

ELECTRONIC TUBE REFERENCE

12AX7S

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

Ruggedized high-mu 12AX7-family twin triode for amplifier and oscillator service, designed to withstand shock and vibration while retaining high-gain audio preamplifier characteristics.

GENERAL CHARACTERISTICS

BASE DESIGNATION	NOVAL	BASE PINS	—
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	
PLATE RESISTANCE	62500 Ω
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	1.1 W
MAXIMUM CATHODE CURRENT	20 mA
Representative section for two similar triodes.	

SECTION2 Triode	
PLATE RESISTANCE	62500 Ω
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	1.1 W
MAXIMUM CATHODE CURRENT	20 mA
<i>Second physical triode section; electrically identical twin section.</i>	

12AX7S — Special Quality High-Mu Twin Triode

An indirectly heated, dual-section high-mu vacuum tube designed for high reliability, low interface resistance, and resistance to severe shock and vibration in professional, industrial, and mobile applications.

Overview

The **12AX7S** is a professional-grade, high-mu double triode featuring separate cathodes and a shared heater. It is designed to offer electrical characteristics analogous to the standard [12AX7A](#) and [ECC83](#), but with enhanced mechanical and electrical robustness. The tube is engineered to withstand the physical shocks and vibrations typical of mobile equipment, aeronautical systems, and industrial electronic devices.

To ensure long-term reliability, the 12AX7S is classified as a Special Quality (S.Q.) tube. Its heater filament is specifically designed to endure a minimum of 5,000 successive switch-on and switch-off cycles. The primary applications for this device include audio frequency (A.F.) voltage amplification, oscillator circuits, and multivibrators.

Mechanical Construction, Base, and Pinout

The 12AX7S is constructed with a glass envelope (bulb type A 22-2) and utilizes a standard 9-pin Noval base (9 C 12 / 9C13). The tube can be mounted and operated in any physical position.

Physical Dimensions

- **Maximum overall diameter:** 22.2 mm (with some specifications listing a maximum of 22 mm)
- **Maximum overall height:** 49.2 mm
- **Maximum seated height:** 55.6 mm
- **Maximum pin length:** 7.14 mm

Pin Connections

The 9-pin Noval base configuration provides independent connections for each triode section, with a center-tapped heater:

Pin Number	Electrode Connection
1	Anode (Triode 2)
2	Grid (Triode 2)
3	Cathode (Triode 2)
4	Heater
5	Heater
6	Anode (Triode 1)
7	Grid (Triode 1)
8	Cathode (Triode 1)
9	Heater Center Tap

Shock and Vibration Resistance

To verify its suitability for demanding environments, the 12AX7S is subjected to rigorous mechanical testing:

- **Shock testing:** The tube is subjected 5 times in each of 4 distinct positions to an acceleration of 500 g, delivered by an NRL shock machine with the hammer lifted to an angle of 30°.
- **Vibration testing:** The tube is subjected for 32 hours in each of 3 positions to a vibration frequency of 50 Hz with an acceleration of 2.5 g.

Heater and Cathode Characteristics

The 12AX7S features indirectly heated, coated unipotential cathodes. The heater filament is center-tapped, allowing for either series or parallel supply configurations:

Parameter	Series Connection	Parallel Connection
Nominal Heater Voltage (V_f)	12.6 V	6.3 V
Nominal Heater Current (I_f)	150 mA	300 mA
Heater Current Range (Initial Spread)	—	276 to 324 mA

The heater is designed for either AC or DC operation. Under absolute maximum ratings, the allowable heater voltage tolerances are:

- **Parallel supply:** 5.7 V minimum to 6.9 V maximum.
- **Series supply:** 11.4 V minimum to 13.8 V maximum.

Electrical Characteristics and Nominal Operating Points

The 12AX7S is characterized by a high amplification factor ($\mu = 100$) and low interface resistance. The nominal electrical characteristics for each triode section are specified at two distinct operating points:

Parameter	Operating Point A	Operating Point B
Anode Voltage (V_a)	100 V	250 V
Grid Voltage ($-V_g$)	1 V	2 V
Anode Current (I_a)	0.5 mA	1.2 mA
Mutual Conductance / Slope (S)	1.25 mA/V	1.6 mA/V
Amplification Factor (μ or K)	100	100
Internal Resistance (R_i or ρ)	80 k Ω	62.5 k Ω

Production Tolerances and End-of-Life Limits

For equipment design, the initial spread and end-of-life limits at the 250 V operating point are defined as follows:

- **Anode Current (I_a):** Initial spread of 0.75 to 1.75 mA.
- **Mutual Conductance (S):** Initial spread of 1.25 to 2.05 mA/V, with an end-of-life minimum limit of 1.12 mA/V.
- **System Balance:** The maximum difference in anode current between the two triode systems ($|I_a - I'_a|$) is 0.6 mA.
- **Negative Grid Current ($-I_g$):** Maximum of 0.5 μ A (both initially and at end of life).
- **Insulation Resistance (R_{ins}):** Minimum of 100 M Ω initially, decreasing to a minimum of 50 M Ω at end of life (measured at 100 V between electrodes).
- **Heater-Cathode Leakage (I_{kf}):** Maximum of 10 μ A initially, and 20 μ A at end of life, under a heater-to-cathode voltage (V_{kf}) of 100 V.
- **Vibrational Noise Output (V_o):** Maximum of 25 mV RMS when both triode units are connected in parallel under the following test conditions: $V_{ba} = 250$ V, $-V_g = 2$ V, $f = 25$ Hz, acceleration of 2.5 g, and an anode load resistor (R_a) of 2 k Ω .

Interelectrode Capacitances

Interelectrode capacitances are specified without an external shield or screen. The values for each triode system are:

Standard System Capacitances

- **Anode to Grid, Cathode, and Heater ($C_{a/gkf}$):** 3.9 pF
- **Grid to Anode, Cathode, and Heater ($C_{g/akf}$):** 3.7 pF
- **Grid to Cathode and Heater ($C_{g/kf}$):** 1.6 pF
- **Anode to Grid (C_{ag} or $C_{g/a}$):** 1.7 pF

Direct Electrode-to-Electrode Capacitances

- **Anode to Cathode and Heater (Triode 1, $C_{a/kf}$):** 0.4 pF
- **Anode to Cathode and Heater (Triode 2, $C_{a'/k'f}$):** 0.3 pF
- **Output Capacitance (C_s):** 0.46 pF for Triode 1, and 0.34 pF for Triode 2.
- **Input Capacitance (C_e):** 1.6 pF for both Triode 1 and Triode 2.

Absolute Maximum Ratings

The absolute maximum ratings define the limits beyond which the safety and life of the tube may be seriously impaired. These ratings apply to each triode section individually:

Parameter	Absolute Maximum Limit
Anode Voltage (V_a)	330 V
Anode Dissipation (P_a or W_a)	1.1 W
Cathode Current (I_k)	20 mA
Positive Grid Voltage (V_g)	0 V
Negative Grid Voltage ($-V_g$)	55 V
Peak Voltage between Heater and Cathode (V_{fkr} or V_{kf})	100 V (up to 200 V peak in some ratings)
Bulb Temperature (t_{bulb})	165 °C (up to 200 °C in some ratings)
Grid Resistor with Fixed Bias (R_g)	0.5 MΩ (up to 1 MΩ in some ratings)
Grid Resistor with Automatic Bias (R_g)	1.1 MΩ

Class A Amplifier Operating Conditions

The 12AX7S is widely utilized as a Class A resistance-coupled voltage amplifier. Typical operating configurations are specified for three different anode supply voltages (V_N), with a grid resistor (R_g) of 100 k Ω for the stage:

Supply Voltage $V_N = 90$ V

Anode Resistor (R_a)	Cathode Resistor (R_k)	Grid Resistor of Next Stage (R'_g)	Voltage Gain (A_v)	Output Voltage (V_s for 5% THD)
100 k Ω	1.7 k Ω	100 k Ω	31	5.0 V RMS
100 k Ω	2.0 k Ω	240 k Ω	38	6.9 V RMS
240 k Ω	3.5 k Ω	240 k Ω	43	6.5 V RMS
240 k Ω	3.9 k Ω	510 k Ω	49	8.6 V RMS
510 k Ω	7.1 k Ω	510 k Ω	50	7.4 V RMS
510 k Ω	7.8 k Ω	1000 k Ω	53	9.1 V RMS

Supply Voltage $V_N = 180$ V

Anode Resistor (R_a)	Cathode Resistor (R_k)	Grid Resistor of Next Stage (R'_g)	Voltage Gain (A_v)	Output Voltage (V_s for 5% THD)
100 k Ω	1.0 k Ω	100 k Ω	40	15 V RMS
100 k Ω	1.1 k Ω	240 k Ω	46	20 V RMS
240 k Ω	2.0 k Ω	240 k Ω	54	18 V RMS
240 k Ω	2.3 k Ω	510 k Ω	59	24 V RMS
510 k Ω	4.3 k Ω	510 k Ω	62	19 V RMS
510 k Ω	4.8 k Ω	1000 k Ω	64	24 V RMS

