



ELECTRONIC TUBE REFERENCE

102F

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	2.1 V / 500 mA	PARALLEL HEATER	— / —
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Triode	
PLATE RESISTANCE	50000 Ω
TRANSCONDUCTANCE	0.00062 S
AMPLIFICATION FACTOR	31
MAXIMUM PLATE VOLTAGE	190 V
<i>Filamentary voltage-amplifier triode; later sheet gives 0.50 A filament rating and detailed operating table.</i>	

102F — Filamentary Voltage Amplifier Triode

A low-power, high-reliability filamentary triode designed for voltage amplification, modulation, and detection in continuous-service telecommunications systems.

Overview

The **102F** is a three-element filamentary triode vacuum tube designed primarily for low-power voltage amplification. It is widely utilized in high-reliability, long-life telecommunications applications, such as

voice-frequency telephone repeaters and carrier-frequency telegraph equipment, as well as serving as a modulator, detector, or in volume indicator circuits.

A defining characteristic of the 102F is its exceptional longevity. When operated within its designed parameters, the tube achieves an average operating life of approximately 70,000 hours. This makes it exceptionally well-suited for continuous, uninterrupted service in critical infrastructure where maintenance access is limited.

The 102F is closely related to the earlier [**102D**](#) triode, sharing similar electrical characteristics. However, the 102F represents a significant advancement in efficiency, operating at a filament current of 0.50 A compared to the 1.0 A filament current of the [**102D**](#). This reduction halves the filament power consumption, making the 102F a much more efficient choice for multi-tube installations.

Physical Construction and Variants

The 102F exists in two distinct physical designs: the original pear-shaped bulb version and a subsequent redesigned "Dome" version. While their electrical characteristics are practically identical, their mechanical construction and physical dimensions differ significantly.

Original Pear-Shaped Version

The original 102F features a pear-shaped glass envelope (S-bulb style) with a maximum diameter of 2 3/8 inches and a maximum overall height of 4 1/2 inches.

Redesigned "Dome" Version

The redesigned 102F (often designated as the "Dome" variant) features a more compact dome-type glass bulb with a maximum diameter of 1 13/16 inches, while maintaining the same maximum overall height of 4 1/2 inches. Mechanically, the Dome version incorporates an improved filament design and utilizes transverse mica supports to secure the internal electrode structure. This mechanical reinforcement significantly enhances the tube's resistance to physical shock and vibration, resulting in a substantial reduction in microphonic noise.

Base, Socket, and Mounting

Both variants utilize a medium four-pin bayonet-type base. To prevent noise disturbances caused by poor electrical contact with socket springs, the base prongs are equipped with special contact metal tips at their ends. The base is designed for use with Western Electric 100L sockets (intended for front-panel mounting), 100R sockets (intended for rear-panel mounting), or similar four-contact bayonet-slot sockets.

The tube can be mounted in either a vertical or horizontal position. When mounted horizontally, the plane of the filament must be oriented vertically to prevent gravitational sag from causing interelectrode shorts or altering the tube's characteristics. For the Dome version, when multiple tubes are installed in close proximity, a minimum spacing of 2 5/8 inches between centers must be maintained to ensure adequate ventilation and prevent overheating.

Filament Ratings and Behavior

The 102F features a directly heated, oxide-coated filament designed to operate on a current-regulated basis.

Filament Parameter	Value
Nominal Filament Voltage	2.1 V
Rated Filament Current	0.50 A (D.C.)

Because the filament is designed for current-basis operation, it should be maintained as close to the rated 0.50 A current as practicable. In the redesigned Dome version, the filament resistance exhibits a slight increase during the first 2000 hours of continuous operation. The nominal filament voltage of 2.1 V represents the stabilized voltage drop across the filament after this initial burn-in period.

Electrical Characteristics and Operating Points

The 102F operates as a high- μ , high-resistance triode under Class A conditions. Its absolute maximum plate voltage rating is 190 V.

The average characteristics of the two variants differ slightly due to the mechanical redesign. The original version exhibits an average amplification factor (μ) of approximately 30, with a plate resistance (r_p) ranging from 45,000 to 55,000 ohms and a transconductance (g_m) of 430 to 670 μ mhos. The redesigned Dome version features a slightly higher average amplification factor of approximately 31, with a plate resistance of 39,000 to 60,000 ohms and a transconductance of 520 to 800 μ mhos.

The following table compares the typical Class A operating points of the original and Dome versions:

Parameter	Original (Point 1)	Original (Point 2)	Original (Point 3)	Dome (Point 1)	Dome (Point 2)	Dome (Point 3)
Plate Voltage (E_b)	130 V	160 V	190 V*	130 V	160 V	190 V*
Grid Bias (E_c)	-1.5 V	-2.0 V	-3.0 V*	-1.5 V	-2.0 V	-3.0 V*
Plate Current (I_b)	0.70 mA	1.00 mA	1.00 mA	0.85 mA	1.15 mA	1.15 mA
Amplification Factor (μ)	30.1	30.3	30.1	31.0	31.0	30.9

Parameter	Original (Point 1)	Original (Point 2)	Original (Point 3)	Dome (Point 1)	Dome (Point 2)	Dome (Point 3)
Plate Resistance (r_p)	54,000 Ω	46,000 Ω	46,000 Ω	50,000 Ω	45,000 Ω	45,000 Ω
Transconductance (g_m)	550 μmhos	660 μmhos	650 μmhos	620 μmhos	690 μmhos	690 μmhos

Note: Operating points at 190 V plate voltage represent the maximum operating conditions.

