



ELECTRONIC TUBE REFERENCE

12BK5

Power - Beam Single (NOT sweep) (under 10W) electronic tube

CONSOLIDATED TECHNICAL
DATA

1 SECTION
CONSTRUCTION
BEAMPOWER

Miniature beam-power output tube for television and radio audio stages, designed to provide useful Class-A power from relatively low-voltage receiver supplies.

GENERAL CHARACTERISTICS

BASE DESIGNATION	9BQ	BASE PINS	9
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 Beam Power	
PLATE RESISTANCE	100000 Ω
TRANSCONDUCTANCE	0.0085 S
MAXIMUM PLATE VOLTAGE	250 V
MAXIMUM SCREEN VOLTAGE	250 V
MAXIMUM PLATE DISSIPATION	9 W
MAXIMUM SCREEN DISSIPATION	2.5 W
<i>Published Westinghouse ratings, characteristics, typical operating conditions, and capacitances extracted from supplied source.</i>	

12BK5 — Beam Power Amplifier

The **12BK5** is a 9-pin miniature beam power amplifier designed primarily for service in the power output stages of television and radio receivers. It is also highly suitable for use as a video amplifier. The tube is

characterized by high power sensitivity, high transconductance, and high plate efficiency. Except for its heater ratings, the 12BK5 is electrically and physically identical to the [6BK5](#).

Overview and Series-Heater Design

The 12BK5 is specifically engineered for use in receivers that employ series-connected heater strings. This is particularly common in television receivers where the picture-tube heater is wired in series with other receiving tubes. In such series circuits, individual tubes can experience severe voltage surges during the warm-up phase if their thermal characteristics are mismatched. To minimize these surges, the 12BK5 features a strictly controlled heater warm-up characteristic, ensuring safe and reliable operation when integrated into a 600 mA series-connected heater string.

Heater Specifications and Warm-up Measurements

The 12BK5 utilizes a coated unipotential cathode. The heater is designed to operate from either an AC or DC supply.

Heater Parameter	Value
Nominal Heater Voltage	12.6 V
Nominal Heater Current	0.6 A
Approximate Warm-up Time	10.5 s

Heater Warm-up Test Conditions

The approximate warm-up time of 10.5 seconds is defined as the time required for the voltage across the heater terminals to rise from zero to a specified test voltage (V_1) in a standardized test circuit. The measurement is conducted using the following parameters:

- **Applied Voltage (E , RMS or DC):** 50 V
- **Total Series Resistance (R):** 63 Ω
- **Heater Test Voltage (V_1 , RMS or DC):** 10.0 V
- **Rated Heater Voltage (E_f):** 12.6 V
- **Rated Heater Current (I_f):** 0.6 A

Physical Characteristics and Pinout Configuration

The 12BK5 is housed in a T-6 1/2 glass bulb with an E9-1 small button 9-pin base. The tube can be mounted and operated in any position.

The device utilizes the **9BQ** basing arrangement. The pin connections, viewed from the bottom of the base, are as follows:

Pin Number	Connection
Pin 1	Grid 1 (Control Grid)
Pin 2	No Connection (NC)
Pin 3	Grid 1 (Control Grid)
Pin 4	Heater
Pin 5	Heater
Pin 6	Cathode and Grid 3 (Beam-Forming Plates)
Pin 7	Grid 1 (Control Grid)
Pin 8	Grid 2 (Screen Grid)
Pin 9	Plate

Grid 1 is connected to three separate pins (Pins 1, 3, and 7) to provide flexibility in circuit layout and minimize lead inductance. Grid 3 (the beam-forming plates) is internally tied to the cathode at Pin 6.

Direct Interelectrode Capacitances

When operated without an external shield, the direct interelectrode capacitances of the 12BK5 are:

- **Grid 1 to Plate:** 0.6 μpF
- **Input (Grid 1 to Cathode, Heater, Grid 2, and Grid 3):** 13 μpF
- **Output (Plate to Cathode, Heater, Grid 2, and Grid 3):** 5.0 μpF

Maximum Ratings (Design Center Values)

The maximum ratings represent the limiting values for safe operation of the 12BK5 under the Design Center system:

Parameter	Maximum Rating
Plate Voltage	250 V
Grid 2 (Screen) Voltage	250 V
Positive Grid 1 Voltage	0 V
Plate Dissipation	9 W
Screen Dissipation	2.5 W
Heater-Cathode Voltage (Heater Negative):	

Parameter	Maximum Rating
Total DC + Peak	200 V
Heater-Cathode Voltage (Heater Positive):	
DC Component	100 V
Total DC + Peak	200 V

Maximum Circuit Values

To prevent thermal runaway and ensure bias stability, the resistance in the Grid 1 circuit must not exceed the following limits:

- **Fixed Bias Operation:** 0.1 MΩ maximum
- **Cathode Bias Operation:** 0.5 MΩ maximum

Class A1 Amplifier Characteristics and Typical Operation

Under typical Class A1 operating conditions, the 12BK5 delivers high power output with relatively low input signal requirements, demonstrating its high power sensitivity.

