

ELECTRONIC TUBE REFERENCE

12AZ7

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

High-mu miniature twin triode for resistance-coupled voltage amplification and phase-inverter service, with two similar triode units and series/parallel heater operation.

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	10900 Ω
TRANSCONDUCTANCE	0.0055 S
AMPLIFICATION FACTOR	60
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	2.5 W
<i>Representative row for electrically identical repeated sections.</i>	

SECTION2 Triode	
PLATE RESISTANCE	10900 Ω
TRANSCONDUCTANCE	0.0055 S
AMPLIFICATION FACTOR	60
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	2.5 W
<i>Second physical triode section; electrically identical twin section.</i>	

12AZ7 — High-Mu Twin Triode

An indirectly heated, dual-section miniature receiving valve designed for high-gain voltage amplification, frequency conversion, and cathode-drive amplifier service in high-frequency and audio-frequency applications.

Overview

The **12AZ7** is a general-purpose, high-mu twin triode of the 9-pin miniature (Noval) construction. It contains two independent, high-gain triode units within a single T-6 1/2 glass envelope. Each section is equipped with its own separate cathode and control grid, while sharing a common, mid-tapped heater. This physical separation of the cathodes provides excellent circuit flexibility, allowing the two sections to be operated in different configurations or at different bias levels.

The 12AZ7 is designed for a wide range of applications in VHF television receivers and audio systems. Its documented uses include service as a cathode-drive amplifier, a frequency converter (functioning as a combined oscillator and mixer), and a general-purpose audio-frequency (AF) voltage amplifier.

Mechanical Specifications and Physical Dimensions

The 12AZ7 is housed in a standard T-6 1/2 glass bulb with a small-button Noval 9-pin base (JETEC No. E9-1). The tube is designed to operate reliably in **any mounting position**.

Its physical dimensions are as follows:

- **Maximum Overall Length:** 2-3/16 inches
- **Maximum Seated Length:** 1-15/16 inches
- **Length from Base Seat to Bulb Top (excluding tip):** 1-9/16 inches $\pm$ 3/32 inch
- **Maximum Diameter:** 7/8 inch

Heater Configuration and Connections

The heater of the 12AZ7 is mid-tapped, allowing for operation from either a 12.6-volt or a 6.3-volt AC or DC power supply. This makes the tube highly adaptable to both series and parallel heater strings.

Heater Arrangement	Voltage (AC or DC)	Current	Connection Method
Series	12.6 V	0.225 A (225 mA)	Apply heater voltage between Pin 4 and Pin 5. Pin 9 is left open.
Parallel	6.3 V	0.450 A (450 mA)	Apply heater voltage between Pin 9 and Pins 4 and 5 connected together.

Pinout and Socket Connections

The 12AZ7 utilizes the **9A** basing diagram. Looking at the bottom of the tube base, the pin connections are assigned as follows:

Pin	Symbol	Connection
1	<u>PT2</u>	Plate of Triode Unit No. 2
2	GT2	Grid of Triode Unit No. 2
3	<u>KT2</u>	Cathode of Triode Unit No. 2
4	HT2	Heater of Triode Unit No. 2
5	HT1	Heater of Triode Unit No. 1
6	PT1	Plate of Triode Unit No. 1
7	<u>GT1</u>	Grid of Triode Unit No. 1
8	KT1	Cathode of Triode Unit No. 1
9	HM	Heater Mid-Tap

The separate cathode terminals (Pin 3 and Pin 8) ensure that the two triode units are electrically independent, preventing unwanted galvanic coupling and allowing different bias levels or circuit topologies to be implemented simultaneously.

Direct Interelectrode Capacitances

The interelectrode capacitances of the 12AZ7 vary depending on whether the circuit is configured for grid-drive or cathode-drive operation, and whether an external shield is employed. The values below represent typical measurements with and without an external shield (specifically JETEC No. 315, connected to the cathode of the unit under test).