Interelectrode Capacitances

The interelectrode capacitances of the 102F vary depending on the physical variant and whether the tube is measured with or without a socket. The redesigned Dome version achieves a significant reduction in grid-to-plate capacitance, which is highly beneficial for minimizing Miller effect feedback in voltage amplifier stages.

Original Version Capacitances

The capacitances of the original pear-shaped version are documented under three distinct measurement conditions:

- **Column A:** Based tube measured without a socket.
- **Column B:** Tube measured in a Western Electric 100L socket mounted on a metal plate, with the socket and mounting plate connected to the filament.
- **Column C:** Tube measured in a Western Electric 100R socket mounted on a metal plate, with the socket and mounting plate connected to the filament.

Capacitance Parameter	Column A	Column B	Column C
Grid to Plate (C_{gp})	9.2 pF	9.0 pF	9.0 pF
Grid to Filament (C_{gf})	3.8 pF	4.3 pF	4.6 pF
Plate to Filament (C_{pf})	1.5 pF	2.9 pF	3.2 pF

Dome Version Capacitances

For the redesigned Dome version, the capacitances of the based tube measured without a socket are:

- Grid to Plate (C_{gp}): 5.1 pF
- Grid to Filament (C_{gf}): 4.0 pF
- Plate to Filament (C_{pf}): 2.3 pF

The reduction of C_{gp} from 9.2 pF in the original version to 5.1 pF in the Dome version represents a substantial improvement in high-frequency performance and stability.

Performance and Distortion Analysis

When operating as a Class A voltage amplifier, the 102F's output voltage and harmonic distortion depend heavily on the selected load resistance (R). The performance tables document operation with sinusoidal input voltages (E_{gm}) whose peak value is numerically equal to the grid bias. Under these conditions, the fundamental output voltage (E_{pm}) and the second (F_{2m}) and third (F_{3m}) harmonic levels (expressed in decibels below the fundamental) are characterized for various loads.

Original Version Performance (at $E_b = 130$ V, $E_c = -1.5$ V, $E_{gm} = 1.5$ V_{peak})

- **With $R = r_p$ (54,000 Ω):** Output voltage is 21 V peak; second harmonic is 26 dB below fundamental; third harmonic is 48 dB below fundamental.
- **With $R = 3r_p$ (162,000 Ω):** Output voltage is 32 V peak; second harmonic is 32 dB below fundamental; third harmonic is 55 dB below fundamental.
- **With $R = 5r_p$ (270,000 Ω):** Output voltage is 34 V peak; second harmonic is 33 dB below fundamental; third harmonic is 55 dB below fundamental.

Dome Version Performance (at $E_b = 130$ V, $E_c = -1.5$ V, $E_{gm} = 1.5$ V_{peak})

- **With $R = 50,000$ Ω ($\approx r_p$):** Output voltage is 22 V peak; second harmonic is 30 dB below fundamental; third harmonic is 48 dB below fundamental.
- **With $R = 100,000$ Ω ($\approx 2r_p$):** Output voltage is 30 V peak; second harmonic is 37 dB below fundamental; third harmonic is 55 dB below fundamental.
- **With $R = 300,000$ Ω ($\approx 6r_p$):** Output voltage is 38 V peak; second harmonic is 49 dB below fundamental; third harmonic is 65 dB below fundamental.

Scaling Calculations for Smaller Input Voltages

For a smaller sinusoidal input voltage (E_g) where $E_g < E_{gm}$, the resulting output voltage (E_p) and the corresponding second (F_2) and third (F_3) harmonic levels in decibels below the fundamental can be calculated using the following mathematical relationships:

Output Voltage Calculation: $E_p = E_{pm} \left(\frac{E_g}{E_{gm}} \right)$

Second Harmonic Calculation: $F_2 = F_{2m} + 20 \log_{10} \left(\frac{E_{gm}}{E_g} \right)$

Third Harmonic Calculation: $F_3 = F_{3m} + 40 \log_{10} \left(\frac{E_{gm}}{E_g} \right)$

These scaling laws demonstrate that reducing the input signal level linearly reduces the output voltage, but significantly improves the distortion performance, pushing the second and third harmonic components much further below the fundamental signal level.

Microphonic Noise

Microphonic noise is a critical parameter in high-gain audio-frequency voltage amplifiers. The mechanical construction of the 102F directly influences its susceptibility to microphonics.

