



ELECTRONIC TUBE REFERENCE

12EK6

Voltage - Pentode or Tetrode (under 100V) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
PENTODE

Seven-pin miniature sharp-cutoff pentode documented for fixed-gain signal-amplifier service. Manufacturer sources provide its electrical ratings and operating characteristics without indicating a stronger specialized functional identity.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
NOMINAL HEATER	12.6 V / 190 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Pentode	
PLATE RESISTANCE	40000 Ω
TRANSCONDUCTANCE	0.0042 S
MAXIMUM PLATE VOLTAGE	16 V
MAXIMUM SCREEN VOLTAGE	16 V
MAXIMUM PLATE DISSIPATION	2 W
<i>Published ratings and characteristics promoted from the approved RCA source.</i>	

12EK6 — Sharp-Cutoff Miniature Pentode

The **12EK6** is a sharp-cutoff pentode of the 7-pin miniature type designed primarily for use as a radio-frequency (RF) or intermediate-frequency (IF) amplifier in "hybrid" automobile receivers. In these applications, the tube operates directly from a nominal 12-volt automotive storage battery, which supplies the heater, plate, and screen grid (grid number 2) potentials without the need for a high-voltage DC-to-DC

converter or vibrator power supply. The 12EK6 is capable of operating as an RF amplifier at frequencies extending up into the very-high-frequency (VHF) range.

Construction, Mechanical Specifications, and Pinout

The 12EK6 is constructed in a compact miniature glass envelope (T-5 1/2 bulb) with a small-button miniature 7-pin base (conforming to JETEC No. E7-1). The physical dimensions of the tube are standardized to ensure compatibility in compact automotive receiver chassis:

- **Maximum Overall Length:** 2-1/8 inches (2.125 inches)
- **Maximum Seated Length:** 1-7/8 inches (1.875 inches)
- **Length from Base Seat to Bulb Top (excluding tip):** 1-1/2 inches $\pm$ 3/32 inch
- **Diameter:** 0.650 inches minimum to 0.750 inches maximum
- **Mounting Position:** Any

The tube features a coated unipotential cathode and an internal shield. The electrical connections are arranged according to the **7BK** basing diagram. Viewed from the bottom of the tube, the pin assignments are as follows:

Pin Number	Electrode Connection
1	Grid Number 1 (Control Grid)
2	Grid Number 3 (Suppressor Grid) / Internal Shield
3	Heater
4	Heater
5	Plate
6	Grid Number 2 (Screen Grid)
7	Cathode

Heater and Low-Voltage Automotive Design

Because the 12EK6 is specifically engineered for automotive service, its heater is designed to withstand the wide voltage fluctuations characteristic of vehicle electrical systems.

- **Nominal Heater Voltage:** 12.6 V (AC or DC)
- **Heater Current:** Approximately 0.19 to 0.2 amperes (190 to 200 mA) at 12.6 V
- **Automotive Operating Range:** The heater is designed to operate over a broad voltage range of 10.0 to 15.9 volts. This wide range provides an adequate safety factor to ensure the tube survives the voltage swings of an automobile battery and charging system.
- **Recommended Range for Longest Life:** For maximum reliability and tube longevity, it is recommended to operate the heater within a narrower range of 11 to 14 volts.

As a calculation of heater power consumption, using the nominal heater voltage of 12.6 V and the nominal heater current range of 0.19 to 0.2 A, the heater power dissipation is calculated as:

- **Power (at 0.19 A):** $12.6\text{ V} \times 0.19\text{ A} = 2.394\text{ W}$
- **Power (at 0.20 A):** $12.6\text{ V} \times 0.20\text{ A} = 2.520\text{ W}$

Operation at or near the absolute limits of 10.0 V or 15.9 V involves trade-offs: low heater voltage can result in a sacrifice in electrical performance, while high heater voltage reduces the overall life expectancy of the heater filament. Improved supply-voltage regulation in the equipment significantly enhances reliability.

