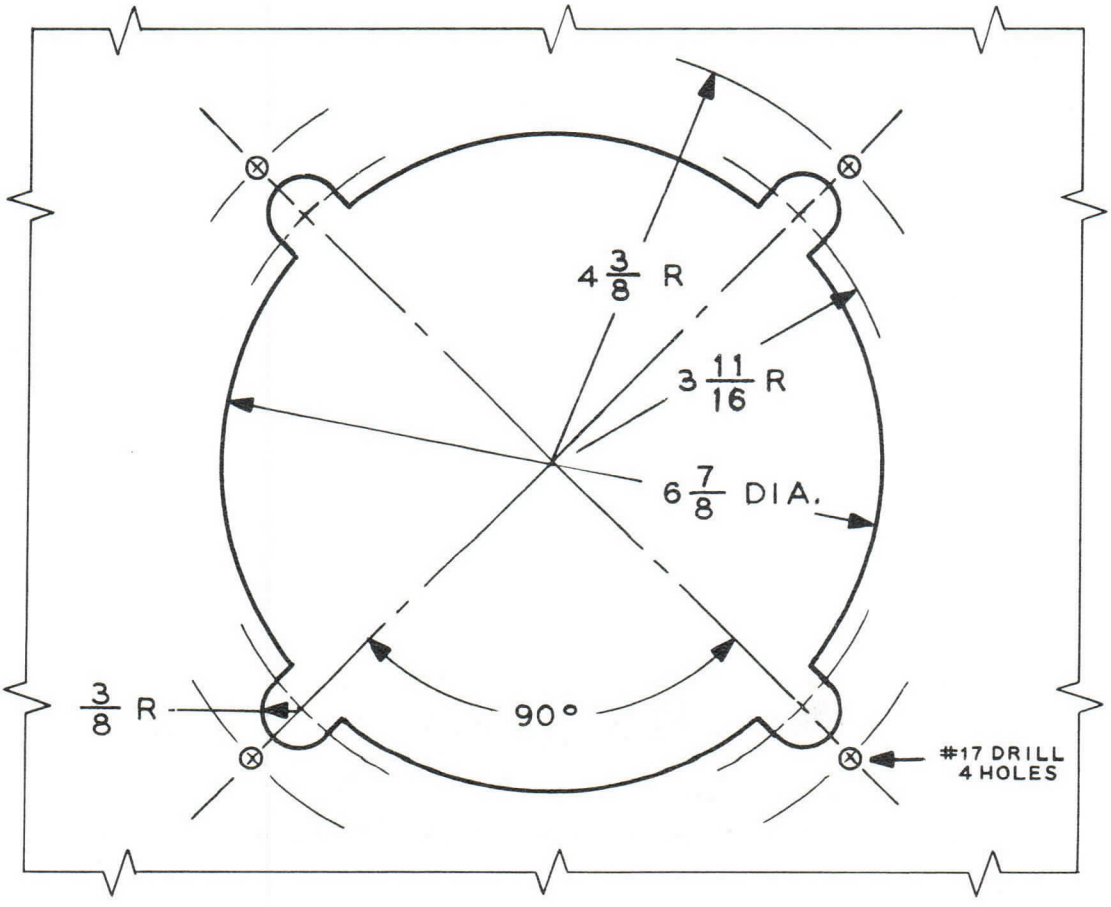
A SUBSIDIARY OF RAYTHEON COMPANY

312 N. NOPAL STREET • SANTA BARBARA, CALIFORNIA 93102

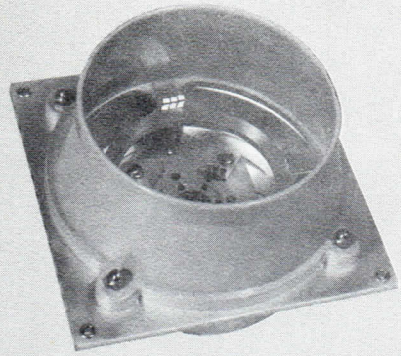
PL-261A

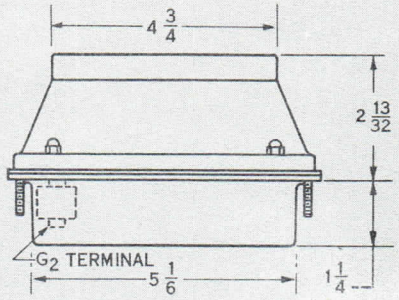


TOP VIEW



CHASSIS CUTOUT





PL-265A Socket

Socket for PL-8576/PL-264 Beam Pentode

DESCRIPTION

The PL-265A socket provides electrical connections and air-flow directing provisions for the Penta PL-8576/PL-264 ceramic beam pentode. The socket includes contacts for all base pins and for the screen-grid and suppressor-grid ring terminals.

