

ELECTRONIC TUBE REFERENCE

12C5

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

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
BEAMPOWER

Beam-power output tube intended for audio-frequency power amplification in receiving equipment, with a 12.6 V heater suited to series-string operation.

GENERAL CHARACTERISTICS

BASE DESIGNATION	7CV	BASE PINS	7
NOMINAL HEATER	12.6 V / 600 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

7CV - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – G3	A	G3 – Suppressor Grid	CONNECTED
PIN1 – K	A	K – Cathode	CONNECTED
PIN2 – G1	A	G1 – Control Grid	CONNECTED
PIN3 – H	–	H – Heater	CONNECTED
PIN4 – H	–	H – Heater	CONNECTED
PIN5 – G1	A	G1 – Control Grid	CONNECTED
PIN6 – G2	A	G2 – Screen Grid	CONNECTED
PIN7 – P	A	P – Plate (Anode)	CONNECTED

SECTION RATINGS

SECTION1 Beam Power	
PLATE RESISTANCE	10000 Ω
TRANSCONDUCTANCE	0.0075 S
MAXIMUM PLATE VOLTAGE	150 V
MAXIMUM SCREEN VOLTAGE	130 V
MAXIMUM PLATE DISSIPATION	7 W
MAXIMUM SCREEN DISSIPATION	1.4 W
<i>Sparse-source exception</i>	

12C5 — Beam Power Pentode

A miniature, seven-pin beam power amplifier designed for high-efficiency audio output stages in television and radio receivers, particularly optimized for series-heater AC/DC mains-operated equipment.

Overview

The **12C5** is a miniature beam power pentode designed primarily for service as an audio output amplifier in amplitude-modulated (AM), frequency-modulated (FM), and television receivers. The tube is characterized by high power sensitivity and high plate efficiency when operating at the relatively low plate and screen-grid (grid No. 2) voltages typical of power-transformerless (AC/DC) receiver designs.

The 12C5 is electrically identical to the [12CU5](#) and shares identical electrical characteristics (excluding heater ratings and heater warm-up characteristics) with the [6CU5](#), [17CU5/17C5](#), [25C5](#), and [50C5](#) beam power tubes. Except for its specific heater ratings and controlled warm-up time, the 12C5 is also identical to the [50C5](#).

Construction, Mechanical Specifications, and Basing

The 12C5 is constructed in a T-5 1/2 glass envelope with a miniature button 7-pin base (JETEC E7-1). The tube features a coated unipotential cathode and can be mounted in any physical position.

Physical Dimensions

- **Maximum Overall Length:** 2-5/8 inches (2.625 in)
- **Maximum Seated Height:** 2-3/8 inches (2.375 in)
- **Maximum Diameter:** 3/4 inch (0.750 in)

Pin Connections (7CV Basing)

The 7CV basing arrangement provides the following pinout connections, viewed from the bottom of the tube:

- **Pin 1:** Grid No. 1 (Control Grid)
- **Pin 2:** Cathode and Grid No. 3 (Beam Plates)
- **Pin 3:** Heater
- **Pin 4:** Heater
- **Pin 5:** Grid No. 1 (Control Grid)
- **Pin 6:** Grid No. 2 (Screen Grid)
- **Pin 7:** Plate

The dual connection for Grid No. 1 on Pin 1 and Pin 5 provides flexibility in circuit layout and wiring.

Heater Characteristics and Controlled Warm-up

The heater of the 12C5 is designed for series-string operation in 600 mA receiver designs, such as television receivers where the picture-tube heater is wired in series with other tube heaters. The thermal characteristics of the heater are tightly controlled to minimize voltage surges across individual tubes during the initial warm-up cycle.