Electrical Ratings and Design Systems

The maximum ratings for the 12EK6 are established under the Design-Maximum Rating System (and in some documentation, the Design-Center Rating System). These ratings represent limiting values that must not be exceeded under the worst probable operating conditions of a bogey device, taking into account supply voltage variations, component tolerances, and environmental changes.

Parameter	Design-Maximum / Design-Center Value
Maximum Plate Voltage	16 V
Maximum Grid No. 2 (Screen Grid) Voltage	16 V
Maximum Grid No. 3 (Suppressor Grid) Voltage	0 V
Maximum Positive DC Grid No. 1 (Control Grid) Voltage	0 V
Maximum Heater-Cathode Voltage (Heater Negative to Cathode)	16 V
Maximum Heater-Cathode Voltage (Heater Positive to Cathode)	16 V
Maximum Grid No. 1 Circuit Resistance	10 MΩ

These low-voltage limits reflect the tube's specialized design for direct operation from 12-volt battery systems, contrasting sharply with conventional vacuum tubes that require plate and screen potentials of 100 to 300 volts.

Typical Operating Conditions and Characteristics

In typical Class A1 amplifier service, the 12EK6 operates with its plate and screen grid tied directly to the 12.6-volt supply. The suppressor grid (grid number 3) is connected directly to the cathode at the socket.

Rather than utilizing an external negative bias supply or a cathode bias resistor, the control grid (grid number 1) is biased using contact potential. This is achieved by placing a high-value resistor in the grid

circuit, allowing a negative bias to develop naturally from the collection of thermally emitted electrons on the grid wire.

The typical operating parameters under these conditions are:

- **Heater Voltage:** 12.6 V
- **Plate Voltage:** 12.6 V
- **Grid No. 2 Voltage:** 12.6 V
- **Grid No. 3 Voltage:** 0 V (connected to cathode)
- **Grid No. 1 Resistor:** 2.2 M Ω
- **Grid No. 1 Voltage (developed via contact potential):** Negative bias (noted as average contact potential across the 2.2 M Ω resistor)
- **Plate Current:** 4.0 to 4.4 mA
- **Grid No. 2 Current:** 1.7 to 2.0 mA
- **Transconductance:** 4200 μ mhos (micromhos)
- **Plate Resistance (Approximate):** 40,000 to 50,000 Ω
- **Grid No. 1 Cutoff Voltage (for Plate Current of 10 μ A):** -3.8 to -4.0 V

Interelectrode Capacitances

To facilitate stable high-frequency operation in RF and IF stages up to the VHF band, the 12EK6 is designed with low internal capacitances. The direct interelectrode capacitances, measured without an external shield, are:

- **Grid No. 1 to Plate (Maximum):** 0.032 to 0.036 pF
- **Input (Grid No. 1 to Cathode + Grid No. 2 + Grid No. 3 + Internal Shield + Heater):** 10 pF
- **Output (Plate to Cathode + Grid No. 2 + Grid No. 3 + Internal Shield + Heater):** 5.0 to 5.5 pF

The extremely low grid-to-plate capacitance (maximum of 0.036 pF) is critical for preventing unwanted feedback and self-oscillation in high-gain amplifier stages.

Analysis of Characteristic Curves

The characteristic curves for the 12EK6 illustrate its behavior under low-voltage conditions:

1. **Average Plate Characteristics:** The curves plotting plate current (I_b) and screen-grid current (I_{c2}) against plate voltage (E_b) show that the tube exhibits classic pentode knee characteristics even at very low voltages. For a screen voltage (E_{c2}) of 12.6 V and a grid-number 1 voltage (E_{c1}) of 0 V, the plate current rises rapidly as plate voltage increases from 0 to approximately 10 V, above which it flattens out, demonstrating high plate resistance. The screen current remains relatively constant across the normal operating plate voltage range.
2. **Average Transfer Characteristics:** The transfer curves plot transconductance (g_m), plate resistance (r_p), plate current (I_b), and screen current (I_{c2}) against negative grid-number 1 voltage (E_{c1}). At the nominal operating point ($E_b = E_{c2} = 12.6$ V), the transconductance peaks near 4200 μ mhos at $E_{c1} = 0$ V and falls smoothly to zero as the grid bias approaches

the cutoff region near -4 V. Concurrently, the plate resistance rises sharply as the grid is biased more negatively, exceeding 100,000 ohms as the tube approaches cutoff.