Proper use of the socket requires that it be mounted in an aperture in a pressurized chamber, such as a chassis. The dimensions of the chassis cut-out necessary to accommodate the PL-265A socket are given on the reverse side of this data sheet. Cooling air must be delivered uniformly to the bottom of the socket, to prevent uneven air flow through the socket and tube cooler.

Cooling requirements* for the PL-8576/PL-264 are as follows:

Plate Dissipation (Watts)	Air Flow (c.f.m.)	Pressure Drop (Inches of Water)
2000	67	0.43
3000	108	0.95

*(At sea level, 50° C. maximum incoming air temperature. Pressure drop includes drop across PL-265A socket.)

Radio-frequency by-pass capacitors for the screen grid are built into the PL-265A socket. The suppressor-grid contacts are grounded to the frame.

ELECTRICAL DATA

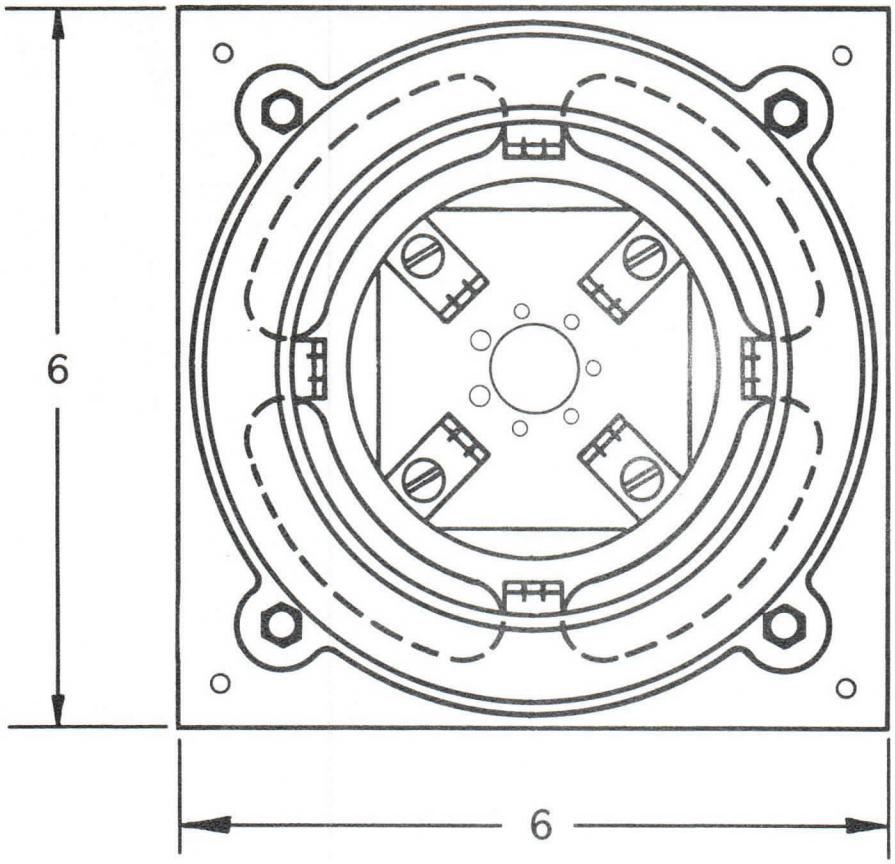
Screen-Grid By-Pass Capacitance . . . . . 2000 μμfd

