

ELECTRONIC TUBE REFERENCE

12AX7WA

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

Military/premium high-mu twin triode for high-gain voltage amplification, phase inversion, and multivibrator service, with ruggedized construction intended for dependable operation.

GENERAL CHARACTERISTICS

|                     |                   |                      |                |
|---------------------|-------------------|----------------------|----------------|
| BASE DESIGNATION    | —                 | BASE PINS            | 9              |
| NOMINAL HEATER      | 12.6 V / 150 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                                                 | 0.00165 S |
| AMPLIFICATION FACTOR                                             | 100       |
| MAXIMUM PLATE VOLTAGE                                            | 330 V     |
| MAXIMUM PLATE DISSIPATION                                        | 1.2 W     |
| MAXIMUM CATHODE CURRENT                                          | 8 mA      |
| Representative row for electrically identical repeated sections. |           |

|                                                                      |                |
|----------------------------------------------------------------------|----------------|
| SECTION2 Triode                                                      |                |
| PLATE RESISTANCE                                                     | 62500 $\Omega$ |
| TRANSCONDUCTANCE                                                     | 0.00165 S      |
| AMPLIFICATION FACTOR                                                 | 100            |
| MAXIMUM PLATE VOLTAGE                                                | 330 V          |
| MAXIMUM PLATE DISSIPATION                                            | 1.2 W          |
| MAXIMUM CATHODE CURRENT                                              | 8 mA           |
| Second physical triode section; electrically identical twin section. |                |

# 12AX7WA — High-Mu Twin Triode

The **12AX7WA** (also designated as **12AX7WA/7025**) is a miniature, high-mu double triode vacuum tube featuring independent triode sections and indirectly heated, equipotential (coated unipotential) cathodes. Designed primarily for high-gain audio amplifier service, low-frequency voltage amplification in radio engineering, and military applications, this tube is highly adaptable to circuits requiring high voltage gain and low heater power consumption. Typical applications include voltage amplifiers, phase inverters, and multivibrators.

## Physical Construction and Pin Configuration

The 12AX7WA is constructed in a miniature glass envelope (T-6 1/2 bulb) with a small button 9-pin noval base (E9-1 outline, JEDEC 6-2). The tube is designed to operate in any mounting position.

## Physical Dimensions

- **Maximum Overall Length:** 2.188 inches (56.5 mm)
- **Maximum Seated Height:** 1.938 inches
- **Bulb Diameter:** 0.750 to 0.875 inches (nominal 22.5 mm with a -2 mm tolerance)

## Pinout and Basing Diagram

The tube utilizes the JEDEC 9A bottom-view basing arrangement, which provides independent connections for each triode section, alongside a center-tapped heater:

| Pin | Electrode Designation |
|-----|-----------------------|
| 1   | Second triode plate   |
| 2   | Second triode grid    |
| 3   | Second triode cathode |
| 4   | Heater                |

| Pin | Electrode Designation |
|-----|-----------------------|
| 5   | Heater                |
| 6   | First triode plate    |
| 7   | First triode grid     |
| 8   | First triode cathode  |
| 9   | Heater center tap     |

## Heater Characteristics and Ratings

The center-tapped heater design allows the 12AX7WA to be operated from either a 6.3 V or a 12.6 V power supply, supporting both series and parallel heater wiring configurations.

| Connection Type | Supply Pins | Nominal Voltage | Nominal Current           | Permissible Voltage Limits     |
|-----------------|-------------|-----------------|---------------------------|--------------------------------|
| Series          | 4 and 5     | 12.6 V          | 150 mA (150–170 mA range) | $12.6 \pm 1.2$ V (12.0–13.2 V) |
| Parallel        | 9 and 4+5   | 6.3 V           | 300 mA (300–340 mA range) | $6.3 \pm 0.6$ V (6.0–6.6 V)    |

## Electrical Characteristics and Operating Points

Under typical Class A1 amplifier operating conditions, each triode section exhibits high amplification and high plate resistance. The nominal electrical parameters per section are defined at a specific operating point:

- **Plate Voltage:** 250 V
- **Grid Voltage:** -2 V
- **Plate Current:** 1.2 mA (with a nominal range of 0.75 to 2.0 mA)
- **Amplification Factor ( $\mu$ ):** 100 (with a nominal range of 82 to 110)
- **Transconductance ( $g_m$ ):** 1,650  $\mu$ mhos (with a minimum characteristic slope of 1.1 mA/V)
- **Plate Resistance ( $r_p$ ):** 62,500  $\Omega$

## Section Matching and Cutoff Characteristics

- **Plate Current Balance:** The difference in plate current between the first and second triode sections is limited to a maximum of  $\pm 40\%$ .
- **Cutoff Plate Current:** At a plate voltage of 250 V and a grid bias of -5.5 V, the plate current at the beginning of the characteristic is restricted to a maximum of 20  $\mu$ A.