Under standard test conditions—consisting of a plate voltage of 130 V, a grid bias of -1.5 V, and a load resistance of 100,000 ohms, measured in a laboratory reference test set—the two variants exhibit markedly different noise profiles:

- **Original Pear-Shaped Version:** The mean microphonic noise output level is 20 dB below 1 volt. The range of levels across individual tubes of this design spans from 9 to 36 dB below 1 volt.
- **Redesigned Dome Version:** Thanks to its improved filament structure and transverse mica supports, the mean microphonic noise output level is reduced to 33 dB below 1 volt. The range of levels for individual Dome tubes is also much tighter and lower, spanning from 25 to 41 dB below 1 volt.

This 13 dB improvement in mean microphonic noise makes the Dome version vastly superior for low-noise preamplifier and telephone repeater applications where physical vibration is present.

Technical Summary

The **102F** is a high-reliability, long-life filamentary triode designed for voltage amplification, modulation, and detection. Operating with a highly efficient 2.1 V, 0.50 A filament, it provides a low-power alternative to the [102D](#) while maintaining similar electrical characteristics. With an average operating life of 70,000 hours, a medium four-pin bayonet base with noise-reducing contact tips, and an amplification factor of approximately 30 to 31, the 102F is optimized for continuous telecommunications service. The redesigned Dome version offers significant performance advantages over the original pear-shaped version, including a reduction in grid-to-plate capacitance from 9.2 pF to 5.1 pF and a 13 dB reduction in mean microphonic noise.



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

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	2.1 V	—
Filament current	500 mA	—
Maximum plate voltage	190 V	—
Plate voltage	130 V	TypicalOperating; Point1
Grid voltage	-2 V	TypicalOperating; Point1
Plate current	0.6 mA	TypicalOperating; Point1
Amplification factor	30.9	TypicalOperating; Point1
Plate resistance	58000 ohm	TypicalOperating; Point1
Transconductance	530 uS	TypicalOperating; Point1
Peak output voltage	28 V	TypicalOperating; Point1
Plate voltage	130 V	TypicalOperating; Point2

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid voltage	-1.5 V	TypicalOperating; Point2
Plate current	0.85 mA	TypicalOperating; Point2
Amplification factor	31	TypicalOperating; Point2
Plate resistance	50000 ohm	TypicalOperating; Point2
Transconductance	620 uS	TypicalOperating; Point2
Peak output voltage	22 V	TypicalOperating; Point2
Plate voltage	130 V	TypicalOperating; Point3
Grid voltage	-1 V	TypicalOperating; Point3
Plate current	1.15 mA	TypicalOperating; Point3
Amplification factor	31	TypicalOperating; Point3
Plate resistance	44000 ohm	TypicalOperating; Point3
Transconductance	700 uS	TypicalOperating; Point3
Peak output voltage	14 V	TypicalOperating; Point3
Plate voltage	160 V	TypicalOperating; Point4
Grid voltage	-3 V	TypicalOperating; Point4
Plate current	0.55 mA	TypicalOperating; Point4
Amplification factor	30.9	TypicalOperating; Point4
Plate resistance	60000 ohm	TypicalOperating; Point4
Transconductance	520 uS	TypicalOperating; Point4
Peak output voltage	42 V	TypicalOperating; Point4
Plate voltage	160 V	TypicalOperating; Point5
Grid voltage	-2 V	TypicalOperating; Point5
Plate current	1.15 mA	TypicalOperating; Point5
Amplification factor	31	TypicalOperating; Point5
Plate resistance	45000 ohm	TypicalOperating; Point5
Transconductance	690 uS	TypicalOperating; Point5
Peak output voltage	29 V	TypicalOperating; Point5
Plate voltage	160 V	MaximumOperating; Point6
Grid voltage	-1 V	MaximumOperating; Point6
Plate current	1.85 mA	MaximumOperating; Point6
Amplification factor	31	MaximumOperating; Point6
Plate resistance	39000 ohm	MaximumOperating; Point6

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	800 μS	MaximumOperating; Point6
Peak output voltage	15 V	MaximumOperating; Point6
Plate voltage	190 V	MaximumOperating; Point7
Grid voltage	-3 V	MaximumOperating; Point7
Plate current	1.15 mA	MaximumOperating; Point7
Amplification factor	30.9	MaximumOperating; Point7
Plate resistance	45000 ohm	MaximumOperating; Point7
Transconductance	690 μS	MaximumOperating; Point7
Peak output voltage	45 V	MaximumOperating; Point7
Plate voltage	190 V	MaximumOperating; Point8
Grid voltage	-2 V	MaximumOperating; Point8
Plate current	1.85 mA	MaximumOperating; Point8
Amplification factor	31	MaximumOperating; Point8
Plate resistance	39000 ohm	MaximumOperating; Point8
Transconductance	800 μS	MaximumOperating; Point8
Peak output voltage	30 V	MaximumOperating; Point8

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-to-plate capacitance	5.1 pF	Based tube without socket
Grid-to-filament capacitance	4 pF	Based tube without socket
Plate-to-filament capacitance	2.3 pF	Based tube without socket

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	50000 ohm	Representative published operating point
Transconductance	620 μS	Representative published operating point
Amplification factor	31	Representative published operating point