ELECTRONIC TUBE REFERENCE

12BD6

Voltage - Pentode Remote Cutoff (single) electronic tube

CONSOLIDATED TECHNICAL DATA
1 SECTION
CONSTRUCTION
PENTODE

> Miniature remote-cutoff pentode designed specifically for RF and IF amplification with automatic gain control.

General characteristics

BASE DESIGNATION	–	**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

Section ratings

SECTION1 Pentode

PLATE RESISTANCE	800000 Ω
TRANSCONDUCTANCE	0.002 S
MAXIMUM PLATE VOLTAGE	300 V
MAXIMUM SCREEN VOLTAGE	125 V
MAXIMUM PLATE DISSIPATION	3 W
MAXIMUM SCREEN DISSIPATION	0.4 W
MAXIMUM CATHODE CURRENT	14 mA

Remote-cutoff RF/IF pentode.

12BD6 — Miniature Remote-Cutoff Pentode

Overview

The **12BD6** is a miniature, remote-cutoff pentode designed primarily for use as a radio-frequency (RF) or intermediate-frequency (IF) amplifier in receiving equipment. Featuring a coated unipotential cathode and housed in a compact T-5 1/2 glass envelope, this seven-pin miniature tube is engineered to provide reliable amplification with variable-gain characteristics.

Electrically, the 12BD6 is similar to the metal-envelope **12SK7** octal pentode. Except for its heater ratings, the 12BD6 is identical to the **6BD6** pentode. Its remote-cutoff characteristic makes it highly suitable for circuits employing automatic volume control (AVC) or automatic gain control (AGC), where the stage gain must be varied over a wide range to accommodate varying signal strengths without introducing severe distortion.

Construction, Physical Dimensions, and Pinout

The 12BD6 is constructed with a compact glass envelope and a miniature button 7-pin base. It is designed to operate in any mounting position.

Physical Dimensions

The physical envelope conforms to the RTMA 5-2 outline, with the following dimensional limits:

- **Maximum Diameter:** 0.750 inches (3/4")
- **Maximum Seated Height:** 1.875 inches (1 7/8")
- **Maximum Overall Height:** 2.125 inches (2 1/8")

Heater Characteristics

The tube features an indirectly heated, coated unipotential cathode. The heater is designed for operation from either an AC or DC supply.

- **Heater Voltage:** 12.6 V
- **Heater Current:** 0.15 A (150 mA)

Terminal Connections and Basing

The 12BD6 utilizes the **7BK** (or E7-1) basing arrangement. Looking at the bottom view of the tube, the pin connections are assigned as follows:

Pin Number	Electrode Connection
1	Grid Number 1 (Control Grid)

Pin Number	Electrode Connection
2	Grid Number 3 (Suppressor Grid) and Internal Shield
3	Heater
4	Heater
5	Plate (Anode)
6	Grid Number 2 (Screen Grid)
7	Cathode

In typical applications, Pin 2 (Grid Number 3) is connected directly to Pin 7 (Cathode) at the tube socket.

Direct Interelectrode Capacitances

The extremely low grid-to-plate capacitance of the 12BD6 is critical for stable high-frequency amplification, preventing unwanted feedback and oscillation. The capacitances are specified both with and without an external shield (such as shield number 316 connected to Pin 7):

Capacitance Parameter	With External Shield	Without External Shield
Grid No. 1 to Plate (Max.)	0.005 pF	0.004 pF
Input (Grid No. 1 to all other electrodes)	4.3 pF	4.3 pF
Output (Plate to all other electrodes)	5.0 pF	5.0 pF

Maximum Ratings

The maximum ratings for the 12BD6 are established under the Design Center Rating System (interpreted according to RMA Standard M8-210). Operating the tube beyond these limits can impair its performance and shorten its operating life.

- **Maximum Plate Voltage:** 300 V
- **Maximum Grid No. 2 (Screen) Voltage:** 125 V
- **Maximum Plate Dissipation:** 3.0 to 4.0 W *(depending on the rating system applied)*
- **Maximum Grid No. 2 Dissipation:** 0.4 to 0.65 W *(depending on the rating system applied)*
- **Maximum Cathode Current:** 14 mA
- **Maximum Peak Heater-Cathode Voltage:**
  - **Heater Negative with Respect to Cathode:** 90 V
  - **Heater Positive with Respect to Cathode:** 90 V

Typical Operating Conditions and Characteristics

The 12BD6 can be operated under several standard Class A1 amplifier conditions. The transconductance and plate resistance vary depending on the selected plate, screen, and grid bias voltages.

Parameter	Operating Point A	Operating Point B	Operating Point C
Plate Voltage	100 V	125 V	250 V
Grid No. 3 (Suppressor) Voltage	Connected to cathode	Connected to cathode	Connected to cathode
Grid No. 2 (Screen) Voltage	100 V	125 V	100 V
Grid No. 1 (Control Grid) Voltage	-1 V	-3 V	-3 V
Plate Current	13 mA	13 mA	9 mA
Grid No. 2 Current	5 mA	5 mA	3.0 to 3.5 mA
Plate Resistance (Approx.)	0.12 to 0.15 MΩ	0.18 MΩ	0.7 to 0.8 MΩ
Transconductance	2250 to 2550 µmhos	2350 µmhos	2000 µmhos
Grid No. 1 Voltage for $g_m = 10$ µmhos (Approx.)	-35 V	-45 V	-35 V

Analysis of Characteristic Curves

The electrical behavior of the 12BD6 is illustrated by its average plate and transfer characteristics.

