



ELECTRONIC TUBE REFERENCE

12A7

Voltage Pentode or Tetrode (with diode) electronic tube

CONSOLIDATED TECHNICAL DATA

2 SECTIONS

CONSTRUCTION

PENTODE-RECTIFIER

Combination half-wave rectifier and power-amplifier pentode designed for compact AC/DC receivers, integrating power-supply rectification with audio output amplification.

GENERAL CHARACTERISTICS

BASE DESIGNATION	7-K	BASE PINS	7
NOMINAL HEATER	12.6 V / 300 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Dissimilar

SECTION RATINGS

SECTION1 Rectifier

NOMINAL OUTPUT CURRENT	30 mA
FORWARD VOLTAGE DROP	15 V

Combined half-wave rectifier diode and power-amplifier pentode for AC/DC receivers. Section 2.

SECTION2 Pentode

PLATE RESISTANCE	102000 Ω
TRANSCONDUCTANCE	0.000975 S
AMPLIFICATION FACTOR	100
MAXIMUM PLATE VOLTAGE	135 V
MAXIMUM SCREEN VOLTAGE	135 V

Combined half-wave rectifier diode and power-amplifier pentode for AC/DC receivers.

12A7 — Diode-Pentode Rectifier-Power Amplifier Vacuum Tube

An indirectly heated, multi-unit vacuum tube combining a half-wave rectifier and a power amplifier pentode in a single glass envelope, designed for compact AC-DC receivers.

Overview

The **12A7** is a specialized multi-unit vacuum tube that integrates a half-wave rectifier (diode) and a power amplifier pentode within a single glass envelope. It was designed primarily for service in the output and power supply stages of small, universal AC-DC radio receivers where physical space and component count are critical design constraints.

By combining the functions of a mains rectifier and an audio power output stage, the 12A7 allows receiver designs to be simplified. The tube features a 12.6-volt heater designed for series or parallel operation in AC-DC power distribution schemes. Manufacturers such as Raytheon, Sylvania, Tung-Sol, and Brimar document this device, with Brimar classifying it as an obsolete type maintained for reference.

Physical Construction, Base, and Pinout

The 12A7 is constructed in an **ST-12** glass bulb (also designated as ST-12C or ST 12-D) and is fitted with a **small 7-pin base** (7-K or U.X. 7-pin configuration). The tube is designed to operate in **any mounting position**.

Internally, the tube features **unipotential cathodes** for both the pentode and rectifier sections. To simplify the internal structure and pin requirements, the pentode cathode, the rectifier cathode, and the pentode's suppressor grid (G3) are internally tied together and connected to a single common pin.

The bottom view of the socket provides the following pin connections:

Pin	Connection
1	Heater (H)
2	Pentode Plate (Pp)
3	Screen Grid (Gs / <u>G2</u>)
4	Common Cathode (Kp, Kr) and Suppressor Grid (G3p)
5	Control Grid (G1)
6	Rectifier Plate (Pr)
7	Heater (H)

Heater Characteristics

The heater of the 12A7 is designed to operate from either an alternating current (AC) or direct current (DC) supply.

Heater Parameter	Value
Heater Voltage	12.6 V
Heater Current	0.3 A
Calculated Heater Power	3.78 W
Cathode Type	Coated, unipotential

The calculated heater power is derived from the nominal voltage and current: $\text{Power} = 12.6 \text{ V} \times 0.3 \text{ A} = 3.78 \text{ W}$

Pentode Section Electrical Characteristics and Class A Operation

The pentode section of the 12A7 is designed for Class A (or Class A1) audio power amplification. Because the tube is intended for small universal receivers, its maximum voltage ratings are relatively low compared to larger power pentodes.

Maximum Ratings

- **Maximum Plate Voltage:** 135 V
- **Maximum Screen Voltage:** 135 V

Typical Operating Conditions and Characteristics

Under typical Class A operating conditions, the pentode section exhibits the following electrical characteristics:

Parameter	Value
Plate Voltage	135 V
Screen Voltage	135 V
Control Grid Bias	-13.5 V
Amplification Factor	100
Plate Resistance	102,000 Ω (0.102 M Ω)
Transconductance (Mutual Conductance)	975 μmhos (1.0 mA/V)

Parameter	Value
Plate Current	9.0 mA
Screen Current	2.5 mA
Load Resistance (Optimum Load)	13,500 Ω
Power Output	0.55 W (550 mW)

The relationship between transconductance (g_m), plate resistance (r_p), and amplification factor (μ) is demonstrated by the standard triode/pentode approximation formula: $\mu \approx g_m \times r_p$ Using the typical values: $0.000975 \text{ S} \times 102,000 \text{ } \Omega \approx 99.45$ This closely matches the published amplification factor of 100.

Due to the low plate voltage of 135 V, the maximum power output is limited to 0.55 watts. This level of output is sufficient for driving high-efficiency speakers in small tabletop or portable receivers.

Rectifier Section Characteristics

The rectifier section of the 12A7 is a single diode designed for half-wave rectification of the AC power line.