Heater Parameter	Value
Nominal Heater Voltage (AC or DC)	12.6 V
Nominal Heater Current	0.6 A ($\pm 6\%$ or ± 0.04 A tolerance)
Calculated Heater Power	7.56 W
Average Heater Warm-up Time	11 seconds

Heater Warm-up Time Definition

The heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated voltage (10.08 V) after applying four times the rated heater voltage (50.4 V) to a test circuit. This test circuit consists of the tube heater connected in series with an external resistance equal to three times the nominal heater operating resistance (calculated as $3 \times \frac{12.6}{0.6} = 63 \text{ } \Omega$).

Electrical Ratings and Rating Systems

The maximum ratings of the 12C5 are documented under both the Design-Center System and the Design-Maximum Rating System. Designers must apply these limits strictly according to the specified system and operating conditions.

Rating Parameter	Design-Center System	Design-Maximum System
Maximum Plate Voltage	135 V	150 V
Maximum Grid No. 2 (Screen-Grid) Voltage	117 V	130 V

Rating Parameter	Design-Center System	Design-Maximum System
Maximum Plate Dissipation	6.0 W	7.0 W
Maximum Grid No. 2 Dissipation	1.25 W	1.4 W
Maximum Positive DC Grid No. 1 Voltage	0 V	0 V
Maximum Bulb Temperature (Hottest Point)	220 °C	220 °C

Heater-Cathode Voltage Limits

- **Heater Negative with Respect to Cathode:**
 - **Total DC and Peak:** 200 V (some design-center specifications list up to 300 V total DC and peak under specific conditions).
- **Heater Positive with Respect to Cathode:**
 - **DC Component:** 100 V
 - **Total DC and Peak:** 200 V

Maximum Grid No. 1 Circuit Resistance

- **For Cathode-Bias Operation:** 0.5 Megohm
- **For Fixed-Bias Operation:** 0.1 Megohm

Typical Class A1 Operating Conditions and Characteristics

Under typical Class A1 audio power amplifier conditions, the 12C5 operates with the following parameters:

- **Plate Voltage:** 120 V
- **Grid No. 2 Voltage:** 110 V
- **Grid No. 1 Voltage:** -8.0 V
- **Peak AF Grid No. 1 Voltage:** 8.0 V
- **Zero-Signal Plate Current:** 49 mA
- **Maximum-Signal Plate Current:** 50 mA
- **Zero-Signal Grid No. 2 Current:** 4.0 mA
- **Maximum-Signal Grid No. 2 Current:** 8.5 mA
- **Plate Resistance (Approximate):** 10,000 Ohms
- **Transconductance:** 7,500 μ mhos
- **Load Resistance:** 2,500 Ohms
- **Total Harmonic Distortion:** 10%

- **Maximum-Signal Power Output:** 2.3 Watts

The high transconductance of 7,500 μmhos and low optimal load resistance of 2,500 Ohms reflect the tube's high power sensitivity, enabling it to deliver over 2 Watts of audio output with a peak input signal of only 8.0 V.

Interelectrode Capacitances

The direct interelectrode capacitances of the 12C5, measured without an external shield, are:

- **Grid No. 1 to Plate:** 0.6 pF
- **Input (Grid No. 1 to Cathode, Heater, Grid No. 2, and Grid No. 3):** 13 pF
- **Output (Plate to Cathode, Heater, Grid No. 2, and Grid No. 3):** 8.5 pF

Performance Curves and Load Characteristics

Average Plate Characteristics

The plate characteristics of the 12C5 show plate current (I_b) and screen-grid current (I_{c2}) plotted against plate voltage for various control-grid bias voltages ($E_{c1}(/tubes/C1)$) at a fixed screen-grid voltage (E_{c2}) of 110 V:

- At $E_{c1}(/tubes/C1) = 0$ V, the plate current rises rapidly, forming a sharp knee around 40–50 V and reaching a peak plate current of over 125 mA.
- At the typical bias point of -8 V, the plate current remains relatively flat across a wide range of plate voltages, stabilizing near 49 mA.
- The screen-grid current (I_{c2}) is highest at low plate voltages and drops significantly as plate voltage rises above the knee.

