



ELECTRONIC TUBE REFERENCE

12AE6

Voltage - Triode (under 100V) electronic tube

CONSOLIDATED TECHNICAL DATA

3 SECTIONS

CONSTRUCTION

DIODE-DIODE-TRIODE

Double-diode triode for low-voltage automobile-radio detector and audio voltage-amplifier service. Two diodes provide signal detection and rectification while the triode operates effectively from the vehicle's low-voltage supply.

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
No fixed ratings recorded.
Published promoted fields populated semantically; identical repeated sections compressed.

SECTION2 Diode
No fixed ratings recorded.
Physical diode section added in approved section-structure reconciliation.

SECTION3 Triode	
PLATE RESISTANCE	15000 Ω
TRANSCONDUCTANCE	0.001 S
AMPLIFICATION FACTOR	15
MAXIMUM PLATE VOLTAGE	20 V
MAXIMUM CATHODE CURRENT	20 mA
MAXIMUM HEATER-CATHODE VOLTAGE	130 V
Published promoted fields populated semantically; identical repeated sections compressed.	

12AE6 — Double-Diode Triode Vacuum Tube

A miniature, indirectly heated double-diode triode designed for detector, automatic volume control (A.V.C.), and audio-frequency (A.F.) voltage amplifier service in automotive receivers operating directly from a 12-volt battery system.

Overview

The **12AE6** is a multi-unit miniature vacuum tube containing a medium-mu triode and two independent detector diodes sharing a common unipotential cathode. Housed in a 7-pin miniature glass envelope, the tube is specifically engineered for mobile and automotive applications. Its primary design feature is the ability to operate both its heater and its plate (anode) circuits directly from a nominal 12-volt automotive battery, eliminating the need for a high-voltage vibrator power supply (H.T. system).

The triode section is optimized for low-voltage audio-frequency voltage amplification, while the dual diode units are intended for AM signal detection and the generation of automatic volume control (A.V.C.) bias. The tube is designed to maintain reliable operation despite the wide voltage fluctuations typical of automotive electrical systems.

Physical Construction, Base, and Pinout

The 12AE6 is constructed in a compact **T-5 1/2** glass bulb outline with a miniature button 7-pin base designated **7BT**. The internal structure features a coated unipotential cathode that is common to both the triode and the two diode units. The tube can be mounted and operated in **any position**.

The physical dimensions of the envelope are as follows:

- **Maximum overall length:** 2 1/8 inches
- **Maximum seated height:** 1 7/8 inches
- **Maximum diameter:** 3/4 inch

The bottom-view pin connections are arranged as follows:

Pin Number	Electrode Connection	Symbol
1	Control Grid (Triode)	g
2	Cathode (Common)	k
3	Heater	h
4	Heater	h
5	Diode Anode 2	a''d / <u>P2</u>
6	Diode Anode 1	a'd / P1
7	Anode / Plate (Triode)	a / P

Heater and Electrical Ratings

The heater of the 12AE6 is designed to operate under the variable voltage conditions of automotive electrical systems. While its nominal rating is centered on a standard 12.6-volt battery system, the heater is specifically designed to withstand a wide operating range.

Heater Characteristics

- **Nominal Heater Voltage:** 12.6 V (AC or DC)
- **Nominal Heater Current:** 0.15 A
- **Calculated Heater Power:** 1.89 W
- **Permissible Automotive Voltage Range:** 10.0 V to 15.9 V

The maximum ratings are established under the **Design Center System** to ensure an adequate safety factor against the voltage variations encountered in automotive service.

Maximum Ratings

- **Maximum Plate Voltage (Triode Anode):** 30 V

- **Maximum Heater-Cathode Voltage:** 130 V
- **Maximum Cathode Current:** 20 mA
- **Maximum Average Diode Current (Each Diode):** 1 mA
- **Maximum Grid Circuit Resistance:** 10 M Ω

Typical Operating Conditions and Characteristics

The 12AE6 is characterized by its ability to provide useful amplification at extremely low plate voltages. The typical operating parameters for the triode and diode sections under standard Class A₁ conditions are detailed below.