Parameter	Typical Value
Plate Voltage	250 V
Grid 2 Voltage	250 V
Grid 1 Voltage	-5.0 V
Peak A-F Grid 1 Voltage	5.0 V
Plate Resistance (Approx.)	100,000 Ω
Transconductance	8,500 μmhos
Zero Signal Plate Current	35 mA
Maximum Signal Plate Current (Approx.)	37 mA
Zero Signal Screen Current	3.5 mA
Maximum Signal Screen Current	10 mA
Load Resistance	6,500 Ω
Total Harmonic Distortion (Approx.)	7%
Power Output	3.5 W

Performance Curves and Operation Characteristics

The electrical behavior of the 12BK5 is illustrated through several characteristic relationships:

- **Transfer Characteristics:** The relationship between plate/screen current and Grid 1 voltage (at a constant plate voltage of 250 V) shows that the tube achieves its nominal transconductance of 8,500 μmhos near the -5.0 V bias point. Curves plotted for screen voltages (E_{c2}) of 100 V, 150 V, 200 V, and 250 V demonstrate how the cutoff point shifts more negative as screen voltage increases, reaching approximately -12 V when the screen is at 250 V.
- **Plate Characteristics:** The plate current curves plotted against plate voltage (at a screen voltage of 250 V) exhibit the characteristic sharp knee of a beam power tube. This knee allows the plate voltage to swing very low before plate current drops off, contributing to the tube's high plate efficiency.
- **Screen Voltage Effects:** At a constant Grid 1 voltage of 0 V, varying the screen voltage from 100 V to 250 V significantly scales the plate current capacity, with the plate current plateau rising from approximately 25 mA at $E_{c2} = 100 \text{ V}$ to nearly 80 mA at $E_{c2} = 250 \text{ V}$.
- **Load Resistance and Distortion:** The operation characteristics under typical Class A1 conditions (with a peak AC signal of 3.54 V RMS) show that the power output peaks at approximately 3.5 W with a 6,500 Ω load. Total harmonic distortion reaches a minimum of approximately 5.5% at a load resistance of 4,500 Ω , rises to 7% at the recommended 6,500 Ω load, and increases rapidly at higher load resistances, exceeding 12% as the load approaches 12,000 Ω .

Technical Summary

The **12BK5** is a high-performance, 9-pin miniature beam power amplifier featuring a **12.6 V, 0.6 A** heater with a controlled **10.5-second warm-up time** designed for series-connected heater strings. It is electrically identical to the [6BK5](#) except for its heater ratings. Operating under Class A1 conditions with a 250 V plate and screen supply, it provides a transconductance of **8,500 μmhos** , a plate resistance of approximately **100,000 Ω** , and delivers **3.5 W** of power output into a **6,500 Ω** load with approximately **7% total harmonic distortion**. Its high power sensitivity and efficiency make it an excellent choice for audio power output and video amplifier stages in television and radio receivers.

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

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater Voltage	12.6 V	—
Heater Current	600 mA	—
Grid To Plate Capacitance	0.6 pF	—
Input Capacitance	13 pF	—
Output Capacitance	5 pF	—
Plate Resistance	100000 ohm	—
Transconductance	8500 uS	—

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	250 V	ClassA
Screen Voltage	250 V	ClassA
Grid Voltage	-5 V	ClassA
Plate Current	35 mA	ClassA
Screen Current	3.5 mA	ClassA
Load Resistance	6500 ohm	ClassA
Power Output	3.5 W	ClassA

1968 General Electric Co

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

1968 GENERAL ELECTRIC CO
Section 1 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	250 V	ClassA
Screen Voltage	250 V	ClassA
Grid1 Voltage	-5 V	ClassA
Peak AF Grid1 Voltage	5 V	ClassA
Zero Signal Plate Current	35 mA	ClassA
Maximum Signal Plate Current	37 mA	ClassA
Zero Signal Screen Current	3.5 mA	ClassA
Maximum Signal Screen Current	10 mA	ClassA
Load Resistance	6500 ohm	ClassA
Total Harmonic Distortion	7 %	ClassA
Maximum Signal Power Output	3.5 W	ClassA
Heater Warmup Time	11 s	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid1 To Plate Capacitance	0.6 pF	—
Input Capacitance	13 pF	—
Output Capacitance	5 pF	—

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