Grid-Drive Operation

In standard grid-drive configurations, the capacitances for each triode unit are:

Parameter	Without External Shield	With External Shield
Grid to Plate (each unit)	1.9 to 2.0 pF	1.9 pF
Grid to Heater and Cathode (each unit)	2.6 to 3.1 pF	2.8 to 3.2 pF
Plate to Heater and Cathode (Unit No. 1)	0.44 to 0.5 pF	1.3 to 1.4 pF
Plate to Heater and Cathode (Unit No. 2)	0.36 to 0.4 pF	1.6 pF
Heater to Cathode (each unit)	3.8 pF	4.0 pF

Cathode-Drive Operation

For cathode-drive applications, the effective capacitances are:

Parameter	Without External Shield	With External Shield
Plate to Cathode (each unit)	0.24 pF	0.23 pF
Cathode to Grid and Heater (each unit)	6.9 pF	7.0 pF
Plate to Grid and Heater (Unit No. 1)	2.0 pF	2.8 pF
Plate to Grid and Heater (Unit No. 2)	2.0 pF	3.2 pF

Maximum Ratings

The ratings for the 12AZ7 are established under the **Design-Center System**. These represent the maximum limits within which the tube can be operated safely and reliably. The values are specified per individual triode unit:

Rating Parameter	Maximum Limit	Unit
Plate Voltage	300	Volts
Negative DC Grid Voltage	-50	Volts
Plate Dissipation	2.5	Watts
Peak Heater-Cathode Voltage (Heater Negative to Cathode)	200	Volts
Peak Heater-Cathode Voltage (Heater Positive to Cathode)	200	Volts
DC Heater-Cathode Voltage (Heater Positive to Cathode)	100	Volts
Grid-No. 1 Circuit Resistance (Fixed-Bias)	0.25	Megohm
Grid-No. 1 Circuit Resistance (Cathode-Bias)	1.0	Megohm

Note: The DC component of the heater-positive-to-cathode voltage must not exceed 100 volts.

Typical Operating Conditions and Characteristics

The 12AZ7 can be operated under various Class A1 amplifier conditions. Typical operating points for each triode unit are detailed below for two different plate supply voltages:

Parameter	Operating Point A	Operating Point B	Unit
Plate Voltage	100	250	Volts
Cathode Bias Resistor	270	200	Ohms
Plate Current	3.7	10	mA
Plate Resistance (Approx.)	15,000	10,900	Ohms
Transconductance	4,000	5,500	μ mhos

Parameter	Operating Point A	Operating Point B	Unit
Amplification Factor (μ)	60	60	
Grid Voltage (Approx.) for $I_b = 10$ μA	-5	-12	Volts

At a plate voltage of 250 V and a cathode bias resistor of 200 ohms, the tube draws 10 mA of plate current, exhibiting a transconductance of 5,500 μmhos and a plate resistance of 10,900 ohms. Under these conditions, the amplification factor remains constant at 60.

Operating Considerations and Characteristic Curves

The maximum ratings of the 12AZ7 are working design-center maximums. To ensure satisfactory performance and longevity, equipment must be designed so that these maximum ratings are not exceeded under normal operating conditions. This includes accounting for power-line supply variations; the design should accommodate fluctuations of up to $\pm 10\%$ around a nominal line-center voltage of 117 volts (for both AC and DC line supplies).

Analysis of Average Characteristics

The average plate characteristics (plate current vs. plate voltage) illustrate the behavior of the triode units across a range of grid bias voltages from 0 V down to -12 V.

- At lower plate voltages (e.g., 100 V), the plate current is highly sensitive to grid bias, dropping to near cutoff (10 μA) at approximately -5 V.
- At higher plate voltages (e.g., 250 V), the grid bias must be increased to approximately -12 V to achieve the same cutoff current.

The relationship between the tube's primary parameters—transconductance (g_m), plate resistance (r_p), and amplification factor (μ)—is also dependent on the operating point:

- **Amplification Factor (μ):** Remains remarkably stable near 60 across a wide range of plate currents, particularly when operating at a plate voltage of 250 V.
- **Transconductance (g_m):** Increases dynamically with plate current. At low plate currents (around 2 mA), the transconductance is approximately 3,000 μmhos , rising to over 5,500 μmhos as the plate current approaches 10 mA and exceeding 6,000 μmhos at higher currents.
- **Plate Resistance (r_p):** Decreases as plate current increases. It starts at approximately 20,000 ohms at very low currents, drops to 15,000 ohms at 3.7 mA, and further decreases to 10,900 ohms at 10 mA.

