



ELECTRONIC TUBE REFERENCE

104D

Voltage - Triode (single) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

TRIODE

Western Electric directly heated triode for professional electronic service. Available source material confirms its construction without establishing a narrower functional role confidently.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	4
NOMINAL HEATER	4.5 V / 1 A	PARALLEL HEATER	— / —
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Triode	
PLATE RESISTANCE	2100 Ω
TRANSCONDUCTANCE	0.00118 S
AMPLIFICATION FACTOR	2.5
MAXIMUM PLATE VOLTAGE	190 V
<i>Filamentary power-amplifier triode; replaces D-86327; dome bulb.</i>	

104D — Filamentary Power Amplifier Triode

The **104D** is a filamentary power amplifier triode designed primarily for telephone communication systems and precision testing applications. It serves as a direct replacement for the older D-86327 tube, retaining similar electrical characteristics while introducing structural and mechanical improvements. These enhancements include an improved filament design, transverse mica supports, and a dome-type glass envelope.

Mechanical Construction, Base, and Mounting

The 104D features a dome-type glass bulb with transverse mica supports to secure the internal electrode structure. The tube is fitted with a medium, four-pin bayonet-type base. The pins are finished with a special contact metal at their ends to ensure reliable electrical connections.

Mounting and Spacing

- **Mounting Position:** The tube can be mounted in either a vertical or horizontal position. When mounted horizontally, the plane of the filament must be oriented vertically.
- **Ventilation:** To ensure adequate heat dissipation and ventilation, a minimum spacing of 2 5/8 inches between tube centers must be maintained when operating multiple tubes in proximity.
- **Socket Compatibility:** The base is designed to fit Western Electric 100L, 100R, or similar socket types, preferably those equipped with matching contact-metal contacts.

Physical Dimensions

- **Maximum Overall Height:** 4 1/2 inches
- **Maximum Bulb Diameter:** 1 13/16 inches
- **Maximum Base Diameter:** 1.474 inches

Filament Ratings and Characteristics

The 104D utilizes an oxide-coated filament designed to operate on a current-regulated basis.

Parameter	Value
Filament Current	1.00 A D.C.
Nominal Filament Voltage	4.5 V
Cathode Type	Oxide-Coated Filament (O-F)

The filament must be operated as close to its rated current of 1.00 A as practicable. During the first 2000 hours of service, the filament resistance increases slightly; the nominal voltage rating of 4.5 V represents the stabilized value after this initial burn-in period. Grid and plate voltages are referenced from the negative terminal of the filament.

Electrical Characteristics and Interelectrode Capacitances

The average direct interelectrode capacitances of a based 104D tube, measured without a socket, are as follows:

- **Grid to Plate:** 4.9 $\Delta\Delta f$ (pF)
- **Grid to Filament:** 4.1 $\Delta\Delta f$ (pF)

- **Plate to Filament:** 3.4 $\Delta\Delta f$ (pF)

Class A Operating Characteristics

At a typical Class A operating point (130 V plate, -20 V grid), the tube exhibits the following average characteristics:

- **Amplification Factor (Δ):** 2.5
- **Plate Resistance (r_p):** 2100 Δ
- **Transconductance (g_m):** 1180 Δ mhos
- **Plate Current (I_b):** 25.0 mA
- **Power Output:** 150 mW into a matching 2100 Δ load, or 125 mW into a 5000 Δ load.

Operating Conditions and Performance

The permissible operating region for plate and grid voltages is bounded by a specific operating area. Operating the tube within recommended limits is preferred to maximize service life, as operation at maximum ratings accelerates filament depletion and shortens tube life.

The following table details the recommended and maximum operating conditions, along with the corresponding output power and harmonic distortion levels. The performance data is specified for two load conditions: a load resistance equal to the plate resistance ($R_L = r_p$) and a standard load of 5000 Δ .

