

ELECTRONIC TUBE REFERENCE

12AD7

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

Sylvania 12AD7 low-hum, low-microphonic high-mu dual triode for audio preamplifiers, with two identical 300 V 1 W sections and 12.6 V/6.3 V series-parallel heater.

GENERAL CHARACTERISTICS

BASE DESIGNATION	9A	BASE PINS	9
NOMINAL HEATER	12.6 V / 225 mA	PARALLEL HEATER	6.3 V / 450 mA
HEATING	Indirect	SERIES OPERATION	Capable
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

9A - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – 2P	B	P – Plate (Anode)	CONNECTED
PIN2 – 2G1	B	G1 – Control Grid	CONNECTED
PIN3 – 2K	B	K – Cathode	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN5 – H	–	H – Heater	CONNECTED
PIN6 – 1P	A	P – Plate (Anode)	CONNECTED
PIN7 – 1G1	A	G1 – Control Grid	CONNECTED
PIN8 – 1K	A	K – Cathode	CONNECTED
PIN9 – HCT	–	HCT – Heater Center Tap	CONNECTED

SECTION RATINGS

SECTION1 Triode	
PLATE RESISTANCE	62500 Ω
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1 W
<i>Sylvania 12AD7 high-mu low-hum low-microphonic dual triode, July 1956, each section. Class A typical plate 250 V, grid -2 V, plate current 1.25 mA, plate resistance 62500 Ω, transconductance 1600 μmhos = 0.0016 A/V, mu 100. Design-center max plate 300 V, plate dissipation 1 W per section, positive DC grid voltage max 0 V, negative DC grid voltage magnitude max 50 V. Heater 12.6 V 225 mA series or 6.3 V 450 mA parallel. Heater negative to cathode total DC and peak max 200 V; heater positive to cathode DC max 100 V and total DC+peak max 200 V. Approx Cgp 1.8 pF each; shielded input 1.7 pF each, output section1 1.6 pF, section2 1.9 pF; unshielded input 1.6 pF each, output section1 0.50 pF, section2 0.45 pF. Low-hum resistance-coupled amplifier: heater 6.3 V balanced to ground, plate supply 250 V, unbypassed cathode 3300 Ω, grid resistor 470000 Ω, plate load 270000 Ω, RMS hum at plate max 3.0 mV. Section 1 pins 6,7,8; section 2 pins 1,2,3. 9A nine-pin miniature base.</i>	

SECTION2 Triode	
PLATE RESISTANCE	62500 Ω
TRANSCONDUCTANCE	0.0016 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1 W
<i>Sylvania 12AD7 high-mu low-hum low-microphonic dual triode, July 1956, each section. Class A typical plate 250 V, grid -2 V, plate current 1.25 mA, plate resistance 62500 Ω, transconductance 1600 μmhos = 0.0016 A/V, mu 100. Design-center max plate 300 V, plate dissipation 1 W per section, positive DC grid voltage max 0 V, negative DC grid voltage magnitude max 50 V. Heater 12.6 V 225 mA series or 6.3 V 450 mA parallel. Heater negative to cathode total DC and peak max 200 V; heater positive to cathode DC max 100 V and total DC+peak max 200 V. Approx Cgp 1.8 pF each; shielded input 1.7 pF each, output section1 1.6 pF, section2 1.9 pF; unshielded input 1.6 pF each, output section1 0.50 pF, section2 0.45 pF. Low-hum resistance-coupled amplifier: heater 6.3 V balanced to ground, plate supply 250 V, unbypassed cathode 3300 Ω, grid resistor 470000 Ω, plate load 270000 Ω, RMS hum at plate max 3.0 mV. Section 1 pins 6,7,8; section 2 pins 1,2,3. 9A nine-pin miniature base.</i>	

12AD7 — High-Mu Double Triode Vacuum Tube

A miniature, non-microphonic, high-mu double triode designed for low-level audio preamplifier service, featuring rigorously controlled hum and microphonic characteristics.

