

ELECTRONIC TUBE REFERENCE

12AG6

Voltage - Pentode or Tetrode (under 100V) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
HEPTODE

Low-voltage heptode converter for automobile-radio frequency-changing service. It performs oscillator and mixer functions directly from the vehicle's approximately 12.6 V supply without conventional high-voltage B-plus.

GENERAL CHARACTERISTICS

BASE DESIGNATION	7CH	BASE PINS	7
NOMINAL HEATER	12.6 V / 150 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

7CH - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – G1	A	G1 – Control Grid	CONNECTED
PIN2 – G5	A	G5 – Fifth Grid	CONNECTED
PIN2 – K	A	K – Cathode	CONNECTED
PIN3 – H	–	H – Heater	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN5 – P	A	P – Plate (Anode)	CONNECTED
PIN6 – G2	A	G2 – Screen Grid	CONNECTED
PIN6 – G4	A	G4 – Fourth Grid	CONNECTED
PIN7 – G3	A	G3 – Suppressor Grid	CONNECTED

SECTION RATINGS

SECTION1 Heptode	
TRANSCONDUCTANCE	0.0003 S
MAXIMUM PLATE VOLTAGE	16 V
MAXIMUM SCREEN VOLTAGE	16 V
MAXIMUM CATHODE CURRENT	4.2 mA
Published promoted fields populated semantically; identical repeated sections compressed.	

12AG6 — Miniature Heptode Vacuum Tube

A miniature heptode designed primarily to perform the combined functions of mixer and oscillator in automobile radio receivers, operating directly from low-voltage power sources.

Overview

The **12AG6** is a miniature heptode vacuum tube featuring a coated unipotential cathode. It is specifically engineered to operate with its plate and screen voltages supplied directly from a 12-volt automobile storage battery, eliminating the need for a high-voltage vibrator power supply. The primary application of the 12AG6 is to serve as a combined mixer and oscillator (converter service) in automotive radio receiver designs.

Construction, Physical Dimensions, and Pinout

The 12AG6 is constructed in a compact T-5 1/2 glass envelope with a miniature button 7-pin base (basing outline 7CH). The tube is designed to operate reliably in any mounting position.

Physical Dimensions

- **Maximum Diameter:** 3/4 inch (0.75 in)
- **Maximum Seated Height:** 1 7/8 inches (1.875 in)
- **Maximum Overall Length:** 2 1/8 inches (2.125 in)

Pin Connections

The 7-pin miniature base configuration provides the following connections, viewed from the bottom of the tube:

Pin Number	Electrode Connection
1	Grid No. 1 (Oscillator Control Grid)
2	Cathode & Grid No. 5 (Suppressor Grid)
3	Heater

Pin Number	Electrode Connection
4	Heater
5	Plate
6	Grid No. 2 & Grid No. 4 (Screen Grids)
7	Grid No. 3 (Signal Input Grid)

Heater Characteristics and Automotive Limits

The heater is designed for AC or DC operation. Because the tube is intended for automotive environments where supply voltages fluctuate significantly depending on the battery charging state, strict operating limits are specified to ensure reliability.

Parameter	Value
Nominal Heater Voltage	12.6 V
Nominal Heater Current	0.15 A
Calculated Heater Power	1.89 W

In automotive service powered by a nominal 12-volt storage battery, the heater voltage must be maintained within the absolute limits of **10.0 Volts minimum** and **15.9 Volts maximum**. While extreme variations within this range can be tolerated for short periods, continuous operation near these limits reduces performance at the low end and severely degrades life expectancy at the high end. Improved supply-voltage regulation is highly recommended to maximize equipment reliability.

Direct Interelectrode Capacitances

The direct interelectrode capacitances of the 12AG6, measured without an external shield, are as follows:

Capacitance Parameter	Value
Grid No. 3 to All Electrodes	6.5 μF
Plate to All Electrodes	7.5 μF
Grid No. 1 to All Electrodes	5.5 μF
Cathode to All Electrodes (except Grid No. 1)	18 μF
Grid No. 3 to Plate (Maximum)	0.28 μF
Grid No. 1 to Grid No. 3 (Maximum)	0.17 μF
Grid No. 1 to Plate (Maximum)	0.065 μF

Capacitance Parameter	Value
Grid No. 1 to Cathode	2.8 μF

Maximum Ratings

The following maximum ratings are established under the Design Center System. These represent the limiting values at which satisfactory tube life can be expected in a bogie tube under typical operating variations.

Rating Parameter	Maximum Value
Plate Voltage	16 V
Screen Voltage (Grids No. 2 & No. 4)	16 V
Positive DC Grid No. 3 Voltage	0 V
DC Grid No. 1 Current	0.2 mA
Grid No. 3 Circuit Resistance	2.2 M Ω

Typical Operating Conditions and Characteristics

The 12AG6 can be operated either as a self-excited converter or analyzed in a non-oscillating state to evaluate its underlying triode and mixer characteristics.