- **Grid Reverse Current:** Under typical operating conditions with a 1.0 MΩ grid circuit resistance, the reverse grid current does not exceed 0.2 μA.
- **Cathode-Heater Insulation:** The insulation resistance between the cathode and the heater is a minimum of 20 MΩ when subjected to a cathode-heater voltage of ± 200 V.

## Maximum Ratings and Limiting Values

To ensure reliable operation, particularly in military and high-reliability applications, the following design maximum and limiting values must not be exceeded for each triode unit:

| Parameter                                    | Value / Limit                                           |
|----------------------------------------------|---------------------------------------------------------|
| Maximum Plate Voltage                        | 300 V to 330 V                                          |
| Maximum Plate Dissipation                    | 1.0 W                                                   |
| Maximum Negative Grid Bias                   | -50 V                                                   |
| Maximum Positive Grid Bias                   | 0 V                                                     |
| Maximum Cathode Current                      | 10 mA                                                   |
| Maximum Cathode-Heater Voltage               | ± 200 V                                                 |
| Maximum Grid Circuit Resistance (Fixed Bias) | 1.0 MΩ                                                  |
| Maximum Grid Circuit Resistance (Self-Bias)  | 2.2 MΩ                                                  |
| Maximum Envelope/Bulb Temperature            | +165 °C (or 368 K / 95 °C depending on rating standard) |
| Maximum Operating Altitude                   | 80,000 feet                                             |

The tube is also rated to withstand specified shock and heater cycling tests to verify structural integrity under demanding environmental conditions.

## Direct Interelectrode Capacitances

The direct interelectrode capacitances of each triode section, measured without an external shield, are approximately:

- **Grid to Plate (C<sub>gp</sub>):** 1.7 pF
- **Input (C<sub>in</sub>):** 1.8 pF
- **Output (Section 1):** 0.46 pF
- **Output (Section 2):** 0.34 pF

# Resistance-Coupled Amplifier Operation

The 12AX7WA is widely utilized in resistance-coupled voltage amplifier stages. Performance characteristics vary based on the plate supply voltage ( $E_{bb}$ ), plate load resistance ( $R_p$ ), grid resistor of the following stage ( $R_g$ ), and grid resistor ( $R_{g1}$ ).

The following table outlines typical operating configurations and performance metrics (where  $E_o$  represents the maximum RMS voltage output for 5% total harmonic distortion, and gain is measured at 2.0 V RMS output):

