

ELECTRONIC TUBE REFERENCE

12EH5

Power - Pentode Single (NOT beam) (under 10W) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
PENTODE

High-perveance miniature power pentode designed for audio-output service, offering high power sensitivity and several watts of Class-A output from comparatively low supply voltage.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
NOMINAL HEATER	12.6 V / 600 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Pentode	
PLATE RESISTANCE	11000 Ω
TRANSCONDUCTANCE	0.0146 S
MAXIMUM PLATE VOLTAGE	150 V
MAXIMUM SCREEN VOLTAGE	130 V
MAXIMUM PLATE DISSIPATION	5.5 W
MAXIMUM SCREEN DISSIPATION	2 W
Published Westinghouse ratings, characteristics, capacitances, pulse/deflection data, and typical operating conditions promoted where applicable; additional values retained as parameters.	

12EH5 — High-Sensitivity Power Pentode

Overview

The **12EH5** is a miniature, 7-pin power pentode designed primarily for use in the audio output stages of radio and television receivers, phonographs, tape recorders, and record players. A key feature of the 12EH5 is its exceptionally high power sensitivity, which allows it to deliver substantial audio power output with very low grid-drive voltage.

The 12EH5 is specifically engineered for series-connected heater strings, particularly in television receivers where the picture-tube heater is wired in series with other heaters. It features a controlled heater warm-up characteristic to minimize voltage surges across individual tubes during the warm-up cycle. Except for its heater ratings, heater warm-up time, and higher heater-to-cathode voltage ratings, the 12EH5 is electrically identical to the [6EH5](#), [25EH5](#), and [50EH5](#) (as well as the [35EH5A](#) and [50EH5A](#)).

Construction, Mechanical Specifications, and Pinout

The 12EH5 is constructed in a T-5 1/2 glass envelope with a small-button miniature 7-pin base (JEDEC E7-1) and conforms to the JEDEC 5-3 outline. It can be mounted in any physical position.

Physical Dimensions

- **Maximum Diameter:** 0.750 inches (3/4")
- **Maximum Seated Height:** 2.375 inches (2 3/8")
- **Maximum Overall Height:** 2.625 inches (2 5/8")

Pinout and Basing Diagram

The tube uses the **7CV** basing arrangement. Viewed from the bottom of the base, the pin connections are as follows:

Pin	Connection
1	Cathode and Grid No. 3 (K, G3)
2	Grid No. 1 (G1)
3	Heater (H)
4	Heater (H)
5	Grid No. 1 (G1)
6	Grid No. 2 / Screen Grid (G2)
7	Plate (P)

Note: Grid No. 1 is internally connected to both Pin 2 and Pin 5, providing flexibility in circuit layout.

Heater Characteristics and Series-String Operation

The 12EH5 features an indirectly heated, coated unipotential cathode. The heater is designed to operate reliably in series-string configurations with other 600 mA tubes.

Heater Parameter	Value
Nominal Heater Voltage (AC or DC)	12.6 V
Nominal Heater Current	0.60 A (600 mA)
Heater Supply Limits (Current Operation)	600 ± 40 mA
Heater Warm-up Time	11 seconds

Controlled Warm-up Definition

The heater warm-up time of 11 seconds is defined as the time required for the voltage across the heater to reach 80% of its rated value (10.08 V) after applying four times the rated heater voltage (50.4 V) to a test circuit. This test circuit consists of the tube heater connected in series with an external resistance equal to three times the nominal heater operating resistance. This resistance is calculated as three times the rated heater voltage divided by the rated heater current:

Series Resistance = $3 \times \frac{12.6 \text{ V}}{0.6 \text{ A}} = 63 \, \Omega$

Heater-Cathode Voltage Ratings

Because the 12EH5 is designed for series-string operation where the cathode-to-heater potential can be high, it features elevated heater-cathode voltage ratings compared to its lower-voltage sibling, the [6EH5](#):

- **Heater Negative with Respect to Cathode:** 300 V (Maximum Peak or Total DC + Peak)
- **Heater Positive with Respect to Cathode:** 200 V (Maximum Peak or Total DC + Peak), with the DC component restricted to a maximum of 100 V.