MECHANICAL DATA

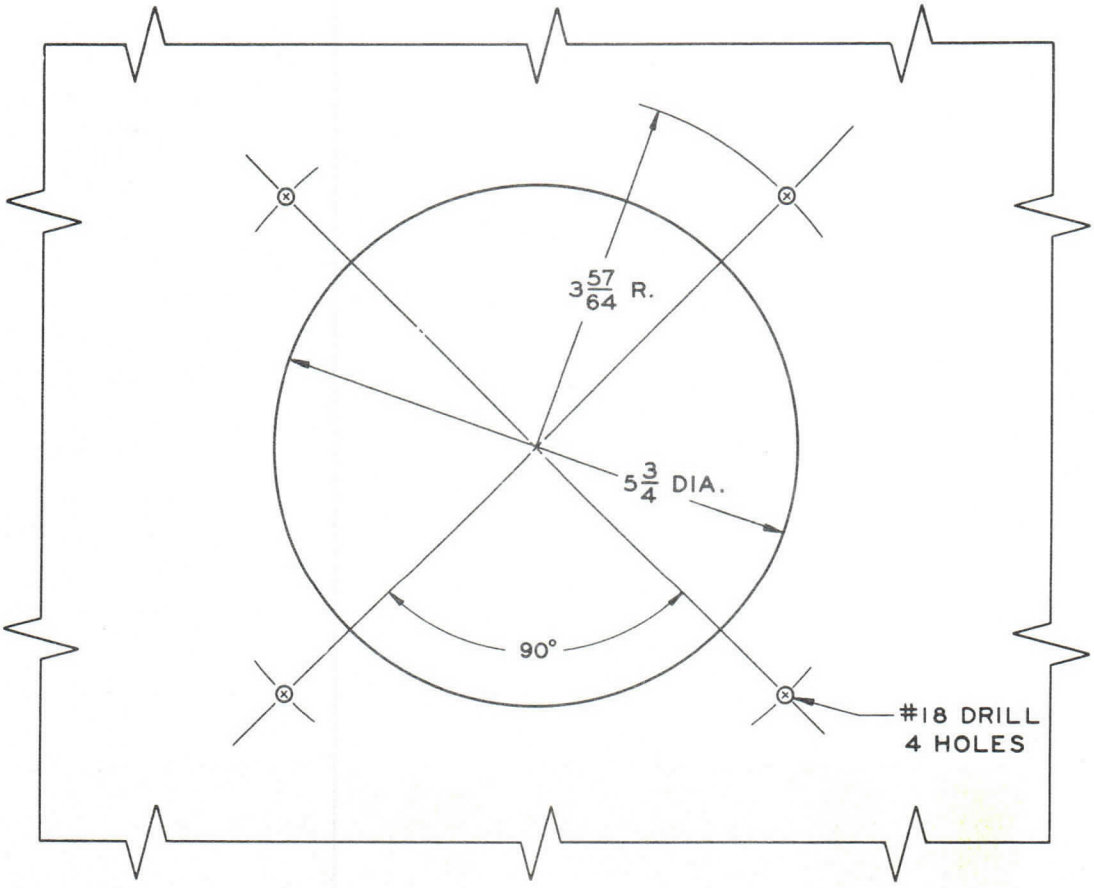
Maximum Overall Dimensions . . . . . 6 x 6 x 3-21/32 inches

Weight . . . . . 1-3/4 pounds

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA



TOP VIEW



CHASSIS CUTOUT FOR PL-265A

Vacuum Switches

Penta vacuum switches are single-pole, double-throw switches enclosed in evacuated glass envelopes. They are ideal for use wherever compact, fast-acting relays are required to switch high-voltage circuits under a wide range of ambient atmospheric conditions, including explosive atmospheres, and in other applications where exposed-contact relays would be unsuitable.

These vacuum switches are operated by external actuating coils, which are excited by direct current and designed so that the soft-iron pole piece and the armature assembly enclosed in the envelope act to complete the magnetic circuit.

Two types of Penta vacuum switches are available with coils. All other types are supplied without coils. Penta does not supply the actuating coils separately. Suitable coils can be purchased from:

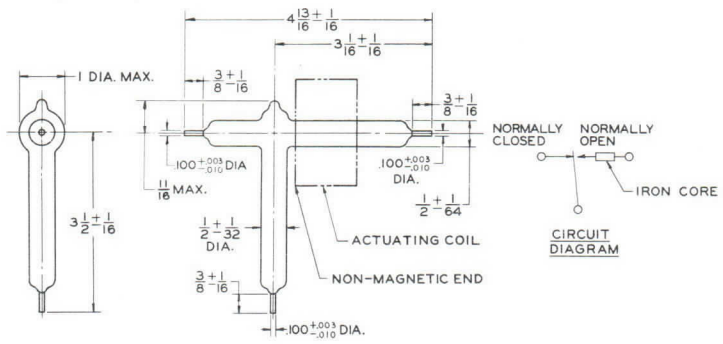
Tur-Bo Jet Products
424 So. San Gabriel Blvd.
San Gabriel, California

The applicable Tur-Bo Jet coil number is listed in this catalog for each vacuum switch for which Penta does not supply a coil.