| $R_p$ (M $\Omega$ ) | $R_s$ (M $\Omega$ ) | $R_{g1}$ (M $\Omega$ ) | $E_{bb} = 90$ V<br>( $R_k$ / Gain / $E_o$ ) | $E_{bb} = 180$ V<br>( $R_k$ / Gain / $E_o$ ) | $E_{bb} = 300$ V<br>( $R_k$ / Gain / $E_o$ ) |
|---------------------|---------------------|------------------------|---------------------------------------------|----------------------------------------------|----------------------------------------------|
| 0.10                | 0.10                | 0.1                    | 1700 $\Omega$ / 31 / 5.0 V                  | 1000 $\Omega$ / 40 / 15 V                    | 760 $\Omega$ / 43 / 30 V                     |
| 0.10                | 0.24                | 0.1                    | 2000 $\Omega$ / 38 / 6.9 V                  | 1100 $\Omega$ / 46 / 20 V                    | 900 $\Omega$ / 50 / 40 V                     |
| 0.24                | 0.24                | 0.1                    | 3500 $\Omega$ / 43 / 6.5 V                  | 2000 $\Omega$ / 54 / 18 V                    | 1600 $\Omega$ / 58 / 37 V                    |
| 0.24                | 0.51                | 0.1                    | 3900 $\Omega$ / 49 / 8.6 V                  | 2300 $\Omega$ / 59 / 24 V                    | 1800 $\Omega$ / 64 / 47 V                    |
| 0.51                | 0.51                | 0.1                    | 7100 $\Omega$ / 50 / 7.4 V                  | 4300 $\Omega$ / 62 / 19 V                    | 3100 $\Omega$ / 66 / 39 V                    |
| 0.51                | 1.00                | 0.1                    | 7800 $\Omega$ / 53 / 9.1 V                  | 4800 $\Omega$ / 64 / 24 V                    | 3600 $\Omega$ / 69 / 46 V                    |
| 0.24                | 0.24                | 10                     | 0 $\Omega$ / 37 / 3.9 V                     | 0 $\Omega$ / 53 / 15 V                       | 0 $\Omega$ / 62 / 32 V                       |
| 0.24                | 0.51                | 10                     | 0 $\Omega$ / 44 / 5.4 V                     | 0 $\Omega$ / 60 / 19 V                       | 0 $\Omega$ / 67 / 41 V                       |
| 0.51                | 0.51                | 10                     | 0 $\Omega$ / 44 / 5.0 V                     | 0 $\Omega$ / 61 / 17 V                       | 0 $\Omega$ / 69 / 35 V                       |
| 0.51                | 1.00                | 10                     | 0 $\Omega$ / 49 / 6.4 V                     | 0 $\Omega$ / 66 / 21 V                       | 0 $\Omega$ / 71 / 41 V                       |

*Note: For zero-bias data (where  $R_{g1} = 10$  M $\Omega$  and  $R_k = 0$ ), the generator impedance is negligible. Coupling capacitors should be selected to achieve the desired frequency response, and the cathode resistor ( $R_k$ ) must be adequately bypassed.*

## Technical Summary

The **12AX7WA** is a highly versatile, **9-pin miniature, high-mu twin triode** designed for low-power, high-gain voltage amplification. With an amplification factor of **100**, a transconductance of **1,650  $\mu\text{mhos}$** , and a plate resistance of **62,500  $\Omega$**  under typical Class A1 conditions, it provides exceptional voltage gain. Its flexible heater design supports both **6.3 V parallel** and **12.6 V series** operation, making it highly compatible with diverse power supply configurations. Built to withstand demanding environments, including high altitudes (up to 80,000 feet) and thermal stress, the 12AX7WA remains a standard choice for robust audio and military voltage amplification applications.



## 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 | 250 V           | —                |

| CHARACTERISTIC |                 |                  |
|----------------|-----------------|------------------|
| PARAMETER      | PUBLISHED VALUE | CONDITION / NOTE |
| Plate Current  | 1.2 mA          | —                |



## SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

# 1966 Tung Sol Electronic Tubes 3 of 4

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

1966 TUNG SOL ELECTRONIC TUBES 3 OF 4

## Section 1 · Triode

| OTHER            |                 |                     |
|------------------|-----------------|---------------------|
| PARAMETER        | PUBLISHED VALUE | CONDITION / NOTE    |
| Plate voltage    | 250 V           | ClassA;EachSection  |
| Plate current    | 1.2 mA          | ClassA;EachSection  |
| Grid voltage     | -2 V            | ClassA;EachSection  |
| Maximum altitude | 80000 ft        | MilitaryApplication |

| CHARACTERISTIC   |                 |                    |
|------------------|-----------------|--------------------|
| PARAMETER        | PUBLISHED VALUE | CONDITION / NOTE   |
| Plate resistance | 62500 ohm       | ClassA;EachSection |
|                  |                 |                    |

| PARAMETER            | PUBLISHED VALUE               | CONDITION / NOTE   |
|----------------------|-------------------------------|--------------------|
| Transconductance     | <b>1650 <math>\mu</math>S</b> | ClassA;EachSection |
| Amplification factor | <b>100</b>                    | ClassA;EachSection |

| CAPACITANCE               |                 |                  |
|---------------------------|-----------------|------------------|
| PARAMETER                 | PUBLISHED VALUE | CONDITION / NOTE |
| Grid-to-plate capacitance | <b>1.7 pF</b>   | EachSection      |
| Input capacitance         | <b>1.8 pF</b>   | EachSection      |