Triode Unit (Class A₁ Amplifier)

- **Heater Voltage:** 12.6 V
- **Heater Current:** 0.15 A
- **Plate Voltage:** 12.6 V
- **Grid Voltage:** 0 V
- **Plate Current:** 750 μ A (0.75 mA)
- **Plate Resistance (Anode Impedance):** 15,000 Ω (15 k Ω)
- **Transconductance (Mutual Conductance):** 1,000 μ Smhos (1 mA/V)
- **Amplification Factor (μ):** 15

The fundamental triode relationship is verified by the product of transconductance and plate resistance:
 $\mu = g_m \times r_p = 0.001 \text{ S} \times 15,000 \Omega = 15$

Diode Units

The two diode units are designed for signal detection and A.V.C. rectification. Under typical test conditions:

- **Average Diode Current (Each Diode):** 2.0 mA (measured with 10 volts DC applied directly to the diode under test).

Resistance-Coupled Amplifier Operation

In typical receiver designs, the triode section of the 12AE6 is utilized as a resistance-capacitance (R.C.) coupled voltage amplifier. The following operating parameters represent a typical application stage operating from a 14.4-volt supply (representing a running automotive charging system):

Parameter	Value
Plate Supply Voltage	14.4 V
Control Grid Voltage	0 V
Plate Load Resistor	470,000 Ω

Parameter	Value
Control Grid Resistor	2.2 M\2126
Input Grid Coupling Capacitor	0.01 \u03bcF
Output Coupling Capacitor	0.01 \u03bcF
Grid Resistor of Following Stage	2.2 M\2126
Maximum Signal Source Impedance	1,000 \u2126
Voltage Gain (at 400 Hz)	10

Note: The voltage gain of 10 is measured at an output voltage of 1 volt RMS.

Interelectrode Capacitances

The direct interelectrode capacitances of the 12AE6 are measured **without an external shield** (screen). These values are critical for high-frequency detector design and for minimizing crosstalk between the diode and triode sections:

- **Grid to Plate (g to p):** 2.0 pF
- **Input (g to $h + k$):** 1.8 pF
- **Output (p to $h + k$):** 1.1 pF
- **Diode Anode to Diode Anode ($a'd$ to $a''d$):** 0.9 pF

Characteristic Curves and Analysis

The published characteristic curves for the 12AE6 provide a graphical representation of the triode's performance across its operating envelope:

- **Plate Current vs. Grid Voltage (I_b vs. E_c):** This family of curves, plotted at a nominal heater voltage of 12.6 V, shows plate current behavior for grid bias values ranging from 0 V down to -5.0 V. Curves are provided for plate voltages (E_b) from 10 V up to 60 V. The curves demonstrate that even at very low plate potentials, the grid retains effective control over the plate current, allowing linear amplification in the microampere region.
- **Plate Current vs. Plate Voltage (I_b vs. E_b):** This set of curves illustrates the plate current response as plate voltage is swept from 0 V to 60 V, plotted for discrete grid bias steps (E_c) from 0 V to -4.0 V.

Although the maximum design center rating for continuous plate voltage is 30 V, the curves extend up to 60 V to assist designers in analyzing dynamic load lines, transient signal peaks, and performance variations under elevated battery supply conditions.

Technical Summary

The **12AE6** is a specialized **7-pin miniature double-diode triode** designed specifically for low-voltage automotive radio applications. By utilizing a common unipotential cathode and a heater designed to operate over a wide **10.0 V to 15.9 V** range, the tube functions directly from a 12-volt vehicle battery without requiring a high-voltage vibrator power supply.

The triode section features an amplification factor of **15**, a plate resistance of **15 k Ω** , and a transconductance of **1,000 μ bmhos** at a typical plate voltage of 12.6 V. When configured as an R.C. coupled amplifier with a 14.4 V supply, it delivers a voltage gain of **10**. The dual diode units provide efficient detection and A.V.C. capabilities, with each diode capable of delivering 2.0 mA of average current under a 10 V test condition. The 12AE6 represents a highly integrated, low-voltage solution for compact, reliable mobile receiver designs of its era.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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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 · Diode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Average diode current	1 mA	EachDiode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Average diode current at 10 V applied	2 mA	EachDiode

1966 TUNG SOL ELECTRONIC TUBES 2 OF 4

Section 3 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	12.6 V	ClassA1;TriodeSection
Plate current	0.75 mA	ClassA1;TriodeSection
Grid voltage	0 V	ClassA1;TriodeSection
Grid circuit resistance	10 Mohm	TriodeSection
Resistance-coupled plate supply voltage	14.4 V	TriodeSection;ResistanceCoupled

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