Operating Points Table

Plate Voltage (V)	Grid Bias (V)	Plate Current (mA)	Amplification Factor	Plate Resistance (Δ)	Transconductance (Δ mhos)	Load Resistance (Δ)	Power Output (mW)	Second Harmonic (dB)	Third Harmonic (dB)
Recommended									
100	-20	12.5	2.4	2700	890	2700 / 5000	110 / 100	23 / 28	50 / 65
100	-10	22.5	2.6	2200	1160	2200 / 5000	38 / 32	34 / 38	60 / 65
130	-30	14.5	2.3	2600	900	2600 / 5000	250 / 225	22 / 25	47 / 75
130	-20	25.0	2.5	2100	1180	2100 / 5000	150 / 125	28 / 32	48 / 58

Plate Voltage (V)	Grid Bias (V)	Plate Current (mA)	Amplification Factor	Plate Resistance (Δ)	Transconductance (Δ mhos)	Load Resistance (Δ)	Power Output (mW)	Second Harmonic (dB)	Third Harmonic (dB)
130	-10	37.0	2.6	1800	1430	1800 / 5000	45 / 36	38 / 44	65 / 70
160	-45	13.0	2.3	2900	810	2900 / 5000	475 / 445	18 / 21	37 / 49
160	-35	21.5	2.4	2300	1040	2300 / 5000	390 / 340	22 / 27	47 / 70
Maximum									
160	-25	33.0	2.5	1900	1300	1900 / 5000	250 / 210	28 / 33	49 / 53
190	-55	15.5	2.3	2800	810	2800 / 5000	735 / 700	18 / 22	36 / 48
190	-45	24.5	2.4	2200	1070	2200 / 5000	650 / 565	22 / 26	45 / 65

Harmonic Distortion Calculations

The harmonic levels (F_{2m} and F_{3m}) and power output (P_m) listed in the table correspond to a peak sinusoidal input voltage (E_{gm}) that is numerically equal to the applied grid bias. For smaller input signal voltages (E_g), the operating parameters can be calculated using the following mathematical relationships:

- **Power Output (P):** $P = P_m \left(\frac{E_g}{E_{gm}} \right)^2$
- **Second Harmonic Level (F_2 in dB below fundamental):** $F_2 = F_{2m} + 20 \log_{10} \left(\frac{E_{gm}}{E_g} \right)$
- **Third Harmonic Level (F_3 in dB below fundamental):** $F_3 = F_{3m} + 40 \log_{10} \left(\frac{E_{gm}}{E_g} \right)$

Microphonic Noise and Applications

Microphonic Performance

The 104D is characterized for microphonic noise under specific test conditions: a plate voltage of 130 V, a grid bias of -20 V, and a load resistance of 100,000 Δ .

- **Mean Microphonic Output:** 31 dB below 1 volt, as measured in a standard laboratory reference test set.
- **Range of Individual Tubes:** Individual production tubes typically exhibit microphonic levels ranging from 20 to 40 dB below 1 volt, depending on the intensity and nature of the external mechanical disturbance.

Applications

The electrical and mechanical design of the 104D makes it suitable for several specialized roles in telecommunications and instrumentation:

1. **Telephone Repeater Amplifiers:** Used as a voice-frequency and carrier-frequency amplifier in telephone repeater equipment where higher power outputs are required than can be delivered by [101D](#) or 101F triodes.
2. **Volume Limiters:** Employed in carrier telephone systems to regulate signal levels.
3. **Testing Apparatus:** Used as an active amplifier element in various laboratory and field testing instruments.

Technical Summary

The **104D** is a filamentary, low-mu power amplifier triode featuring an oxide-coated filament, transverse mica supports, and a dome-type glass envelope. Operating on a 4.5 V, 1.00 A DC filament supply, it provides reliable Class A amplification with an amplification factor of approximately 2.3 to 2.6, transconductance ranging from 810 to 1430 Δ mhos, and a plate resistance between 1800 and 2900 Δ depending on the chosen operating point. With its robust mechanical construction and detailed characterization for harmonic distortion and microphonic noise, the 104D is optimized for high-reliability service in telephone repeaters, volume limiters, and precision testing equipment.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1956 Western Electric Tubes

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1956 WESTERN ELECTRIC TUBES

Section 1 · Triode

CHARACTERISTICS

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum/Typical Power Output	0.16 W	Catalog-table value

OTHER

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum Plate Voltage	190 V	Catalog-table value



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

2026 Western Electric 100s

Published test conditions and operating points. Values on this page are preserved as reported by this source.