Maximum Ratings

- **Maximum AC Plate Voltage (RMS):** 125 V
- **Maximum DC Output Current:** 30 mA

Operating Characteristics

- **Average Tube Voltage Drop:** 15 V (measured at a transient or test current of 60 mA)

The maximum continuous DC output current is strictly limited to 30 mA, which is sufficient to supply the plate and screen currents of the 12A7's own pentode section (totaling 11.5 mA) along with the current requirements of a few small preamplifier or RF stages in a typical receiver.

Performance Curves and Circuit Integration

The performance of both sections is highly dependent on the operating conditions and external component values.

Pentode Section Performance

The average plate characteristics of the pentode section show that at a screen voltage of 135 V, the plate current remains relatively constant across a wide range of plate voltages above 40 V, which is characteristic of pentode operation.

The relationship between load resistance, power output, and distortion is critical for optimizing the audio stage:

- **Power Output:** The power output peaks at approximately 0.55 W when the load resistance is matched to the optimum value of 13,500 Ω .
- **Distortion:** At this optimum load, the second harmonic distortion is minimized, while the third harmonic distortion remains within acceptable limits for consumer radio applications. If the load resistance is decreased below 10,000 Ω or increased above 15,000 Ω , the power output drops and harmonic distortion increases.

Rectifier Section Performance

The DC output voltage delivered by the rectifier section depends on the AC input voltage, the DC load current, and the value of the input filter capacitor (condenser).

- With an AC input of 115 V RMS and a 4 μ F condenser input to the filter, the DC output voltage at the input to the filter varies with the load current:
 - At a **10 mA** load, the DC output voltage is approximately **125 V**.
 - At a **20 mA** load, the DC output voltage drops to approximately **105 V**.
 - At the maximum rated **30 mA** load, the DC output voltage is approximately **90 V**.
- Increasing the filter capacitor value (e.g., from 2 μ F to 4 μ F or 8 μ F) improves the DC output voltage for a given load current by reducing the ripple and increasing the peak charging voltage, though it increases the peak plate current of the rectifier.

Common Cathode Considerations

Because the pentode cathode and the rectifier cathode share a single external pin (Pin 4), they are galvanically tied together. In practical receiver circuits, this common connection requires that the rectifier's return path and the pentode's bias network share the same reference point. The suppressor grid (G3) is also tied to this point, ensuring it remains at cathode potential to suppress secondary emission from the pentode plate.

Technical Summary

The **12A7** is a specialized **diode-pentode vacuum tube** designed for space-saving applications in AC-DC receivers. It features a **12.6 V, 0.3 A heater** and is housed in an **ST-12 glass bulb** with a **small 7-pin base**.

The **pentode section** operates as a Class A power amplifier, delivering **0.55 W** of audio output into a **13,500 Ω load** when operated with plate and screen voltages of **135 V**. The **rectifier section** provides half-wave rectification, supporting a maximum **AC input of 125 V RMS** and delivering up to **30 mA of DC output current**.

By integrating both power rectification and audio amplification into a single envelope with a common cathode structure, the 12A7 served as a key component in minimizing the size and complexity of early universal radio receivers.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1937 Raytheon Radio Receiving Tubes

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

1937 RAYTHEON RADIO RECEIVING TUBES

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum AC plate voltage RMS	125 V	HalfWave
Maximum DC output current	30 mA	HalfWave

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Average tube voltage drop	15 V	AtOutputCurrent=60mA

1937 RAYTHEON RADIO RECEIVING TUBES

Section 2 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	135 V	ClassA
Screen voltage	135 V	ClassA
Grid bias	-13.5 V	ClassA
Plate current	9 mA	ClassA
Screen current	2.5 mA	ClassA
Load resistance	13500 ohm	ClassA
Power output	0.55 W	ClassA

1948 Brimar Radio Valve Manual

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

1948 BRIMAR RADIO VALVE MANUAL

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
RMS Input	125 V	Rectifier section

1948 BRIMAR RADIO VALVE MANUAL

Section 2 · Pentode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode Current	9 mA	—
Screen Current	2.5 mA	—
Control Grid Voltage	-13.5 V	—
Optimum Load	13500 ohm	—
Power Output	0.55 W	—



SOURCE DATA APPENDIX

1950 Sylvania

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

1950 SYLVANIA

Section 1 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
ACVoltagePerPlate	125 V	—
RectifiedCurrent	30 mA	—

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 · Rectifier

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
AC Voltage Per Plate RMS	125 V	Rectifier
Power Output	0.55 W	ClassA
Ac Voltage Per Plate (Rms)	125 V	—
Dc Output Current	30 mA	—

1961 TUNG SOL

Section 2 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Pentode Plate Voltage	135 V	ClassA
Pentode Screen Voltage	135 V	ClassA
Plate Voltage	135 V	—
Screen Voltage	135 V	—
Control Grid Voltage	-13.5 V	—
Plate Current	9 mA	—
Screen Current	2.5 mA	—
Plate Resistance	102000 ohm	—
Transconductance	975 uS	—
Load Resistance	13500 ohm	—