



ELECTRONIC TUBE REFERENCE

12AY7EH

Voltage - Dual Triode (similar) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

TRIODE-TRIODE

Modern 12AY7-type twin triode intended for low-noise audio voltage amplification, combining moderate gain with useful linearity for preamplifier and driver applications.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	9
NOMINAL HEATER	6.3 V / 355 mA	PARALLEL HEATER	6.3 V / 355 mA
HEATING	Indirect	SERIES OPERATION	Capable
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Triode	
TRANSCONDUCTANCE	0.0017 S
AMPLIFICATION FACTOR	35
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1.5 W
Representative section for two electrically identical triodes.	

SECTION2 Triode	
TRANSCONDUCTANCE	0.0017 S
AMPLIFICATION FACTOR	35
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	1.5 W
Second physical triode section; electrically identical twin section.	

12AY7EH / 6072A Miniature Twin Triode

The **12AY7EH** (also designated as **12AY7EH/6072A**) is a miniature twin triode vacuum tube featuring independent, equipotential cathodes. It is specifically designed for low-frequency voltage amplification in radio engineering devices. By combining two electrically separate triode sections within a single compact glass envelope, the 12AY7EH provides a space-efficient solution for preamplifier stages, voltage amplifiers, and phase-inverter circuits.

Physical Specifications and Pin Configuration

The 12AY7EH is constructed in a miniature glass envelope with a nine-pin base arrangement. The physical dimensions are tightly controlled to ensure compatibility with standard miniature tube sockets:

- **Maximum Overall Height:** 56.5 mm
- **Envelope Diameter:** 22.5 mm (with a tolerance of -2 mm, resulting in an effective diameter range of 20.5 mm to 22.5 mm)
- **Pin Circle Diameter:** 12 mm
- **Pin Diameter:** 1.0 mm (with a tolerance of +0.03 mm / -0.07 mm)
- **Pin Spacing:** 36° angular spacing between adjacent pins, spanning a total of 288° across the eight gaps of the nine-pin circle.

The tube can be operated in any mounting position. The electrode connections are routed to the base pins according to the following layout, viewed from the underside of the tube:

Pin Number	Electrode Designation	Associated Triode Section
1	Plate (Anode)	Second Triode
2	Control Grid	Second Triode
3	Cathode	Second Triode
4	Heater	Common
5	Heater	Common
6	Plate (Anode)	First Triode
7	Control Grid	First Triode
8	Cathode	First Triode
9	Heater (Center Tap)	Common

The independent connections for the plates, grids, and cathodes of both triodes allow each section to be biased and operated completely independently, subject only to the shared heater supply and heater-to-cathode voltage limitations.

Heater and Power Supply Configurations

The heater design of the 12AY7EH is highly versatile, utilizing a three-terminal configuration (pins 4, 5, and 9) that supports both parallel and series power supply arrangements. This flexibility allows the tube to be integrated into standard 6.3 V or 12.6 V equipment power rails.

Parallel Connection (6.3 V Nominal)

In a parallel configuration, the heater supply is applied across the combined pins 4 and 5 connected together, and pin 9.

- **Nominal Filament Voltage:** 6.3 V
- **Permissible Voltage Range:** 6.0 V to 6.6 V
- **Heater Current Draw:** 340 mA to 370 mA
- **Calculated Power Consumption:** 2.14 W to 2.33 W (calculated as $P = V * I$ using the minimum and maximum current limits at 6.3 V)

Series Connection (12.6 V Nominal)

In a series configuration, the heater supply is applied directly across pins 4 and 5, while the center tap (pin 9) is left unconnected or referenced to a potential.

- **Nominal Filament Voltage:** 12.6 V
- **Permissible Voltage Range:** 12.0 V to 13.2 V
- **Heater Current Draw:** 170 mA to 185 mA
- **Calculated Power Consumption:** 2.14 W to 2.33 W (calculated as $P = V * I$ using the minimum and maximum current limits at 12.6 V)

Heater-to-Cathode Insulation

Because the cathodes are equipotential and separate from the heater filament, a high level of electrical isolation is maintained between them. The minimum insulation resistance between the heater and the cathode is **10 MΩ**, measured at a heater-to-cathode voltage of +/- 100 V under either 6.3 V or 12.6 V filament operation.