Electrical Ratings

The maximum ratings of the 12EH5 are defined under two rating systems in manufacturer documentation: the **Design Maximum System** (EIA Standard RS-239) and the **Design Center System**. Designers must adhere strictly to these limits to ensure tube longevity.

Parameter	Design Maximum Rating	Design Center Rating
Plate Voltage	150 V	135 V
Grid No. 2 (Screen-Grid) Voltage	130 V	117 V

Parameter	Design Maximum Rating	Design Center Rating
Grid No. 1 Positive Voltage	0 V	0 V
Plate Dissipation	5.5 W	5.0 W
Grid No. 2 Input	2.0 W	1.75 W
Bulb Temperature (at hottest point)	220 °C	220 °C

Grid No. 1 Circuit Resistance Limits

To prevent thermal runaway, the maximum allowable resistance in the control grid (Grid No. 1) circuit is strictly limited based on the biasing method:

- **Fixed-Bias Operation:** 0.1 MΩ maximum
- **Cathode-Bias (Self-Bias) Operation:** 0.5 MΩ maximum

Thermal Dissipation and Shielding

High ambient operating temperatures or the use of close-fitting tube shields can significantly increase bulb temperature. If a tube shield is employed, it is recommended to paint both its inner and outer surfaces a dull black and to provide ventilation slots to facilitate heat dissipation and keep the bulb temperature below the 220 °C limit.

Direct Interelectrode Capacitances

Measured without an external shield, the typical direct interelectrode capacitances of the 12EH5 are:

- **Grid No. 1 to Plate:** 0.65 pF
- **Input** (g_1 to $k + g_3 + g_2 + h$): 17 pF
- **Output** (p to $k + g_3 + g_2 + h$): 9 pF

Typical Operating Characteristics

The 12EH5 can be operated as a single-ended Class A1 amplifier or in a push-pull Class [AB1](#) configuration.

Class A1 Audio Amplifier (Single Tube)

At a typical operating point, the tube exhibits extremely high transconductance ($14,600 \mu\text{mhos}$) and can deliver 1.4 Watts of audio output with a peak AF grid drive of only 3 Volts.

- **Plate Supply Voltage:** 110 V
- **Grid No. 2 Supply Voltage:** 115 V
- **Cathode Bias Resistor:** 62 Ω

- **Peak AF Grid No. 1 Voltage:** 3 V
- **Zero-Signal Plate Current:** 42 mA
- **Maximum-Signal Plate Current:** 42 mA
- **Zero-Signal Grid No. 2 Current:** 11.5 mA
- **Maximum-Signal Grid No. 2 Current:** 14.5 mA
- **Transconductance:** $14,600\ \mu\text{mhos}$
- **Plate Resistance (Approximate):** 11,000 Ω
- **Load Resistance:** 3,000 Ω
- **Total Harmonic Distortion:** 7%
- **Maximum-Signal Power Output:** 1.4 W

Push-Pull AF Power Amplifier (Class AB1)

For push-pull operation, the characteristics for two tubes are as follows:

- **Plate Supply Voltage:** 140 V
- **Grid No. 2 Supply Voltage:** 120 V
- **Cathode Bias Resistor:** 68 Ω
- **Peak AF Grid-to-Grid Voltage:** 9.4 V (*or 4.7 V peak per grid*)
- **Zero-Signal Plate Current:** 47 mA
- **Maximum-Signal Plate Current:** 51 mA
- **Zero-Signal Grid No. 2 Current:** 11 mA
- **Maximum-Signal Grid No. 2 Current:** 17.7 mA
- **Effective Load Resistance (Plate-to-Plate):** 6,000 Ω
- **Total Harmonic Distortion:** 5%
- **Maximum-Signal Power Output:** 3.8 W