PENTA LABORATORIES, INC.
312 NORTH NOPAL STREET • SANTA BARBARA, CALIFORNIA

16 April 1962 Form 541R

PL-R1



The PL-R1 is especially suited to antenna changeover and pulse network switching applications, and is widely used in compact military equipment.

ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts)	21,000 volts
Peak-Current Rating (pulses, 5 μs. max.)	150 amperes
Average-Current Rating (60 cycles a-c)	6 amperes
Required Coil * (not supplied)	1,100 ampere-turns
Contact Arrangement	Single-Pole, Double-Throw

MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions	
Length	4.88 inches
Width	4.25 inches
Net Weight (maximum)	2 ounces

* Tur-Bo Jet #HAC-420-53-3876
(28 volts d-c, nominal, @ 255 ma)

PL-169A

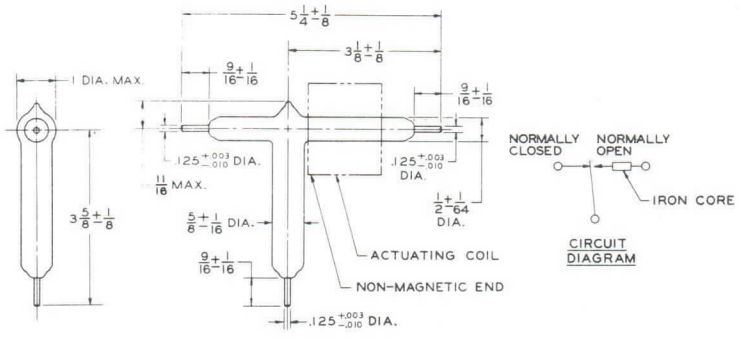
ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts)	21,000 volts
Peak-Current Rating (pulses, 1 ms maximum)	500 amperes
Average-Current Rating (60 cycles a-c)	30 amperes
Required Coil * (not supplied)	1,900 ampere-turns
Contact Arrangement	Single-Pole, Double-Throw

MECHANICAL CHARACTERISTICS

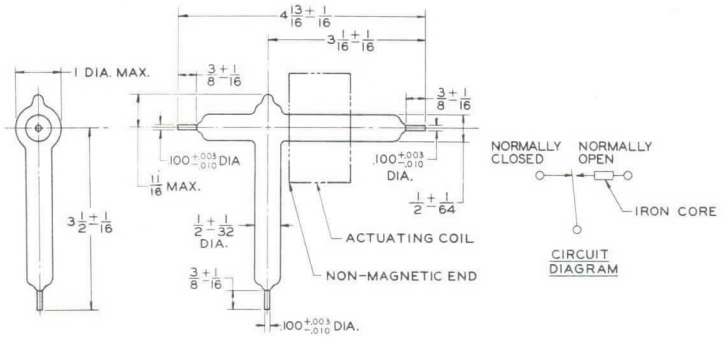
Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions	
Length	5.38 inches
Width	4.33 inches
Net Weight (maximum)	3 ounces

* Tur-Bo Jet #TJ27-43
(28 volts d-c, nominal, @ 650 ma)



The Penta PL-169A vacuum switch is designed for use in high-voltage transfer applications in which a compact switch is required for transfer between circuits, or for low-voltage switching use where exposed-contact switches are unsuitable.

PL-186



Copper plating is used extensively in the PL-186, to insure minimum losses when used in r-f applications. The PL-186 is widely used in aircraft communications equipment, and is well suited for antenna changeover applications.

ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts)	21,000 volts
Peak-Current Rating (pulses)	Not Rated
Average-Current Rating (60 cycles a-c)	6 amperes
Required Coil * (not supplied)	1,000 ampere-turns
Contact Arrangement	Single-Pole, Double-Throw

MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions	
Length	4.88 inches
Width	4.25 inches
Net Weight (maximum)	2 ounces

* Tur-Bo Jet #TJ28-48
(28 volts d-c, nominal, @ 580 ma)