This inverse relationship between g_m and r_p maintains the constant amplification factor ($\mu \approx g_m \times r_p$). For example, at the 250 V operating point, the calculation is: $0.0055 \text{ S} \times 10,900 \Omega = 59.95 \approx 60$

Technical Summary

The **12AZ7** is a versatile, **9-pin miniature high-mu twin triode** featuring **independent unipotential cathodes** and a **mid-tapped heater** configurable for **12.6 V / 0.225 A** or **6.3 V / 0.450 A** operation. With an amplification factor of **60**, a transconductance of up to **5,500 μ mhos**, and a plate resistance of **10,900 ohms** at typical operating points, it provides high gain and moderate plate impedance.

Its design-center ratings permit a maximum plate voltage of **300 V** and a plate dissipation of **2.5 W** per unit. The separate cathode connections and low interelectrode capacitances make the 12AZ7 highly effective for a range of demanding applications, including **VHF television cathode-drive amplifiers, frequency converters, oscillators, mixers, and general-purpose AF voltage amplifiers.**



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1940 RCA

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

1940 RCA

Section 1 · Triode

APPLICATION

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Application	VHF_Television_Amplifier text	—



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1961 Tung Sol

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

1961 TUNG SOL

Section 1 · Triode

OTHER

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	150 V	—

CHARACTERISTIC

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	6 mA	—



1966 Tung Sol Electronic Tubes 2 of 4

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

1966 TUNG SOL ELECTRONIC TUBES 2 OF 4

Section 1 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
I I6	12.6 V	Published datasheet; operating column 1
I I6	6.3 V	Published datasheet; operating column 2
SECTION #2	0.5 pF	Published datasheet; operating column 1
SECTION #2	1.6 pF	Published datasheet; operating column 2
MAXIMUM PLATE VOLTAGE	300 V	Published datasheet
MAXIMUM NEGATIVE DC GRID VOLTAGE	-50 V	Published datasheet
MAXIMUM PLATE DISSIPATION	2.5 W	Published datasheet
FOR FIXED BIAS	0 Mohm	Published datasheet; operating column 1
FOR FIXED BIAS	0.25 Mohm	Published datasheet; operating column 2
CATHODE BIAS RESISTOR	270 ohm	Published datasheet; operating column 1
CATHODE BIAS RESISTOR	200 ohm	Published datasheet; operating column 2
CATHODE BIAS RESISTOR	0 ohm	Published datasheet; operating column 3
T RANSCONDUCTANCE	4 uS	Published datasheet; operating column 1
T RANSCONDUCTANCE	0 uS	Published datasheet; operating column 2
T RANSCONDUCTANCE	5 uS	Published datasheet; operating column 3
FOR Ib = i0 μA	-5 V	Published datasheet; operating column 1
FOR Ib = i0 μA	-12 V	Published datasheet; operating column 2

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
GRID TO PLATE: (G TO P) EACH SECTION	2 pF	Published datasheet; operating column 1
GRID TO PLATE: (G TO P) EACH SECTION	1.9 pF	Published datasheet; operating column 2
INPUT: G TO (H}KJ EACH SECTION	2.6 pF	Published datasheet; operating column 1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
INPUT: G TO (H)KJ EACH SECTION	2.8 pF	Published datasheet; operating column 2

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
HEATER VOLTAGE t2	6 V	Published datasheet; operating column 1
HEATER VOLTAGE t2	3 V	Published datasheet; operating column 2
Hf ATER VOLTAGE G	3 V	Published datasheet; operating column 1
Hf ATER VOLTAGE G	12.6 V	Published datasheet; operating column 2
HEATER CURRENT	450 mA	Published datasheet; operating column 1
HEATER CURRENT	225 mA	Published datasheet; operating column 2
PLATE VOLTAGE L00	250 V	Published datasheet
PLATE CURRENT	3 mA	Published datasheet
PLATE RESISTANCE Z5	0 ohm	Published datasheet; operating column 1
PLATE RESISTANCE Z5	900 ohm	Published datasheet; operating column 2
Plate resistance	10900 ohm	Published datasheet; promoted section value
Transconductance	0.0055 A/V	Published datasheet; promoted section value
Amplification factor	60	Published datasheet; promoted section value

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