



ELECTRONIC TUBE REFERENCE

12HL5

Power - Beam (NOT sweep) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

BEAMPOWER

High-perveance beam-power audio-output pentode with high power sensitivity, capable of Class-A service and substantially greater output in push-pull Class-AB operation.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	9
NOMINAL HEATER	12.6 V / 450 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Beam Power	
PLATE RESISTANCE	7500 Ω
TRANSCONDUCTANCE	0.017 S
AMPLIFICATION FACTOR	13
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM SCREEN VOLTAGE	250 V
MAXIMUM PLATE DISSIPATION	12 W
MAXIMUM SCREEN DISSIPATION	2.5 W
<i>Published Westinghouse ratings, characteristics, capacitances, pulse/deflection data, and typical operating conditions promoted where applicable; additional values retained as parameters.</i>	

12HL5 — High-Perveance Beam Power Pentode

The **12HL5** is a high-perveance, nine-pin miniature beam power pentode designed primarily for service in the output stage of audio power amplifiers. It is characterized by exceptionally high power sensitivity,

which allows the tube to deliver its full rated power output with a very low grid-drive voltage. The 12HL5 belongs to a family of structurally identical tubes that includes the [6HL5](#) and [60HL5](#), differing only in their heater ratings.

Heater and Physical Construction

The 12HL5 features an indirectly heated, coated unipotential cathode. The heater is designed for operation from either an AC or DC supply. The heater specifications for the 12HL5 and its sister types are as follows:

Tube Type	Heater Voltage	Heater Current
6HL5	6.3 V	0.95 A
12HL5	12.6 V	0.45 A
60HL5	60.0 V	0.10 A

Mechanical Specifications and Basing

The tube is housed in a T-6 1/2 glass bulb with a JEDEC E9-1 9-pin miniature base. It has a physical outline designation of 6-4 and can be mounted in any position.

The electrical connections are arranged according to the **9QW** basing diagram, viewed from the bottom of the tube:

- **Pin 1:** Grid 1 (Control Grid)
- **Pin 2:** Cathode and Grid 3 (Beam Plates)
- **Pin 3:** Grid 1 (Control Grid)
- **Pin 4:** Heater
- **Pin 5:** Heater
- **Pin 6:** Internal Connection (Do Not Use)
- **Pin 7:** Plate
- **Pin 8:** Internal Connection (Do Not Use)
- **Pin 9:** Grid 2 (Screen Grid)

The control grid (Grid 1) is internally connected to both Pin 1 and Pin 3. Pins 6 and 8 are designated as internal connections and should not be used for external circuit tie points.

Maximum Ratings and Circuit Limits

The limits below are established under the Design Maximum rating system. Operating the tube beyond these limits may impair its performance or service life.

Design Maximum Values

- **Plate Voltage:** 330 V max.

- **Grid 2 (Screen) Voltage:** 250 V max.
- **Plate Dissipation:** 12 W max.
- **Grid 2 Dissipation:** 2.5 W max. (Screen dissipation is permitted to reach a peak of 4.0 W during periods of maximum input of speech and music signals.)
- **DC Cathode Current:** 110 mA max.

Heater-Cathode Voltage Limits

- **Heater Negative with Respect to Cathode:** 200 V max. (Total DC + Peak)
- **Heater Positive with Respect to Cathode:**
 - **DC Component:** 100 V max.
 - **Total DC + Peak:** 200 V max.

Maximum Circuit Values

- **Grid 1 Circuit Resistance (Fixed Bias):** 0.1 Megohm max.
- **Grid 1 Circuit Resistance (Cathode Bias):** 0.5 Megohm max.

Electrical Characteristics and Operating Points

At a standard test point, the 12HL5 exhibits extremely high transconductance and low plate resistance for a beam power tube of its class:

- **Plate Voltage:** 130 V
- **Grid 2 Voltage:** 130 V
- **Bypassed Cathode Bias Resistor:** 56 ohms
- **Plate Current:** 70 mA
- **Grid 2 Current:** 5 mA
- **Plate Resistance (Approximate):** 7500 ohms
- **Transconductance:** 17,000 micromhos
- **Triode Amplification Factor:** 13
- **Grid 1 Cutoff Bias (for 100 microamperes plate current):** -33 V

Typical Class A1 Amplifier Operation

The 12HL5 can be operated in Class A1 single-ended configurations using either cathode bias or fixed bias. The following table outlines three typical operating conditions:

Parameter	Cathode Bias (Bypassed)	Cathode Bias (Unbypassed)	Fixed Bias
Plate Voltage	130 V	140 V	140 V
Grid 2 Voltage	130 V	140 V	140 V