Technical Summary

The **12EK6** is a specialized **7-pin miniature sharp-cutoff pentode** designed for low-voltage RF and IF amplification in hybrid automotive receivers. By operating its heater, plate, and screen grid directly from a nominal **12.6 V** supply, it eliminates the need for high-voltage power generation in car radios. The tube features a **T-5 1/2** glass envelope, a **7BK** pinout configuration, and a rugged heater capable of operating across a **10.0 to 15.9 V** range. Under typical operating conditions with a **2.2 MΩ** grid resistor, it provides a transconductance of **4200 μmhos**, a plate current of **4.0 to 4.4 mA**, and a plate resistance of **40,000 to 50,000 Ω**, making it a highly efficient and reliable solution for mobile communications equipment of its era.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1940 RCA

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

1940 RCA

Section 1 · Pentode

APPLICATION

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Application	IF_VHF_RF_Amplifier text	—



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	150 mA	Nominal
Plate voltage	16 V	Typical operating conditions
Screen voltage	16 V	Typical operating conditions



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

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
GRID TO PLATE (MAX.)	0.036 mA	GRID TO PLATE (MAX.) 0.036 ~ μpf
MAXIMUM PLATE VOLTAGE	16 V	MAXIMUM PLATE VOLTAGE 16 voLrs
MAXIMUM GRID #	2 V	MAXIMUM GRID #2 VOLTAGE 16 VOLTS
MAXIMUM POSITIVE DC GRID #	1 V	MAXIMUM POSITIVE DC GRID #1 VOLTAGE O VOLTS
MAXIMUM GRID #	1 mA	MAXIMUM GRID #1 CIRCUIT RESISTANCE LO MEGOHMS

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
HEATER VOLTAGE S	12.6 V	HEATER VOLTAGE S 12.6 VOLTS
HEATER NEGATIVE WITH RESPECT TO CATHODE	16 V	HEATER NEGATIVE WITH RESPECT TO CATHODE 16 VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE	16 V	HEATER POSITIVE WITH RESPECT TO CATHODE 16 VOLTS
TXE ME ATER IS THEREFORE DESIGNED TO OPERATE OVER THE	10 V	TXE ME ATER IS THEREFORE DESIGNED TO OPERATE OVER THE 10.0 TO 15.9 VOLTAGE RANGE ENCOUNTERED IN
HEATER VOLTAGE	1 V	HEATER VOLTAGE 1Z.0 VOLTS
HEATER CURRENT O	3 A	HEATER CURRENT 0.3 AMP.
PLATE VOLTAGE L	2 V	PLATE VOLTAGE L 2.~ VOLTS
GRID #	2 V	GRID #2 VOLTAGE 1Z.G VOLTS
GRID #	1 V	GRID #1 VOLTAGE C
GRID #	1 MΩ	GRID #1 RESISTOR ~.P MEGOHMS
PLATE CURRENT	4 mA	PLATE CURRENT 4.Q ~- MA.
GRID #	2 mA	GRID #2 CURRENT 1.JF MA.
PLATE RESISTANCE (APPROX.)	5 Ω	PLATE RESISTANCE (APPROX.) 5Q QQQ F OHMS
GRID #	1 V	GRID #1 VOLTAGE FOR Ib 10 μA — 3,8 ~ voLTs

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	4.4 mA	AverageCharacteristics
Screen Current	2 mA	AverageCharacteristics

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