Overview

The **12AD7** is a high-mu double triode vacuum tube housed in a miniature 9-pin envelope. It is specifically engineered and rigorously controlled for low-level audio preamplifier applications where hum and microphonics must be minimized. The device contains two independent triode sections, each utilizing a coated unipotential cathode, sharing a common heater structure that can be configured for either series or parallel operation.

A defining characteristic of the 12AD7 is its specified maximum hum output level, making it highly suitable for high-gain, low-noise audio input stages. Its electrical parameters, including an amplification factor of 100, position it as a specialized high-gain voltage amplifier.

Mechanical Specifications and Physical Dimensions

The 12AD7 is constructed using a T-6 1/2 glass bulb and utilizes an E9-1 small button 9-pin base. The physical outline is designated as 6-2, and the tube can be mounted in any position.

Key physical dimensions include:

- **Maximum overall length:** 2 3/16 inches
- **Maximum seated height:** 1 15/16 inches
- **Maximum diameter:** 7/8 inch
- **Seated height range:** 1 21/32 inches to 1 15/16 inches

Heater Characteristics and Basing Configuration

The heater of the 12AD7 is designed for versatility, allowing operation from either a 12.6 V or a 6.3 V supply, using alternating or direct current (AC or DC).

Heater Parameter	Series Connection	Parallel Connection
Heater Voltage (AC or DC)	12.6 V	6.3 V
Heater Current	225 mA	450 mA

Heater-Cathode Voltage Limits (Design Center Values)

To maintain reliable operation and prevent insulation breakdown, the voltage difference between the heater and the cathode must be kept within the following limits:

- **Heater Negative with Respect to Cathode:** 200 V maximum (Total DC and Peak)
- **Heater Positive with Respect to Cathode:**
 - DC: 100 V maximum
 - Total DC and Peak: 200 V maximum

Pinout and Basing Arrangement (9A)

The 12AD7 uses the **9A** basing diagram, which provides separate connections for the electrodes of both triode sections, as well as a center-tapped heater.

- **Pin 1:** Plate (Triode Section 2)
- **Pin 2:** Grid (Triode Section 2)
- **Pin 3:** Cathode (Triode Section 2)
- **Pin 4:** Heater
- **Pin 5:** Heater
- **Pin 6:** Plate (Triode Section 1)
- **Pin 7:** Grid (Triode Section 1)
- **Pin 8:** Cathode (Triode Section 1)
- **Pin 9:** Heater Center Tap

Section 1 is connected to Pins 6, 7, and 8, while Section 2 is connected to Pins 1, 2, and 3. For parallel heater operation at 6.3 V, the heater supply is connected between Pin 9 and Pins 4 and 5 tied together. For series heater operation at 12.6 V, the supply is connected across Pin 4 and Pin 5, leaving Pin 9 open or used as a center tap.

Direct Interelectrode Capacitances

The direct interelectrode capacitances of the 12AD7 are detailed below. Measurements are provided for both shielded (using a standard Shield No. 315) and unshielded conditions. The input and output capacitance values are measured relative to the heater, cathode, internal shield, and external shield (h+k+is+es).

Capacitance Parameter	Shielded (Triode 1)	Shielded (Triode 2)	Unshielded (Triode 1)	Unshielded (Triode 2)
Grid to Plate	1.8 μpF	1.8 μpF	1.8 μpF	1.8 μpF
Input (g to h+k+is+es)	1.7 μpF	1.7 μpF	1.6 μpF	1.6 μpF
Output (p to h+k+is+es)	1.6 μpF	1.9 μpF	0.50 μpF	0.45 μpF

Maximum Ratings (Design Center Values)

The ratings below represent the absolute limits for each independent triode section of the 12AD7. Operating the tube beyond these design center values may impair performance or shorten tube life.