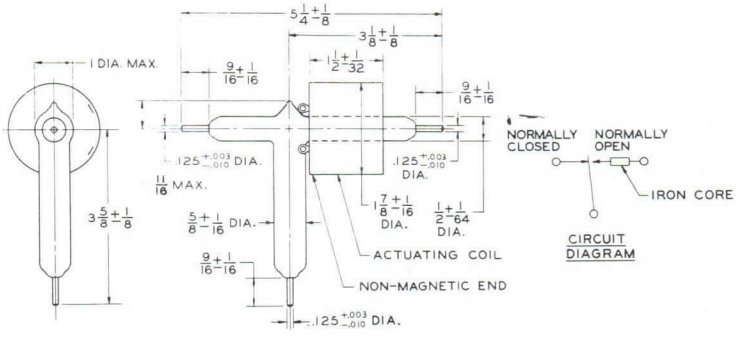
PL-187

ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts	21,000 volts
Peak-Current Rating (pulses, 1 ms maximum)	500 amperes
Average-Current Rating (60 cycles a-c)	30 amperes
Coil Voltage (d-c nominal)	28 volts
Coil Current	650 ma
Contact Arrangement	Single-Pole, Double-Throw

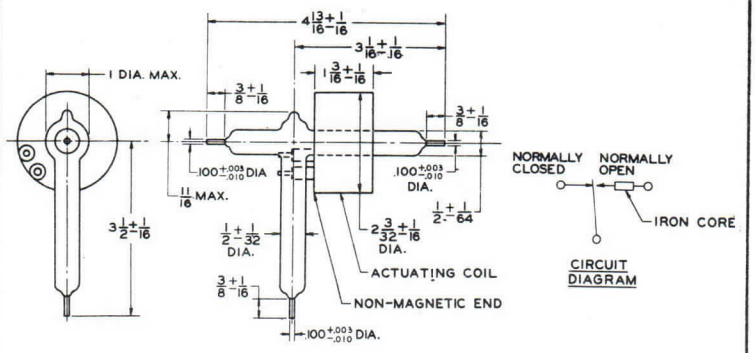
MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions	
Length	5.38 inches
Width	4.72 inches
Net Weight (maximum)	15 ounces



The PL-187 is identical to the PL-169A, except that it is supplied with the actuating coil, mounted on the switch.

PL-190



The Penta PL-190 vacuum switch is identical to the PL-R1, except that it is supplied with the actuating coil, mounted on the switch.

ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts)	21,000 volts
Peak-Current Rating (pulses, 5 μs max.)	150 amperes
Average-Current Rating (60 cycles a-c)	6 amperes
Coil Voltage (d-c, nominal)	28 volts
Coil Current	255 ma
Contact Arrangement	Single-Pole, Double-Throw

MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions	
Length	4.88 inches
Width	4.64 inches
Net Weight (maximum)	15 ounces

PL-191

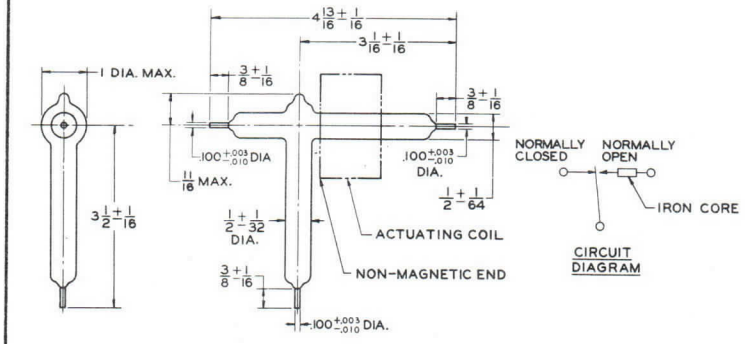
ELECTRICAL CHARACTERISTICS

Peak-Voltage Rating (between open contacts)	21,000 volts
Peak-Current Rating (pulses)	Not Rated
Average-Current Rating (60 cycles a-c)	3 amperes
Required Coil * (not supplied)	1,000 ampere-turns
Contact Arrangement	Single-Pole, Double-Throw

MECHANICAL CHARACTERISTICS

Mounting Position	Any
Terminal Arrangement	See Drawing
Maximum Overall Dimensions	
Length	4.88 inches
Width	4.25 inches
Net Weight (maximum)	2 ounces

* Tur-Bo Jet #TJ28-48
(28 volts d-c, nominal, @ 580 ma)



The PL-191 is similar to the PL-186, but is economically designed for use in high-voltage transfer applications. It is also usable for antenna change-over applications.