



ELECTRONIC TUBE REFERENCE

12AJ6

Voltage - Triode (under 100V) electronic tube

CONSOLIDATED TECHNICAL DATA

3 SECTIONS

CONSTRUCTION

DIODE-DIODE-TRIODE

Double-diode high-mu triode for low-voltage detector and voltage-amplifier service. The diode sections handle detection or control-voltage rectification while the triode provides substantial subsequent signal gain.

GENERAL CHARACTERISTICS

BASE DESIGNATION	7BT	BASE PINS	7
NOMINAL HEATER	12.6 V / 150 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Common cathode	SECTION CONSTRUCTION	Dissimilar

7BT - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – 1G1	A	G1 – Control Grid	CONNECTED
PIN2 – K	A	K – Cathode	CONNECTED
PIN3 – H	–	H – Heater	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN5 – 2P	B	P – Plate (Anode)	CONNECTED
PIN6 – 3P	C	P – Plate (Anode)	CONNECTED
PIN7 – 1P	A	P – Plate (Anode)	CONNECTED

SECTION RATINGS

SECTION1 Diode	
<i>No fixed ratings recorded.</i>	
<i>Published promoted fields populated semantically; identical repeated sections compressed.</i>	

SECTION2 Triode	
PLATE RESISTANCE	45000 Ω
TRANSCONDUCTANCE	0.0012 S
AMPLIFICATION FACTOR	55
MAXIMUM PLATE VOLTAGE	30 V
MAXIMUM CATHODE CURRENT	20 mA
MAXIMUM HEATER-CATHODE VOLTAGE	30 V
<i>Published promoted fields populated semantically; identical repeated sections compressed.</i>	

SECTION3 Diode	
<i>No fixed ratings recorded.</i>	
<i>Second physical detector diode; duplicated from identical diode section.</i>	

12AJ6 — Double-Diode High-Mu Triode Miniature Vacuum Tube

Overview

The **12AJ6** is a miniature double-diode high-mu triode vacuum tube designed for use in automotive receiver applications. It combines a double-diode detector and a high-mu triode voltage amplifier within a single 7-pin miniature envelope. The tube features a common unipotential cathode shared between the triode and diode sections.

The primary design objective of the 12AJ6 is to operate directly from a nominal 12-volt automotive storage battery. Both the heater and the plate potentials are obtained directly from this battery source, eliminating the need for high-voltage vibrator power supplies or step-up transformers for these stages. In this service, the triode section functions as an audio-frequency (AF) voltage amplifier, while the diode units serve as a second detector and automatic volume control (AVC) or automatic gain control (AGC) rectifier.

Mechanical Specifications and Pinout

The 12AJ6 is constructed in a compact glass envelope with a miniature button 7-pin base. The physical dimensions and mechanical configuration are as follows:

- **Bulb Type:** T-5 1/2
- **Base:** E7-1, Miniature Button 7-Pin
- **Outline Designation:** 5-2
- **Basing Diagram:** 7BT
- **Maximum Overall Length:** 2 1/8 inches
- **Maximum Seated Height:** 1 7/8 inches
- **Maximum Diameter:** 3/4 inch
- **Mounting Position:** Any

The 7BT basing arrangement provides the following pin connections, viewed from the bottom of the tube:

Pin Number	Electrode Connection
1	Control Grid (G)
2	Cathode (K)
3	Heater (H)
4	Heater (H)
5	Diode Plate 2 (<u>P</u> 2)
6	Diode Plate 1 (P1)
7	Triode Plate (P)

Heater and Cathode Characteristics

The 12AJ6 utilizes a coated unipotential cathode. The heater is designed to operate under the wide voltage variations typical of automotive electrical systems.

Parameter	Value
Nominal Heater Voltage	12.6 V
Nominal Heater Current	0.15 A (150 mA)
Heater Supply Type	AC or DC
Permissible Heater Voltage Range	10.0 V to 15.9 V

Because the tube is intended for direct connection to a nominal 12-volt automotive battery, the heater is engineered to operate satisfactorily over a range of 10.0 to 15.9 volts. The maximum ratings of the tube

provide an adequate safety factor to ensure reliable operation and survival despite these wide supply voltage fluctuations.