Average Plate Characteristics

The plate characteristics plot plate current (I_b) and screen current (I_{c2}) against plate voltage for various control grid ($E_{[c1](/tubes/C1)}$) bias steps ranging from 0 V down to -15 V. At very low plate voltages, the plate current rises sharply. Once the plate voltage exceeds approximately 30 to 50 volts, the plate current curves flatten out, becoming nearly horizontal. This flat region indicates a very high dynamic plate resistance, which is characteristic of pentode construction. The screen current remains relatively constant across the flat region of the plate voltage sweep, though it rises as plate voltage approaches zero.

Average Transfer Characteristics

The transfer characteristics plot plate current, screen current, and transconductance (g_m) against negative control grid voltage ($E_{[c1](/tubes/C1)}$) at a fixed plate voltage of 250 V and screen voltage of 100 V. As the control grid bias is made more negative, the plate current and transconductance decrease

gradually rather than cutting off abruptly. This smooth, extended cutoff curve is the defining feature of a remote-cutoff pentode. For example, while the transconductance is 2000 µmhos at a grid bias of -3 V, it decreases to approximately 10 µmhos only when the grid bias is increased to approximately -35 V. This allows the tube to handle large input signals without clipping or cross-modulation when a negative AGC bias is applied.

Related Designations and Comparisons

The 12BD6 belongs to a family of miniature tubes designed for 12.6-volt heater systems, often utilized in automotive or series-string receiver designs.

- **6BD6:** The 6BD6 is the 6.3-volt equivalent of the 12BD6. It is identical in all electrical characteristics, physical dimensions, and pin configurations, except for its heater, which requires 6.3 V at 300 mA.
- **12SK7:** The 12BD6 is electrically similar to the older, octal-based 12SK7 pentode, offering comparable RF/IF amplification performance in a much smaller physical package.
- **12BA6 and 12BA7:** In 12.6-volt receiver lineups, the 12BD6 is frequently grouped alongside the **12BA6** (a remote-cutoff pentode with different characteristics) and the **12BA7** (a pentagrid converter), which share the same 12.6 V, 150 mA heater rating.

Technical Summary

The **12BD6** is a **7-pin miniature remote-cutoff pentode** designed for RF and IF amplifier service. Operating with a **12.6 V, 150 mA** heater, it features a T-5 1/2 glass envelope, a 7BK basing diagram, and a coated unipotential cathode. It provides a transconductance of **2000 to 2550 µmhos** and a plate resistance of up to **0.8 MΩ** under typical Class A1 operating conditions. Its remote-cutoff design allows for smooth gain control via negative grid bias, making it a highly effective component in automatic gain control circuits.

SOURCE OPERATING CONDITIONS

1966 Tung Sol Electronic Tubes 2 of 4

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

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OTHER		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
INPUT	**4.3 pF**	Published datasheet; operating column 1
INPUT	**3 pF**	Published datasheet; operating column 2
HEATER NEGATIVE WITH RESPECT TO CATHODE	**90 V**	Published datasheet
HEATER POSITIVE WITH RESPECT TO CATHODE	**90 V**	Published datasheet
MAXIMUM PLATE VOLTAGE	**300 V**	Published datasheet
MAXIMUM PLATE DISSIPATION	**3 W**	Published datasheet
MAXIMUM GRID k2 DISSIPATION	**0.4 W**	Published datasheet
MAXIMUM CATHODE CURRENT	**14 mA**	Published datasheet
TR ANSCONDUCTANCE	**2 uS**	Published datasheet; operating column 1
TR ANSCONDUCTANCE	**550 uS**	Published datasheet; operating column 2
FOR Gm =	**10 V**	Published datasheet; operating column 1
FOR Gm =	**-35 V**	Published datasheet; operating column 2
FOR Gm =	**-45 V**	Published datasheet; operating column 3
Et =	**12.6 V**	Published datasheet
EC2 =	**100 V**	Published datasheet
Eb =	**250 V**	Published datasheet

CHARACTERISTIC		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
NEATER VOLTAGE	**12.6 V**	Published datasheet
HEATER VOLTAGE	**12.6 V**	Published datasheet; operating column 1
HEATER CURRENT	**150 mA**	Published datasheet; operating column 1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
GRlD k2 VOLTAGE	**100 V**	Published datasheet; operating column 1
GRlD k2 VOLTAGE	**125 V**	Published datasheet; operating column 2
GRID M1 VOLTAGE	**-1 V**	Published datasheet; operating column 1
GRID M1 VOLTAGE	**-3 V**	Published datasheet; operating column 2
PLATE CURRENT	**13 mA**	Published datasheet; operating column 1
PLATE CURRENT	**9 mA**	Published datasheet; operating column 3
GRID N2 CURRENT	**5 mA**	Published datasheet; operating column 1
GRID N2 CURRENT	**3 mA**	Published datasheet; operating column 3
PLATE RESISTANCE	**0.15 Mohm**	Published datasheet; operating column 1
PLATE RESISTANCE	**0.18 Mohm**	Published datasheet; operating column 2
PLATE RESISTANCE	**0 Mohm**	Published datasheet; operating column 3

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Section 1 · Pentode

OTHER		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Plate Voltage	**300 V**	DesignCenter
Screen Voltage	**125 V**	DesignCenter
Plate Dissipation	**3 W**	DesignCenter
Screen Dissipation	**0.65 W**	DesignCenter
Plate Voltage	**250 V**	ClassA
Screen Voltage	**100 V**	ClassA
Plate Resistance	**800000 ohm**	ClassA
Transconductance	**2000 uS**	ClassA
Plate Current	**9 mA**	ClassA
Screen Current	**3 mA**	ClassA

SOURCE OPERATING CONDITIONS

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1971 RCA HB3 BINDER 5 OF 7

Section 1 · Pentode

CHARACTERISTICS		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Heater voltage nominal	**12.6 V**	—
Heater current	**150 mA**	—

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