- **Plate Voltage:** 300 V maximum
- **Plate Dissipation:** 1.0 W maximum per section
- **Positive DC Grid Voltage:** 0 V maximum

- **Negative DC Grid Voltage:** 50 V maximum

Electrical Characteristics and Typical Operation

Under typical Class A1 amplifier operation, each triode section exhibits the following electrical characteristics:

- **Plate Voltage:** 250 V
- **Grid Voltage:** -2 V
- **Plate Current:** 1.25 mA
- **Plate Resistance (rp):** 62,500 Ω
- **Transconductance (gm):** 1,600 μmhos
- **Amplification Factor (μ):** 100

The fundamental triode relationship is verified by these typical values: $0.0016 \text{ S} * 62,500 \Omega = 100$

Resistance-Coupled Preamplifier Application

The 12AD7 is optimized for low-level audio preamplifier service. A specific operating point is established to demonstrate its low-hum performance. In this application, the heater sections are operated in parallel from a 6.3 V supply balanced to ground to minimize induced hum.

- **Heater Voltage:** 6.3 V (parallel, balanced to ground)
- **Plate Supply Voltage:** 250 V
- **Unbypassed Cathode Resistance:** 3,300 Ω
- **Grid Circuit Resistance:** 470,000 Ω
- **Plate Load Resistance:** 270,000 Ω
- **Maximum RMS Hum Level at Plate:** 3.0 mV

The unbypassed cathode resistor provides local negative feedback, which stabilizes the stage gain and linearizes the transfer characteristics, while the balanced-to-ground heater supply minimizes capacitive and inductive hum coupling into the high-impedance grid circuit.

Analysis of Characteristic Curves

The behavior of the 12AD7 across various operating conditions is illustrated by its average characteristic curves:

Average Plate Characteristics

The plate characteristics plot plate current (I_b) against plate voltage (E_b) for grid voltages (E_{c1}) ranging from 0 V down to -4.5 V. At a grid bias of 0 V, the plate current rises steeply, reaching 4.0 mA at approximately 180 V. As the grid bias becomes more negative, the curves shift to the right, requiring higher plate voltages to initiate conduction. For example, at a grid bias of -2.0 V, a plate voltage of 250 V yields the nominal plate current of 1.25 mA.

Plate Resistance vs. Plate Current

The transfer curves show that plate resistance (r_p) is highly dependent on plate current. At very low plate currents (below 0.5 mA), the plate resistance rises sharply, exceeding 120 k Ω . As plate current increases toward 4.0 mA, the plate resistance drops and flattens out, reaching approximately 45 k Ω at higher plate voltages ($E_b = 250$ V). At the typical operating point of 1.25 mA, the plate resistance is stable around 62.5 k Ω .

Plate Current vs. Grid Voltage

The transfer curves of plate current versus grid voltage demonstrate the control action of the grid. At a plate voltage of 250 V, the cutoff grid voltage is approximately -3.5 V. The curves show a highly linear region between -1.0 V and -2.5 V, which is ideal for low-distortion Class A1 amplification.

Amplification Factor and Transconductance vs. Plate Current

- **Amplification Factor (μ):** The amplification factor remains remarkably stable across a wide range of plate currents. For plate currents between 1.0 mA and 4.0 mA, μ varies only slightly, remaining between approximately 95 and 100.
- **Transconductance (g_m):** Unlike the amplification factor, transconductance is strongly dependent on plate current. It starts near 500 μ mhos at very low currents and rises continuously, reaching over 2,000 μ mhos as plate current approaches 4.0 mA. At the typical operating point of 1.25 mA, the transconductance is 1,600 μ mhos.

Technical Summary

The **12AD7** is a **miniature, 9-pin, high-mu double triode** designed specifically for high-gain, low-noise, and low-hum audio preamplifier applications. It features a versatile heater structure that can be operated in series (**12.6 V, 225 mA**) or parallel (**6.3 V, 450 mA**). Each independent triode section is rated for a maximum plate voltage of **300 V** and a plate dissipation of **1.0 W**.

At its typical Class A1 operating point, each section provides an amplification factor of **100**, a transconductance of **1,600 μ mhos**, and a plate resistance of **62,500 Ω** at a plate current of **1.25 mA**. When operated in a recommended resistance-coupled preamplifier circuit with a 6.3 V heater supply balanced to ground, the maximum RMS hum level at the plate is strictly controlled to a maximum of **3.0 mV**, ensuring exceptionally quiet performance in sensitive audio input stages.

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