



ELECTRONIC TUBE REFERENCE

12AX7WC

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

High-mu ruggedized twin triode for high-gain voltage amplification and phase-inverter service, produced as a high-reliability member of the 12AX7 family.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	9
NOMINAL HEATER	6.3 V / 300 mA	PARALLEL HEATER	6.3 V / 300 mA
HEATING	Indirect	SERIES OPERATION	Capable
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Triode	
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1 W
MAXIMUM CATHODE CURRENT	8 mA
Representative section for two electrically identical sections.	

SECTION2 Triode	
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1 W
MAXIMUM CATHODE CURRENT	8 mA
Second physical triode section; electrically identical twin section.	

12AX7WC — Miniature Twin Triode Vacuum Tube

The **12AX7WC** is a miniature, indirectly heated twin triode vacuum tube featuring equipotential cathodes. It is designed primarily for the amplification of low-frequency voltages in radio engineering devices and electronic circuits. The tube incorporates two independent triode sections within a single envelope, sharing a common heater structure that supports both series and parallel operation.

Physical Characteristics and Pin Configuration

The 12AX7WC is housed in a miniature glass envelope with a 9-pin base. The physical dimensions and pinout configuration are detailed below:

Dimensions and Geometry

- **Maximum Overall Height:** 56.5 mm
- **Envelope Diameter:** 22.5 mm (with a tolerance of -2 mm)
- **Pin Circle Diameter:** 12 mm
- **Pin Diameter:** 1.0 mm (with a tolerance of +0.03 mm / -0.07 mm)
- **Angular Spacing:** 36° between adjacent pins, with the 9 pins arranged over a total angle of 288° (8 intervals of 36°).

Pinout and Electrode Connections

The lead designations and corresponding electrode connections are as follows:

Pin Number	Electrode Designation
1	Second triode plate (anode)
2	Second triode grid
3	Second triode cathode

Pin Number	Electrode Designation
4	Heater
5	Heater
6	First triode plate (anode)
7	First triode grid
8	First triode cathode
9	Heater

The heater is connected to pins 4, 5, and 9, allowing for flexible supply configurations.

Heater and Power Supply Configurations

The heater of the 12AX7WC is designed to operate from either a 6.3 V or a 12.6 V power source, depending on whether the heater filaments are wired in parallel or in series.

- **Parallel Connection (6.3 V nominal):** The heater supply is applied across pins 4 and 5 connected together, and pin 9. The allowable filament voltage range is **6.0 V to 6.6 V**. Under these conditions, the nominal heater current is between **300 mA and 340 mA**.
- **Series Connection (12.6 V nominal):** The heater supply is applied across pins 4 and 5, with pin 9 acting as the center tap. The allowable filament voltage range is **12.0 V to 13.2 V**. Under these conditions, the nominal heater current is between **150 mA and 170 mA**.

Heater Power Calculation

Using the nominal voltage and current limits, the power consumed by the heater can be calculated:

- **At 6.3 V:**
 - Minimum Power: $6.3\text{ V} \times 0.300\text{ A} = 1.89\text{ W}$
 - Maximum Power: $6.3\text{ V} \times 0.340\text{ A} = 2.142\text{ W}$
- **At 12.6 V:**
 - Minimum Power: $12.6\text{ V} \times 0.150\text{ A} = 1.89\text{ W}$
 - Maximum Power: $12.6\text{ V} \times 0.170\text{ A} = 2.142\text{ W}$

Thus, the calculated nominal heater power dissipation remains consistent at **1.89 W to 2.14 W** across both operating modes.

Electrical Parameters and Operating Points

The nominal electrical parameters of each triode section are specified under a defined set of operating conditions. Unless otherwise noted, these parameters are measured at a filament voltage of either 6.3 V

or 12.6 V, a plate voltage of 250 V, and a negative grid bias of -2.0 V.