Characteristic Curves and Design Interpretation

Average Plate Characteristics

The plate characteristics of the 12EH5 demonstrate classic pentode behavior with a remarkably sharp "knee" at very low plate voltages. When operated with a screen grid (Grid No. 2) voltage of 115 V:

- At a control grid voltage ($E_{c1}(\text{tubes}/C1)$) of 0 V, the plate current (I_b) rises extremely rapidly, reaching approximately 90 mA at a plate voltage of only 40 V, above which it flattens out, showing high dynamic plate resistance.
- As the control grid bias is made more negative (from -1 V down to -7 V), the plate current curves step down in regular increments. At $E_{c1}(\text{tubes}/C1) = -7$ V, the plate current is nearly cut off.
- The screen grid current (I_{c2}) curves show that screen current is highest when the plate voltage is near zero (reaching about 55 mA at $E_{c1}(\text{tubes}/C1) = 0$ V and $E_b = 0$ V). As plate voltage increases past the knee (above 30 V), the screen current drops sharply and stabilizes at a much lower value (around 10 to 15 mA), as the plate successfully collects the bulk of the electron stream.

Load Resistance and Distortion Curves

The performance of the 12EH5 is highly sensitive to the choice of load resistance. Under typical Class A1 operating conditions ($E_b = 110\text{ V}$, $E_{c2} = 115\text{ V}$, $R_k = 62\ \Omega$, with a $100\ \mu\text{ext}F$ cathode bypass capacitor and an input signal of 2.1 V RMS):

- **Power Output:** The power output curve rises rapidly from low load values, peaking at approximately 1.4 Watts with a load resistance between 3,000 and 4,000 Ω . Beyond 4,000 Ω , the power output gradually declines, falling to about 1.1 Watts at 8,000 Ω .
- **Total Harmonic Distortion:** Distortion is lowest at very low load resistances (around 5% at 1,500 Ω) and rises continuously as the load resistance increases. At the optimal power output load of 3,000 Ω , the total harmonic distortion is approximately 7%. If the load resistance is increased further to 8,000 Ω , the distortion rises steeply to over 20%. This behavior indicates that a load resistance of 3,000 Ω represents a carefully chosen compromise between maximizing power output and keeping harmonic distortion within acceptable limits for consumer audio applications.

Technical Summary

The **12EH5** is a high-sensitivity, miniature power pentode designed for cost-effective audio output stages in consumer electronics. Featuring a 12.6 V, 600 mA heater with controlled warm-up characteristics, it is optimized for series-string heater circuits where it prevents damaging voltage surges. Its extremely high transconductance of $14,600\ \mu\text{ext}\{\text{mhos}\}$ enables it to deliver 1.4 Watts of output power from a modest 110 V plate supply with a grid drive of only 3 V peak. While it shares electrical characteristics with the [6EH5](#), [25EH5](#), and [50EH5](#), its unique heater ratings and robust 300 V heater-cathode insulation make it uniquely suited for series-string television and radio chassis.



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 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	Nominal
Heater current	450 mA	Nominal



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1965 Westinghouse Data Book

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

1965 WESTINGHOUSE DATA BOOK

Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Typical plate voltage	110 V	ClassA
Typical screen voltage	115 V	ClassA
Zero-signal screen current	11.5 mA	ClassA
Maximum-signal screen current	14.5 mA	ClassA
Power output	1.4 W	ClassA

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	14600 μ S	—

APPLICATION		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Application	Audio output amplifier	—