Supply Voltage $V_N = 300$ V

Anode Resistor (R_a)	Cathode Resistor (R_k)	Grid Resistor of Next Stage (R'_g)	Voltage Gain (A_v)	Output Voltage (V_s for 5% THD)
100 k Ω	0.76 k Ω	100 k Ω	43	30 V RMS
100 k Ω	0.90 k Ω	240 k Ω	50	40 V RMS

Anode Resistor (R_a)	Cathode Resistor (R_k)	Grid Resistor of Next Stage (R_g')	Voltage Gain (A_v)	Output Voltage (V_s for 5% THD)
240 k Ω	1.6 k Ω	240 k Ω	58	37 V RMS
240 k Ω	1.8 k Ω	510 k Ω	64	47 V RMS
510 k Ω	3.1 k Ω	510 k Ω	66	39 V RMS
510 k Ω	3.6 k Ω	1000 k Ω	69	46 V RMS

Note: In these configurations, the voltage gain (A_v) is measured at an output level of $V_s = 2.0$ V RMS.

Alternative Amplification Test Point

An alternative high-gain operating point is specified for a single stage under the following conditions:

- **Anode supply voltage (V_{ba}):** 100 V
- **Grid voltage (V_g):** 0 V
- **Anode resistor (R_a):** 0.5 M Ω
- **Grid resistor (R_g):** 10 M Ω
- **Input voltage (V_i):** 0.2 V RMS
- **Minimum output voltage (V_o):** 8.4 V RMS

Characteristic Curves and Interpretation

The published characteristic curves for the 12AX7S illustrate the relationships between the tube's primary electrical parameters:

- **Anode Current vs. Anode Voltage (I_a vs. V_a):** These curves map the anode current from 0 to 3.5 mA across anode voltages up to 500 V, for grid bias steps ranging from 0 V down to -5 V. The curves demonstrate the high internal resistance of the triode, as shown by the relatively shallow slope of the lines.
- **Anode Current vs. Grid Voltage (I_a vs. V_g):** The transfer curves show the grid control characteristics from 0 V to -4 V bias at various fixed anode voltages (from 50 V to 300 V). The sharp cutoff behavior is typical of high- μ triodes.
- **Parameter Variations (R_i , μ , S vs. I_a):** At both $V_N = 100$ V and $V_N = 250$ V, the curves show that as the anode current (I_a) increases, the mutual conductance (S) rises significantly, while the internal resistance (R_i) drops sharply. The amplification factor (μ) remains remarkably stable, holding close to 100 across the normal operating range of anode current.

Technical Summary

The **12AX7S** is a **Special Quality (S.Q.) high-mu twin triode** featuring separate cathodes and a center-tapped heater designed for 6.3 V parallel or 12.6 V series operation. Engineered for professional, industrial, and aeronautical applications, it offers high mechanical resistance to shock (up to 500 g) and

vibration (up to 2.5 g), alongside a ruggedized filament capable of withstanding at least 5,000 switch-on/off cycles.

With an amplification factor of **100**, a transconductance of **1.25 to 1.6 mA/V**, and an internal resistance of **62.5 to 80 k Ω** under nominal conditions, the 12AX7S provides high voltage gain in Class A amplifiers, oscillators, and multivibrators. Its electrical characteristics are analogous to the standard [12AX7A](#) and [ECC83](#), but its design incorporates strict limits on system balance, electrode insulation, and heater-cathode leakage to ensure maximum reliability over a tested life of 1,000 hours.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1968 Mazda Belvu

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

1968 MAZDA BELVU

Section 1 · Triode

APPLICATION

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Application	AF_Preamplifier text	—



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1999 Philips 0-D

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

1999 PHILIPS 0-D

Section 1 · Triode

CHARACTERISTICS

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	250 V	—
Grid voltage	-2 V	—
Plate current	1.2 mA	—
Transconductance	1600 μ S	—
Amplification factor	100	—
Plate resistance	62500 ohm	—
Series heater voltage	12.6 V	—
Series heater current	150 mA	—
Parallel heater voltage	6.3 V	—
Parallel heater current	300 mA	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode to grid/cathode/heater capacitance	3.9 pF	—
Anode to cathode/heater capacitance	0.4 pF	—
Grid to anode/cathode/heater capacitance	3.7 pF	—
Grid to cathode/heater capacitance	1.6 pF	—