Electrical Parameters and Operating Points

The nominal electrical characteristics of each triode section are evaluated under specific, standardized operating conditions. Unless otherwise specified, these parameters apply to either 6.3 V or 12.6 V heater operation at an ambient temperature:

- **Plate Voltage (E_p):** 250 V
- **Grid Bias Voltage (E_g):** -4.0 V
- **Grid Circuit Resistance (R_g):** 1.0 MΩ

Under these test conditions, the individual triode sections exhibit the following electrical parameters:

Parameter	Minimum Value	Maximum Value	Unit
Plate Current (Ip)	2.2	3.75	mA
Slope of Characteristic (Transconductance, gm)	1.3	2.1	mA/V
Amplification Factor (mu)	35	—	—
Grid Reverse Current (Ig_rev)	—	0.2	μA
Section-to-Section Plate Current Difference	—	+/- 40	%

Cutoff Characteristics

The cutoff behavior of the control grid is defined by measuring the residual plate current near the beginning of the characteristic. At a plate voltage of 250 V and a negative grid bias of **-11.0 V**, the plate current is restricted to a maximum of **30 μA**, indicating effective channel cutoff.

Triode Parameter Relationships

The fundamental triode relationship is defined by $\mu = g_m \cdot r_p$, where r_p is the internal plate resistance. Using the minimum amplification factor ($\mu = 35$) and the transconductance range ($g_m = 1.3$ to 2.1 mA/V), the calculated plate resistance under nominal conditions ranges as follows:

- At maximum transconductance (2.1 mA/V): r_p is approximately 16.7 kΩ (calculated as $35 / 0.0021$ A/V)
- At minimum transconductance (1.3 mA/V): r_p is approximately 26.9 kΩ (calculated as $35 / 0.0013$ A/V)

The relatively low plate resistance and moderate amplification factor make the 12AY7EH highly linear and less prone to high-frequency roll-off caused by Miller effect capacitance compared to higher- μ triodes like the [12AX7](#).

Absolute Maximum Ratings

To ensure reliable operation and prevent premature failure or degradation of the tube, the following limiting values must not be exceeded. These ratings are absolute maximums and should be applied independently:

- **Maximum Plate Voltage:** 300 V
- **Maximum Plate Dissipation (per triode section):** 1.5 W
- **Maximum Cathode Current:** 10 mA
- **Maximum Heater-to-Cathode Voltage:** +/- 100 V

- **Maximum Grid Circuit Resistance (Fixed Bias):** 1.0 MΩ
- **Maximum Grid Circuit Resistance (Self-Bias):** 2.0 MΩ

Operating the tube with self-bias (cathode bias) allows for a higher grid circuit resistance (up to 2.0 MΩ) because the cathode resistor provides negative feedback that stabilizes the plate current against thermal runaway caused by minor grid emission or gas currents. Under fixed bias conditions, the grid resistance must be restricted to 1.0 MΩ to maintain bias stability.

Analysis of Characteristic Curves

The behavior of the 12AY7EH across its operating envelope is illustrated by two primary sets of characteristic curves: the transfer characteristics (I_p vs. E_g) and the plate characteristics (I_p vs. E_p).

Transfer Characteristics ($I_p = f(E_g)$)

The transfer curves plot plate current in milliamperes against negative grid voltage in volts, evaluated at three distinct plate voltages: 200 V, 250 V, and 300 V.

- **Linearity:** The curves exhibit a highly linear slope over the grid voltage range of -1 V to -5 V, which corresponds to the nominal operating region. This linearity is crucial for minimizing total harmonic distortion (THD) in low-frequency voltage amplifiers.
- **Cutoff Region:** As the grid voltage becomes more negative, the curves converge toward zero plate current. At a plate voltage of 250 V, the plate current drops below 1 mA as the grid bias approaches -8 V, and reaches the microampere level (cutoff) near -11 V.
- **Voltage Dependence:** Increasing the plate voltage shifts the transfer curve to the left, requiring a more negative grid bias to maintain a constant plate current. For example, to maintain a plate current of 4 mA, the grid voltage must be approximately -2.2 V at $E_p = 200$ V, -3.5 V at $E_p = 250$ V, and -4.8 V at $E_p = 300$ V.

Plate Characteristics ($I_p = f(E_p)$)

The plate curves plot plate current in milliamperes against plate voltage in volts, with individual curves representing discrete grid bias steps from 0 V down to -8 V.

- **Triode Knee and Saturation:** The curves rise smoothly from the origin without the sharp knee characteristic of pentodes, demonstrating classic triode behavior.
- **Grid Bias Spacing:** The uniform spacing between the grid bias curves (especially between $E_g = 0$ V and $E_g = -4$ V) indicates that the amplification factor (μ) remains highly stable across a wide range of plate voltages and currents.
- **Load Line Selection:** For a typical Class A amplifier stage, a load line can be plotted across these curves. For instance, with a 300 V supply and a typical anode load, the operating point can be safely positioned within the 1.5 W plate dissipation boundary (which corresponds to a curve of $I_p * E_p = 1.5$ W, such as 5 mA at 300 V or 10 mA at 150 V).

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