2026 WESTERN ELECTRIC 100S

Section 1 · Triode

OTHER

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Filament voltage	4.5 V	—
Filament current	1 A	—
Maximum plate voltage	190 V	—
Plate voltage	100 V	RecommendedOperating; Point1
Grid voltage	-20 V	RecommendedOperating; Point1
Plate current	12.5 mA	RecommendedOperating; Point1
Amplification factor	2.4	RecommendedOperating; Point1
Plate resistance	2700 ohm	RecommendedOperating; Point1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	890 μS	RecommendedOperating; Point1
Power output	110 mW	RecommendedOperating; Point1
Plate voltage	100 V	RecommendedOperating; Point2
Grid voltage	-10 V	RecommendedOperating; Point2
Plate current	22.5 mA	RecommendedOperating; Point2
Amplification factor	2.6	RecommendedOperating; Point2
Plate resistance	2200 ohm	RecommendedOperating; Point2
Transconductance	1160 μS	RecommendedOperating; Point2
Power output	38 mW	RecommendedOperating; Point2
Plate voltage	130 V	RecommendedOperating; Point3
Grid voltage	-30 V	RecommendedOperating; Point3
Plate current	14.5 mA	RecommendedOperating; Point3
Amplification factor	2.3	RecommendedOperating; Point3
Plate resistance	2600 ohm	RecommendedOperating; Point3
Transconductance	900 μS	RecommendedOperating; Point3
Power output	250 mW	RecommendedOperating; Point3
Plate voltage	130 V	RecommendedOperating; Point4
Grid voltage	-20 V	RecommendedOperating; Point4
Plate current	25 mA	RecommendedOperating; Point4
Amplification factor	2.5	RecommendedOperating; Point4
Plate resistance	2100 ohm	RecommendedOperating; Point4
Transconductance	1180 μS	RecommendedOperating; Point4
Power output	150 mW	RecommendedOperating; Point4
Plate voltage	130 V	RecommendedOperating; Point5
Grid voltage	-10 V	RecommendedOperating; Point5
Plate current	37 mA	RecommendedOperating; Point5
Amplification factor	2.6	RecommendedOperating; Point5
Plate resistance	1800 ohm	RecommendedOperating; Point5
Transconductance	1430 μS	RecommendedOperating; Point5
Power output	45 mW	RecommendedOperating; Point5
Plate voltage	160 V	RecommendedOperating; Point6
Grid voltage	-45 V	RecommendedOperating; Point6

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate current	13 mA	RecommendedOperating; Point6
Amplification factor	2.3	RecommendedOperating; Point6
Plate resistance	2900 ohm	RecommendedOperating; Point6
Transconductance	810 uS	RecommendedOperating; Point6
Power output	475 mW	RecommendedOperating; Point6
Plate voltage	160 V	RecommendedOperating; Point7
Grid voltage	-35 V	RecommendedOperating; Point7
Plate current	21.5 mA	RecommendedOperating; Point7
Amplification factor	2.4	RecommendedOperating; Point7
Plate resistance	2300 ohm	RecommendedOperating; Point7
Transconductance	1040 uS	RecommendedOperating; Point7
Power output	390 mW	RecommendedOperating; Point7
Plate voltage	160 V	MaximumOperating; Point8
Grid voltage	-25 V	MaximumOperating; Point8
Plate current	33 mA	MaximumOperating; Point8
Amplification factor	2.5	MaximumOperating; Point8
Plate resistance	1900 ohm	MaximumOperating; Point8
Transconductance	1300 uS	MaximumOperating; Point8
Power output	250 mW	MaximumOperating; Point8
Plate voltage	190 V	MaximumOperating; Point9
Grid voltage	-55 V	MaximumOperating; Point9
Plate current	15.5 mA	MaximumOperating; Point9
Amplification factor	2.3	MaximumOperating; Point9
Plate resistance	2800 ohm	MaximumOperating; Point9
Transconductance	810 uS	MaximumOperating; Point9
Power output	735 mW	MaximumOperating; Point9
Plate voltage	190 V	MaximumOperating; Point10
Grid voltage	-45 V	MaximumOperating; Point10
Plate current	24.5 mA	MaximumOperating; Point10
Amplification factor	2.4	MaximumOperating; Point10
Plate resistance	2200 ohm	MaximumOperating; Point10
Transconductance	1070 uS	MaximumOperating; Point10

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Power output	650 mW	MaximumOperating; Point10

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-to-plate capacitance	4.9 pF	Based tube without socket
Grid-to-filament capacitance	4.1 pF	Based tube without socket
Plate-to-filament capacitance	3.4 pF	Based tube without socket

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	2100 ohm	Representative published operating point
Transconductance	1180 uS	Representative published operating point
Amplification factor	2.5	Representative published operating point

TUBE TINKER

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