



ELECTRONIC TUBE REFERENCE

12CN5

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

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

PENTODE

Sylvania pentode documented in manufacturer literature. The available source does not provide sufficiently readable application or cutoff detail beyond its placement in the sharp-cutoff population, so classification remains conservative.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
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 Pentode	
PLATE RESISTANCE	40000 Ω
TRANSCONDUCTANCE	0.0038 S
MAXIMUM PLATE VOLTAGE	16 V
MAXIMUM SCREEN VOLTAGE	16 V
<i>Published source values promoted where applicable.</i>	

12CN5 — Miniature Sharp-Cutoff Pentode

Overview

The **12CN5** is a miniature, sharp-cutoff pentode designed primarily for use as an intermediate-frequency (IF) amplifier in automobile radio receivers. Developed to operate directly from a nominal 12-volt automotive storage battery, the 12CN5 eliminates the need for high-voltage power supplies by running its heater, plate, and screen grid (Grid No. 2) directly at battery potential.

The tube features a compact seven-pin miniature construction, a coated unipotential cathode, and electrical characteristics optimized for low-voltage operation. Its design incorporates specific safeguards to handle the wide voltage fluctuations typical of automotive electrical systems.

Mechanical Specifications and Basing

The 12CN5 is housed in a small glass envelope with a miniature button base. The physical and mechanical parameters are defined as follows:

Parameter	Specification
Bulb	T-5 1/2
Base	E7-1, Miniature Button 7-Pin
Outline	5-3
Basing	7CV
Cathode	Coated Unipotential
Mounting Position	Any

Pin Connection Diagram

The 7CV basing arrangement provides the following pin connections, viewed from the underside of the tube:

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

The inclusion of two separate pin connections (Pin 2 and Pin 5) for Grid No. 1 is a design feature that can assist in circuit layout and minimize lead inductance in high-frequency applications.

Heater and Power Supply Characteristics

The heater of the 12CN5 is specifically engineered to withstand the harsh electrical environment of automotive applications.

Heater Parameter	Value
Nominal Heater Voltage	12.6 V

Heater Parameter	Value
Heater Current	450 mA
Satisfactory Operating Range	10.0 V to 15.9 V
Max. Heater-Cathode Voltage (Heater Negative)	16 V
Max. Heater-Cathode Voltage (Heater Positive)	16 V

Heater Power Calculation

Using the nominal heater voltage and current, the power consumed by the heater is calculated as:

$$\text{Heater Power} = 12.6 \text{ V} \times 0.45 \text{ A} = 5.67 \text{ W}$$

The heater is designed to operate satisfactorily even when the battery voltage drops to 10.0 V or rises to 15.9 V during generator charging. The maximum ratings are established to provide a safety factor for these wide voltage variations.

Maximum Ratings (Design Center Values)

The maximum ratings of the 12CN5 are tailored for low-voltage operation, reflecting its direct-battery-connection design:

- **Plate Voltage:** 16 Volts maximum
- **Grid No. 2 (Screen) Voltage:** 16 Volts maximum
- **Positive Grid No. 1 Voltage:** 0 Volts maximum
- **Grid No. 1 Circuit Resistance:** 2.2 Megohms maximum

These ratings must not be exceeded under the worst-case operating conditions of the automotive battery supply.

Characteristics and Typical Operation

In a typical IF amplifier circuit, the 12CN5 operates with both its plate and screen grid connected directly to the 12.6-volt supply. Grid bias is obtained via contact potential across a high-value grid resistor rather than an external bias supply.

Parameter	Typical Value
Plate Voltage	12.6 V
Grid No. 2 Voltage	12.6 V
Grid No. 1 Resistor	2.2 MΩ
Grid No. 1 Voltage	Contact Potential Bias
Plate Current	4.5 mA

Parameter	Typical Value
Grid No. 2 Current	0.35 mA
Transconductance	3800 μmhos
Plate Resistance (approx.)	40,000 Ω

Electrode Power Dissipation Calculations

Under typical operating conditions, the power dissipated by the plate and screen grid can be calculated as follows:

- **Plate Dissipation:** $P_p = 12.6 \text{ V} \times 0.0045 \text{ A} = 0.0567 \text{ W}$ (56.7 mW)
- **Grid No. 2 Dissipation:** $P_{[g2]}(/tubes/G2) = 12.6 \text{ V} \times 0.00035 \text{ A} = 0.00441 \text{ W}$ (4.41 mW)
- **Total Signal-Electrode Power:** $P_{\text{total}} = 56.7 \text{ mW} + 4.41 \text{ mW} = 61.11 \text{ mW}$

This extremely low signal-electrode power consumption is a direct consequence of the low-voltage design, making the tube highly efficient in terms of high-voltage current drain on the vehicle's electrical system.

Direct Interelectrode Capacitances

The capacitances of the tube control the high-frequency performance and stability of the amplifier stage:

- **Grid No. 1 to Plate (Shielded):** 0.2 pF maximum
- **Grid No. 1 to Plate (Unshielded):** 0.25 pF maximum

Analysis of Characteristic Curves

Average Plate Characteristics

The plate characteristics map the plate current (I_b) and screen current (I_{c2}) against plate voltage for various fixed Grid No. 1 voltages ($E_{[c1]}(/tubes/C1)$).

- At $E_{[c1]}(/tubes/C1) = 0 \text{ V}$ and a plate voltage of 12.6 V, the plate current is approximately 9 mA.
- In actual typical operation, the use of a 2.2-megohm grid resistor develops an average negative contact potential bias. This shifts the operating point to a region where the plate current is reduced to 4.5 mA, effectively preventing excessive current draw and optimizing the transconductance-to-current ratio.
- The curves exhibit a classic pentode knee below 5 volts, above which the plate current curves flatten out, demonstrating high dynamic plate resistance.

Average Transfer Characteristics

The transfer characteristics, plotted at $E_b = 12.6 \text{ V}$ and $E_{c2} = 12.6 \text{ V}$, illustrate the sharp-cutoff behavior of the 12CN5:

- **Transconductance (g_m):** At 0 V grid bias, the transconductance is near its peak of 3800 μmhos . As the grid bias is made negative, g_m falls rapidly, dropping to approximately 1800 μmhos at -1.0 V and to about 500 μmhos at -2.0 V .
- **Plate Resistance (r_p):** Conversely, the plate resistance rises steeply as negative bias increases. From its nominal value of 40,000 ohms at 0 V bias, it increases to approximately 100,000 ohms at -1.0 V and exceeds 200,000 ohms as the bias approaches -2.0 V .
- **Cutoff Point:** The plate current and transconductance approach zero as the grid bias reaches approximately -3.0 V to -4.0 V , confirming the sharp-cutoff classification of the device.

Technical Summary

The **12CN5** is a specialized **miniature sharp-cutoff pentode** designed for low-voltage automotive applications, specifically as an **IF amplifier**. Operating directly from a **12.6 V** nominal battery supply, it eliminates the need for high-voltage power generation in car radios. It features a **7-pin miniature button base (7CV basing)**, a **12.6 V / 450 mA heater** capable of handling a wide **10.0 V to 15.9 V** range, and a typical transconductance of **3800 μmhos** achieved via **contact potential biasing** across a **2.2 M Ω** grid resistor. With its low electrode power dissipation and robust design, the 12CN5 represents a highly optimized solution for mid-century automotive receiver technology.

TUBE TINKER

An independent reference for electronic tubes, vacuum tubes,
and their source documents.

[Catalog](#) [Tube types](#) [Full books](#) [Blog](#) [Feedback & corrections](#)

© 2026 Tube Tinker