Converter Service

Under typical operating conditions in a standard converter circuit, the tube operates with plate and screen voltages supplied directly from the 12.6 V source:

- **Heater Voltage:** 12.6 V
- **Heater Current:** 0.15 A
- **Plate Voltage:** 12.6 V
- **Screen Voltage:** 12.6 V
- **Grid No. 3 Supply Voltage:** 0 V
- **Grid No. 3 Resistor (Bypassed):** 2.2 M Ω
- **Grid No. 1 Voltage (RMS, Approximate):** 0.85 V
- **Grid No. 1 Resistor:** 20,000 Ω
- **Conversion Transconductance:** 300 μmhos
- **Plate Current:** 0.55 mA
- **Screen Current:** 1.4 mA
- **Grid No. 1 Current:** 0.050 mA
- **Grid No. 3 Voltage (Approximate, for $g_c = 10 \mu\text{mhos}$):** -2.0 V

Note: These characteristics are obtained using a standard 60-cycle conversion transconductance test set, with the applied Grid No. 3 signal voltage reduced from 1.0 V peak-to-peak to 0.1 V peak-to-peak.

Oscillator Characteristics (Not Oscillating)

To evaluate the oscillator section independently, the tube can be measured in a non-oscillating state with the screen grids (Grids No. 2 and No. 4) connected directly to the plate, forming a triode-connected structure where Grid No. 1 acts as the control grid:

- **Plate & Screen Voltage:** 12.6 V
- **Grid No. 3 Voltage:** 0 V
- **Grid No. 1 Voltage:** 0 V
- **Amplification Factor (between Grid No. 1 and Grids No. 2 & 4 connected to Plate):** 9.0
- **Transconductance:** 3,400 μmhos
- **Cathode Current:** 4.2 mA
- **Grid No. 1 Voltage (Approximate, for $I_b = 10 \mu\text{A}$):** -4 V

Analysis of Characteristic Curves

Triode-Connected Operation

When Grids No. 2 and No. 4 are tied to the plate and Grid No. 3 is held at 0 V, the 12AG6 behaves as a low-voltage triode. At positive Grid No. 1 voltages (ranging up to +2.0 V), the plate current (I_b) rises steeply with plate voltage, reaching over 4 mA at 10 V. Under these positive bias conditions, a small grid current (I_{c1} ($/tubes/C1$)) is also present. When Grid No. 1 is biased negatively (from 0 V down to -4.5 V), the plate current curves shift progressively to the right, demonstrating smooth control characteristics even at very low plate potentials (under 30 V).

Conversion Performance vs. Oscillator Grid Current

In a separately excited converter configuration with a 12.6 V supply, the conversion transconductance (g_c) is highly dependent on the DC Grid No. 1 current. As Grid No. 1 current increases from 0 to 50 microamperes, the conversion transconductance rises sharply from near zero to its peak value of approximately 300 μmhos . Beyond 50 microamperes, g_c remains relatively stable, showing a very gradual decline as grid current approaches 200 microamperes. Concurrently, the plate current (I_b) decreases from about 0.6 mA to 0.4 mA, while the combined screen current (I_{c2+4}) stabilizes around 1.3 mA.

Automatic Gain Control (AGC) via Grid No. 3

The remote-cutoff characteristic of Grid No. 3 allows for effective automatic gain control. With a fixed Grid No. 1 current of 0.05 mA and screen/plate supplies at 12.6 V, varying the Grid No. 3 supply voltage from 0 V down to -2.0 V results in a nearly linear reduction of conversion transconductance from 300 μmhos to approximately 10 μmhos . This wide range of transconductance control is accompanied by a reduction in plate current from 0.55 mA to less than 0.1 mA, while the screen current decreases from 1.4

mA to approximately 1.1 mA. This behavior confirms that Grid No. 3 provides excellent control sensitivity for AGC without requiring high negative bias voltages.

Technical Summary

The **12AG6** is a specialized **miniature heptode** designed for low-voltage automotive applications, operating directly from a 12-volt battery system. Featuring a **12.6 V, 0.15 A heater** with wide voltage tolerance, a **7-pin miniature base**, and a **T-5 1/2 glass envelope**, it combines the functions of an RF mixer and local oscillator in a single compact device.

With a maximum plate and screen rating of **16 V**, the 12AG6 delivers a conversion transconductance of **300 μ mhos** under typical operating conditions, with a plate current of only **0.55 mA** and a screen current of **1.4 mA**. Its independent triode-connected oscillator section exhibits an amplification factor of **9.0** and a transconductance of **3,400 μ mhos**. The tube's remote-cutoff Grid No. 3 provides effective automatic gain control down to -2.0 V, making it an exceptionally efficient and optimized solution for mid-20th-century mobile receiver designs.



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 · Heptode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Conversion Transconductance	200 μ S	Converter



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater current	150 mA	—
Plate voltage	12.6 V	Converter
Screen voltage	12.6 V	Converter
Plate current	0.55 mA	Converter
Screen current	1.4 mA	Converter

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Conversion transconductance	300 μ S	Converter
Oscillator amplification factor	9	Oscillator
Oscillator transconductance	400 μ S	Oscillator

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Cathode current	4.2 mA	Converter

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid #3 to all capacitance	6.5 pF	—
Plate to all capacitance	7.5 pF	—
Grid #1 to all capacitance	5.5 pF	—

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