Parameter	Minimum	Maximum	Conditions / Notes
Plate Current (I_p)	0.75 mA	2.0 mA	$E_p = 250 \text{ V}$, $E_g = -2.0 \text{ V}$
Amplification Factor (μ)	82	110	$E_p = 250 \text{ V}$, $E_g = -2.0 \text{ V}$
Slope of Characteristic (g_m)	1.1 mA/V	—	Transconductance at $E_p = 250 \text{ V}$, $E_g = -2.0 \text{ V}$
Grid Reverse Current	—	0.2 μA	Measured with a grid circuit resistance of 1.0 M Ω
Plate Current Difference	—	$\pm 40\%$	Difference between the first and second triode sections
Cutoff Plate Current	—	20 μA	Measured at $E_p = 250 \text{ V}$, $E_g = -5.5 \text{ V}$
Cathode-Heater Insulation Resistance	20 M Ω	—	Measured at a cathode-heater voltage of $\pm 200 \text{ V}$

The plate current difference limit of $\pm 40\%$ indicates the maximum allowable mismatch between the two triode sections within a single envelope under nominal operating conditions. The cutoff characteristic is defined by a maximum plate current of **20 μA** when the grid is biased to **-5.5 V** with a plate voltage of **250 V**.

Limiting Values and Operating Constraints

To ensure reliable operation and prevent premature failure of the tube, the following absolute maximum and minimum limiting values must be observed:

Parameter	Minimum	Maximum
Filament Voltage (Parallel)	6.0 V	6.6 V
Filament Voltage (Series)	12.0 V	13.2 V
Plate Voltage (E_p)	—	300 V

Parameter	Minimum	Maximum
Cathode-to-Heater Voltage	—	$\pm 200\text{ V}$
Cathode Current (I_k)	—	10 mA
Plate Power Dissipation (per triode)	—	1.0 W
Grid Circuit Resistance (Fixed Bias)	—	1.0 M Ω
Grid Circuit Resistance (Self-Bias)	—	2.2 M Ω
Envelope Temperature (at hottest part)	—	368 K

Grid Bias Considerations

The maximum allowable resistance in the grid circuit depends on the biasing method:

- For **fixed bias** configurations, the grid circuit resistance must not exceed **1.0 M Ω** to prevent thermal runaway caused by grid reverse currents.
- For **self-bias (cathode bias)** configurations, the negative feedback provided by the cathode resistor stabilizes the operating point, allowing a higher maximum grid circuit resistance of **2.2 M Ω** .

Characteristic Curves and Behavior

The electrical behavior of the 12AX7WC is illustrated by its transfer and plate characteristic curves.

Transfer Characteristics (I_p vs. E_g)

The transfer curves plot plate current (I_p) in milliamperes against negative grid voltage (E_g) in volts at three distinct plate voltages ($E_p = 200\text{ V}$, 250 V , and 300 V):

- At a plate voltage of **250 V**, a grid bias of **-2.0 V** yields a nominal plate current within the specified **0.75 mA to 2.0 mA** range.
- Increasing the plate voltage to **300 V** shifts the curve to the left, requiring a more negative grid voltage to achieve the same plate current.
- The curves converge toward the cutoff region. At a grid bias of **-5.5 V**, the plate current is reduced to less than **20 μA** for all plate voltages up to 250 V, demonstrating the tube's cutoff behavior.

Plate Characteristics (I_p vs. E_p)

The plate curves plot plate current (I_p) against plate voltage (E_p) for various fixed grid bias voltages (E_g) ranging from **0 V to -3.5 V** in steps of 0.5 V:

- **At $E_g = 0$ V:** The plate current rises steeply with plate voltage, reaching approximately **10 mA** at a plate voltage of roughly **180 V to 200 V**.
 - **At $E_g = -1.5$ V:** The curve is shifted to the right; a plate voltage of **250 V** results in a plate current of approximately **2.5 mA**.
 - **At $E_g = -3.0$ V:** The plate current remains below **1.0 mA** for plate voltages up to **250 V**, illustrating the high- μ nature of the triode where small changes in grid voltage have a large effect on plate current.
 - The family of curves shows relatively parallel, evenly spaced lines in the typical operating region, indicating consistent transconductance and amplification factors across a range of plate voltages.
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Technical Summary

The **12AX7WC** is a high- μ , miniature twin triode designed for low-frequency voltage amplification. It features a 9-pin base, separate cathodes for each triode section, and a versatile heater arrangement that supports both **6.3 V (parallel)** and **12.6 V (series)** operation.

With a nominal amplification factor (μ) of **82 to 110** and a transconductance slope of at least **1.1 mA/V** at a plate voltage of 250 V and grid bias of -2.0 V, the tube is optimized for high-gain voltage amplifier stages. Designers must adhere to the maximum plate voltage limit of **300 V**, a maximum plate dissipation of **1.0 W per triode**, and a maximum cathode current of **10 mA** to ensure stable and reliable operation within the specified envelope temperature limit of **368 K**.