Parameter	Cathode Bias (Bypassed)	Cathode Bias (Unbypassed)	Fixed Bias
Grid 1 Voltage	—	—	-5.7 V
RMS A.F. Grid 1 Voltage	3.3 V	7.3 V	4.0 V
Cathode Bias Resistor	56 ohms	68 ohms	—
Zero Signal Plate Current	70 mA	72 mA	71 mA
Zero Signal Grid 2 Current	5 mA	4 mA	4 mA
Max. Signal Plate Current	68 mA	67 mA	68.5 mA
Max. Signal Grid 2 Current	15 mA	13.5 mA	14.5 mA
Load Resistance	2000 ohms	2000 ohms	1700 ohms
Power Output	3.0 W	3.5 W	4.0 W
Total Harmonic Distortion	8%	8%	9%

The high transconductance of 17,000 micromhos is reflected in the low drive requirements. For example, under bypassed cathode bias, an RMS input signal of only 3.3 V is required to achieve a full 3.0 W of power output.

Typical Class AB1 Push-Pull Operation

For higher power output and lower distortion, two 12HL5 tubes can be configured in a Class [AB1](#) push-pull arrangement. The typical operating parameters for a two-tube circuit are:

- **Plate Voltage:** 260 V
- **Grid 2 Voltage:** 130 V
- **Cathode Bias Resistor (Bypassed):** 69 ohms
- **Peak A.F. Grid 1-to-Grid 1 Voltage:** 16.5 V
- **Zero Signal Plate Current:** 90 mA (combined)
- **Zero Signal Grid 2 Current:** 3 mA (combined)
- **Max. Signal Plate Current:** 106 mA (combined)
- **Max. Signal Grid 2 Current:** 15 mA (combined)
- **Plate-to-Plate Load Resistance:** 5500 ohms

- **Power Output:** 16.5 W
- **Total Harmonic Distortion:** 1.5%

This push-pull configuration significantly reduces total harmonic distortion to 1.5% while delivering 16.5 W of output power, demonstrating the efficiency and high power sensitivity of the design.

Analysis of Characteristic Curves

The electrical behavior of the 12HL5 is further illustrated by its average characteristic curves:

- **Average Plate Characteristics:** The plate current curves plotted against plate voltage for various Grid 1 voltages (from 0 V to -12 V) show a rapid rise in plate current at low plate voltages, characteristic of high-perveance designs. At a Grid 2 voltage of 130 V and Grid 1 at 0 V, the plate current quickly knee-bends and flattens out, reaching approximately 150 to 160 mA by 40 V on the plate.
- **Average Grid 2 Characteristics:** Grid 2 current is highest when the plate voltage is near zero, as the screen grid intercepts a larger portion of the electron stream. As plate voltage rises above 40 V, the Grid 2 current drops sharply and stabilizes at a low value (typically below 15 mA under normal signal conditions), protecting the screen grid from excessive dissipation.
- **Average Transfer Characteristics:** The transfer curve (plate current versus Grid 1 voltage at a plate voltage of 200 V and Grid 2 voltage of 130 V) shows a steep slope, confirming the high transconductance of 17,000 micromhos. The plate current approaches cutoff near -16 V under these specific test conditions, although complete cutoff (100 microamperes) is rated at -33 V when both plate and screen are at 130 V.

Technical Summary

The **12HL5** is a high-perveance, nine-pin miniature beam power pentode featuring a 12.6 V, 0.45 A heater and a JEDEC E9-1 base. It is designed specifically for high-efficiency audio output stages, where its high transconductance of 17,000 micromhos provides exceptional power sensitivity. With a maximum plate dissipation rating of 12 W and a maximum plate voltage of 330 V, it can deliver up to 4.0 W in single-ended Class A1 service or 16.5 W in a Class [AB1](#) push-pull configuration with very low distortion.

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 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Class-A plate voltage	130 V	ClassA
Class-A grid2 voltage	130 V	ClassA
Class-A RMS grid1 voltage	3.3 V	ClassA
Class-A cathode-bias resistor	56 ohm	ClassA
Class-A zero-signal plate current	70 mA	ClassA
Class-A zero-signal grid2 current	5 mA	ClassA
Class-A maximum-signal grid2 current	15 mA	ClassA
Class-A load resistance	2000 ohm	ClassA
Class-A power output	3 W	ClassA
Class-A THD	8 %	ClassA
Class-AB1 push-pull grid2 voltage	130 V	ClassAB,PushPull
Class-AB1 push-pull power output	16.5 W	ClassAB,PushPull

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	7500 ohm	—
Triode-connected amplification factor	13	TriodeConnection

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