SOURCE DATA APPENDIX

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 · Pentode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
GRID	1 pF	GRID 1 TO PLATE 0.65 pf
GRID	1 pF	GRID 1 TO CATHODE & GRID 3, HEATER & GRID 2 17 pf
PLATE TO CATHODE & GRID	3 pF	PLATE TO CATHODE & GRID 3, HEATER & GRK) 2 9 pf
HEATER WARM-UP TIME '~'	11 s	HEATER WARM-UP TIME '~' 11 SECONDS
CURRENT OPERATION	600 mA	CURRENT OPERATION 600 * 40 MA.
HEATER NEGATIVE WITH RESPECT TO CATHODE	300 V	HEATER NEGATIVE WITH RESPECT TO CATHODE 300 VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	200 V	HEATER POSITIVE WITH RESPECT TO CATHODE 200 8 VOLTS
PLATE VOLTAGE ~	150 V	PLATE VOLTAGE ~ 150 VOLTS
GRID	2 V	GRID 2 (SCREEN-GRID) VOLTAGE ~ 130 VOLTS
PLATE DISSIPATION -->	5.5 W	PLATE DISSIPATION --> 5.5 WATTS
GRID	2 W	GRID 2 INPUT -> 2 WATTS
PLATE SUPPLY VOLTAGE	110 V	PLATE SUPPLY VOLTAGE 110 VOLTS
GRID	2 V	GRID 2 SUPPLY VOLTAGE L15 VOLTS
CATHODE RESISTOR	62 Ω	CATHODE RESISTOR 62 OHMS
PEAK AF GRID	1 V	PEAK AF GRID 1 VOLTAGE 3 VOLTS
PLATE RESISTANCE (APPROX.)	11 Ω	PLATE RESISTANCE (APPROX.) 11,000 OHMS

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
PLATE SUPPLY VOLTAGE	140 V	PLATE SUPPLY VOLTAGE 140 VOLTS
GRID	2 V	GRID 2 SUPPLY VOLTAGE 120 VOLTS
CATHODE RESISTOR	68 Ω	CATHODE RESISTOR 68 OHMS
PEAK AF GRID	1 V	PEAK AF GRID 1 TO GRID 1 VOLTAGE 9.4 VOLTS
REACH BOR OF ITS RATED VOLTAGE AFTER APPLYING	1 V	REACH BOR OF ITS RATED VOLTAGE AFTER APPLYING 1 TIMES RATED HEATER VOLTAGE TO A CIRCUIT
Ef =	12 V	Ef = 12.E Volts Cathode Resistor = 62 Ohms
Eb =	110 V	Eb = 110 Volts Cathode Bypass Capacitor = 100 μ f

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
FOR FIXED-BIAS OPERATION	0.1 MΩ	FOR FIXED-BIAS OPERATION 0.1 MEGOHM
FOR CATHODE-BIAS OPERATION	0.5 MΩ	FOR CATHODE-BIAS OPERATION 0.5 MEGOHM
ZERO-SIGNAL PLATE CURRENT	42 mA	ZERO-SIGNAL PLATE CURRENT 42 MA.
SIGNAL PLATE CURRENT (MAX.)	42 mA	SIGNAL PLATE CURRENT (MAX.) 42 MA.
ZERO-SIGNAL GRID	2 mA	ZERO-SIGNAL GRID 2 CURRENT 11.5 MA.
SIGNAL GRID	2 mA	SIGNAL GRID 2 CURRENT (MAX.) 14.5 MA.
LOAD RESISTANCE	3 Ω	LOAD RESISTANCE 3,000 OHMS
SIGNAL POWER OUTPUT (MAX.)	1.4 mA	SIGNAL POWER OUTPUT (MAX.) 1.4 WATTS
ZERO-SIGNAL PLATE CURRENT	47 mA	ZERO-SIGNAL PLATE CURRENT 47 MA.
MAX. SIGNAL PLATE CURRENT	51 mA	MAX. SIGNAL PLATE CURRENT 51 MA,
ZERO-SIGNAL GRID	2 mA	ZERO-SIGNAL GRID 2 CURRENT 11 MA.
MAX:SIGNAL GRID	2 mA	MAX:SIGNAL GRID 2 CURRENT 17.7 MA.
EFFECTIVE LOAD RESISTANCE (PLATE TO PLATE)	6000 Ω	EFFECTIVE LOAD RESISTANCE (PLATE TO PLATE) 6000 OHMS
MAX. -SIGNAL POWER OUTPUT	3.8 mA	MAX.-SIGNAL POWER OUTPUT 3.8 WATTS.

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