The heater-to-cathode insulation is rated to withstand moderate potential differences, which is critical in automotive circuits where the cathode may be biased above ground:

- **Maximum Heater-Cathode Voltage (Heater Negative with respect to Cathode):** 30 V
- **Maximum Heater-Cathode Voltage (Heater Positive with respect to Cathode):** 30 V

Direct Interelectrode Capacitances

The direct interelectrode capacitances of the 12AJ6 are measured without an external shield. These values determine the high-frequency performance and isolation between the triode and diode sections:

- **Grid to Plate (G to P):** 2.0 μF
- **Input (G to [H + K]):** 2.2 μF
- **Output (P to [H + K]):** 0.8 μF
- **Diode to Diode (P1 to P2):** 0.9 μF

Maximum Ratings

The maximum ratings for the 12AJ6 are established under the Design-Center System. Operating the tube beyond these limits may impair performance or shorten its operating life.

- **Maximum Plate Voltage:** 30 V
- **Maximum Cathode Current:** 20 mA
- **Maximum Average Diode Current (per diode):** 1.0 mA
- **Maximum Grid Circuit Resistance:** 10 Megohms

Electrical Characteristics and Typical Operation

The triode section of the 12AJ6 is characterized by a high amplification factor, making it highly effective for voltage amplification at low plate voltages. The typical operating parameters for Class A1 amplifier service are outlined below:

Triode Unit Characteristics

- **Plate Voltage:** 12.6 V
- **Grid Voltage:** 0 V
- **Plate Current:** 750 μA (0.75 mA)
- **Plate Resistance:** 45,000 Ohms
- **Transconductance:** 1,200 μmhos
- **Amplification Factor (μ):** 55

Diode Units Characteristics

The two diode units are independent of the triode section except for the shared cathode. They are designed for low-current detection and AVC rectification.

- **Average Diode Current (per diode):** 2.0 mA under a test condition of 10 Volts applied.

Resistance-Coupled Amplifier Application

In typical automotive receiver designs, the triode section of the 12AJ6 is operated as a resistance-coupled audio-frequency voltage amplifier. Under these conditions, the grid bias is typically developed via contact potential across a high-value grid resistor.

Parameter	Operating Value
Plate Supply Voltage	12.6 V
Control Grid Voltage	0 V (nominal)
Grid Resistor	1.0 Megohm
Plate Load Resistor	1.0 Megohm
Input Coupling Capacitor	0.02 μ F
Output Coupling Capacitor	0.01 μ F
Grid Resistor of Following Stage	2.0 Megohms
Voltage Gain (at 400 CPS)	16

The voltage gain of 16 is measured at an audio frequency of 400 CPS (Hz) with an output voltage of 1.0 Volt RMS. The grid bias is maintained by the average contact potential developed across the 1.0 Megohm grid resistor.

Average Plate Characteristics

The average plate characteristics of the 12AJ6 triode unit illustrate the relationship between plate voltage, grid bias, and plate current.

At a nominal heater voltage of 12.6 V, the plate current (I_b) is plotted against plate voltage (E_b) for grid voltages (E_c) ranging from 0 V down to -1.0 V:

- **At $E_c = 0$ V:** The plate current rises rapidly from zero, reaching approximately 0.5 mA at 10 V, 0.8 mA at 20 V, 1.0 mA at 32 V, and continuing up to approximately 1.35 mA at 50 V.
- **At $E_c = -0.2$ V:** The plate current is shifted downward, reaching approximately 0.5 mA at 20 V and 0.9 mA at 50 V.
- **At $E_c = -0.4$ V:** The current reaches approximately 0.3 mA at 25 V and 0.7 mA at 50 V.
- **At $E_c = -0.6$ V:** The current is approximately 0.15 mA at 25 V and 0.4 mA at 50 V.

- **At $E_c = -0.8$ V:** The current is approximately 0.2 mA at 50 V.
- **At $E_c = -1.0$ V:** The triode is near cutoff over much of the low-voltage range, with plate current barely exceeding 0.05 mA at 50 V.

These curves demonstrate that the triode section remains highly active and controllable even when operating at plate potentials well below 50 V, which is essential for direct-battery-operated automotive equipment.

Technical Summary

The **12AJ6** is a specialized miniature double-diode high-mu triode designed specifically for 12-volt automotive radio applications. By combining a double-diode detector and a high-mu triode in a single 7-pin miniature envelope, it provides both second-detector and first-stage audio amplification functions. Its key design feature is its ability to operate both its heater and its plate directly from a nominal 12-volt automotive battery, withstanding voltage fluctuations from 10.0 V to 15.9 V. With an amplification factor of 55, a transconductance of 1,200 μmhos , and a plate resistance of 45,000 Ohms under typical Class A1 conditions, the triode section delivers a voltage gain of 16 in a standard resistance-coupled amplifier configuration. The 12AJ6 represents a highly integrated, low-voltage solution for mid-20th-century mobile receiver designs.

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