Operation Characteristics vs. Load Resistance

When operated at $E_b = 110$ V, $E_{c2} = 110$ V, $E_{c1}(/tubes/C1) = -7.5$ V, and driven by an input signal of 5.3 V RMS:

- **Power Output (P_O):** Rises rapidly with load resistance, peaking at approximately 1.9 Watts at a load resistance of 2.5 k Ω , before gradually declining at higher load values.
- **Total Harmonic Distortion (Dist.):** Reaches a distinct minimum of approximately 4.5% at a load resistance of 2.5 k Ω . Operating the tube with load resistances significantly lower or higher than this optimal value causes distortion to rise sharply (e.g., exceeding 10% at 5.0 k Ω).
- **Current Variations:** As the load resistance increases from 0 to 6,000 Ohms, the maximum-signal plate current decreases, while the maximum-signal screen-grid current increases.

Thermal Considerations and Shielding

The maximum bulb temperature must not exceed 220 °C at the hottest point on the bulb surface. High ambient operating temperatures or the use of close-fitting tube shields can cause the bulb temperature to exceed this limit, necessitating a reduction in operating dissipation.

When tube shields are employed, it is recommended to paint both the inside and outside surfaces of the shield a dull black and to provide ventilation slots to facilitate heat dissipation and maintain safe operating temperatures.

Related Designations and Comparisons

The **12C5** is electrically identical to the **12CU5**. Except for heater ratings, its electrical characteristics are identical to those of the **6CU5** (6.3 V, 1.2 A heater), **17CU5/17C5** (16.8 V, 0.45 A heater), **25C5** (25.0 V, 0.3 A heater), and **50C5** (50.0 V, 0.15 A heater). It is also closely related to the **50B5**, sharing identical electrical data except for heater characteristics and basing layout.

Another related type is the **12CA5**, which is a 12.6 V beam pentode identical to the **6CA5** except for heater ratings and heater-cathode voltage ratings.

Technical Summary

The **12C5** is a **miniature, seven-pin beam power pentode** featuring a **12.6 V, 0.6 A heater** with controlled warm-up characteristics. It is designed for high-efficiency Class A1 audio power amplification in series-heater television and radio receivers. Operating at a typical plate voltage of 120 V and screen voltage of 110 V, it delivers **2.3 Watts** of output power into a **2,500 Ohm** load with **10% total harmonic distortion**. Its controlled 11-second warm-up time prevents heater voltage surges in series-string circuits, making it a highly reliable and specialized choice for transformerless consumer electronics of its era.

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 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater voltage	12.6 V	Nominal
Heater current	600 mA	Nominal
Plate voltage	135 V	Typical operating conditions
Screen voltage	117 V	Typical operating conditions
Plate current	49 mA	Typical operating conditions

SOURCE OPERATING CONDITIONS

1965 Sylvania Electronic Tubes Vol3

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

1965 SYLVANIA ELECTRONIC TUBES VOL3

Section 1 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	120 V	ClassA
Plate current	49 mA	ClassA

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	10000 Ohm	—
Transconductance	7500 uS	—



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
Typical plate voltage	120 V	ClassA
Typical screen voltage	110 V	ClassA
Maximum signal power output	2.3 W	ClassA

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate resistance	10000 ohm	—

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



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

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 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	110 V	ClassA1
Screen voltage	110 V	ClassA1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid 1 voltage	-7.5 V	ClassA1
Plate current	50 mA	ClassA1
Signal power output	2.3 W	ClassA1

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater warm-up time	11 s	WholeTube


SOURCE DATA APPENDIX

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 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	110 V	ClassA
Screen Voltage	110 V	ClassA
Plate Current	49 mA	ClassA
Screen Current	4 mA	ClassA
Load Resistance	2500 ohm	ClassA
Power Output	1.9 W	ClassA
Total Harmonic Distortion	9 %	ClassA


SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1975 RCA RC30

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

1975 RCA RC30

Section 1 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater Voltage (ac/dc) 6.3 12.6	16.8 V	Published in approved 17CU5 target datasheet entry; Section1
Heater Current 1.2 0.6	450 mA	Published in approved 17CU5 target datasheet entry; Section1
Heater Warm-up Time (Average) 11	11 seconds	Published in approved 17CU5 target datasheet entry; Section1
Plate Voltage	150 V	Published in approved 17CU5 target datasheet entry; Section1
Grid-No.2 (Screen-Grid) Voltage	130 V	Published in approved 17CU5 target datasheet entry; Section1
Grid-No.1 (Control-Grid) Voltage, Positive-bias value	0 V	Published in approved 17CU5 target datasheet entry; Section1
Plate Dissipation	7 W	Published in approved 17CU5 target datasheet entry; Section1
Grid-No.2 Input	1.4 W	Published in approved 17CU5 target datasheet entry; Section1
Plate Voltage	120 V	Published in approved 17CU5 target datasheet entry; Section1
Grid-No.2 Voltage	110 V	Published in approved 17CU5 target datasheet entry; Section1
Grid-No.1 Voltage	-8 V	Published in approved 17CU5 target datasheet entry; Section1
Peak AF Grid-No.1 Voltage	8 V	Published in approved 17CU5 target datasheet entry; Section1
Zero-Signal Plate Current	49 mA	Published in approved 17CU5 target datasheet entry; Section1
Zero-Signal Grid-No.2 Current	4 mA	Published in approved 17CU5 target datasheet entry; Section1
Maximum-Signal Grid-No.2 Current	8.5 mA	Published in approved 17CU5 target datasheet entry; Section1
Plate Resistance (Approx.)	10000 Ω	Published in approved 17CU5 target datasheet entry; Section1
Transconductance	7500 μS	Published in approved 17CU5 target datasheet entry; Section1
Load Resistance	2500 Ω	Published in approved 17CU5 target datasheet entry; Section1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Total Harmonic Distortion	10 %	Published in approved 17CU5 target datasheet entry; Section1
Maximum-Signal Power Output	2.3 W	Published in approved 17CU5 target datasheet entry; Section1
For fixed-bias operation	0.1 MΩ	Published in approved 17CU5 target datasheet entry; Section1
For cathode-bias operation	0.5 MΩ	Published in approved 17CU5 target datasheet entry; Section1
Heater Voltage (ac/dc) 2.1 6.3	13.5 V	Published in approved 17CU5 target datasheet entry; Section1
Heater Current 0.45 0.135	60 mA	Published in approved 17CU5 target datasheet entry; Section1
Plate Voltage	135 V	Published in approved 17CU5 target datasheet entry; Section1
Negative-bias value	55 V	Published in approved 17CU5 target datasheet entry; Section1
Peak positive value	0 V	Published in approved 17CU5 target datasheet entry; Section1
Cathode Current	15 mA	Published in approved 17CU5 target datasheet entry; Section1
Plate Dissipation	1.5 W	Published in approved 17CU5 target datasheet entry; Section1

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid No.1 to Plate	0.6 pF	Published in approved 17CU5 target datasheet entry; Section1
Grid No.1 to Cathode, Heater, Grid No.2, and Grid No.3	13 pF	Published in approved 17CU5 target datasheet entry; Section1
Plate to Cathode, Heater, Grid No.2, and Grid No.3	8.5 pF	Published in approved 17CU5 target datasheet entry; Section1
Grid to Plate	0.92 pF	Published in approved 17CU5 target datasheet entry; Section1
Grid to Cathode, Heater, and Shell	4.3 pF	Published in approved 17CU5 target datasheet entry; Section1
Plate to Cathode, Heater, and Shell	1.8 pF	Published in approved 17CU5 target datasheet entry; Section1
Plate to Cathode	0.18 pF	Published in approved 17CU5 target datasheet entry; Section1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater to Cathode	1.6 pF	Published in approved 17CU5 target datasheet entry; Section1