



ELECTRONIC TUBE REFERENCE

12CA5

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

CONSOLIDATED TECHNICAL
DATA

1 SECTION
CONSTRUCTION
BEAMPOWER

Miniature beam-power output tube designed for audio-frequency power stages in radio and television receivers, combining compact size with useful Class-A output capability.

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	15000 Ω
TRANSCONDUCTANCE	0.0092 S
MAXIMUM PLATE VOLTAGE	130 V
MAXIMUM SCREEN VOLTAGE	130 V
MAXIMUM PLATE DISSIPATION	5 W
MAXIMUM SCREEN DISSIPATION	1.4 W
<i>Promoted values are limited to values explicitly present in this supplied 12-V datasheet block; additional published values are retained in parameter rows.</i>	

12CA5 — Beam Power Pentode

An indirectly heated miniature beam power tube designed for audio-frequency power output stages in series-heater television and radio receivers.

Overview

The **12CA5** is a miniature beam power tube (also classified as a beam pentode) designed primarily for service in the audio-frequency (AF) power output stage of television and radio receivers. It is specifically engineered for use in equipment employing a series heater-string arrangement, particularly those with a **600 mA** series-heater current.

The 12CA5 is characterized by high power sensitivity and efficiency when operating at relatively low plate and screen-grid voltages. Except for its heater ratings and specific heater-cathode voltage limits, the 12CA5 is electrically identical to the [6CA5](#) and [25CA5](#) vacuum tubes.

Construction, Mechanical Specifications, and Pinout

The 12CA5 is constructed with a T-5-1/2 glass bulb and a small-button miniature 7-pin base (JETEC No. E7-1). The tube features a coated unipotential cathode and can be operated in any mounting position.

Physical Dimensions

- **Maximum Overall Length:** 2-5/8 inches
- **Maximum Seated Length:** 2-3/8 inches
- **Length from Base Seat to Bulb Top (excluding tip):** 2 ± 3/32 inches
- **Maximum Diameter:** 3/4 inch

Pinout and Basing (7CV)

The tube utilizes the **7CV** basing arrangement. Viewed from the bottom of the tube, the pin connections are assigned as follows:

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

The control grid (Grid No. 1) is internally connected to both Pin 2 and Pin 5 to facilitate flexible circuit layout and heat dissipation.

Direct Interelectrode Capacitances

When measured without an external shield, the approximate interelectrode capacitances of the 12CA5 are:

- **Grid No. 1 to Plate:** 0.5 μF
- **Input (Grid No. 1 to Cathode & Grid No. 3, Grid No. 2, and Heater):** 15 μF
- **Output (Plate to Cathode & Grid No. 3, Grid No. 2, and Heater):** 9 μF

Heater Characteristics and Series-String Design

The heater of the 12CA5 is designed for series-string operation, where its thermal characteristics are tightly controlled to prevent voltage surges during the receiver's warm-up cycle.

Heater Parameter	Value
Nominal Heater Voltage (AC or DC)	12.6 V
Nominal Heater Current	0.6 A
Average Heater Warm-up Time	11.0 seconds

Heater Power Calculation

Using the nominal heater voltage (V_f) and heater current (I_f), the nominal power consumption (P_f) of the 12CA5 heater is calculated as: $P_f = V_f \times I_f = 12.6 \text{ V} \times 0.6 \text{ A} = 7.56 \text{ W}$

Controlled Warm-up Specification

The heater warm-up time is defined as the time required for the voltage across the heater to reach 80% of its rated voltage after applying four times the rated heater voltage (50.4 V) to a circuit consisting of the tube heater in series with a resistance equal to three times the nominal heater operating resistance. This controlled warm-up minimizes transient voltage surges when the tube is operated in series with other similarly controlled tubes.

Heater-Cathode Voltage Ratings

Because the heater is operated in a series string, it may experience high potential differences relative to the cathode. The maximum ratings for heater-cathode voltage depend on the polarity and the specific manufacturer rating system:

- **Heater Positive with Respect to Cathode:**
 - **Total DC and Peak:** 200 V max
 - **DC Component / Average Value:** 100 V max
- **Heater Negative with Respect to Cathode:**
 - **Total DC and Peak:** 300 V max (some specifications list 200 V max)
 - **DC Component / Average Value:** 200 V max (some specifications list 100 V max)

Maximum Ratings (Design-Center Values)

The following maximum ratings must not be exceeded under Class A1 amplifier service:

Parameter	Maximum Value
Plate Voltage	130 V
Grid No. 2 (Screen-Grid) Voltage	130 V
Grid No. 1 (Control-Grid) Voltage, Positive-bias value	0 V
Plate Dissipation	5.0 W
Grid No. 2 Input	1.4 W
Bulb Temperature (at hottest point on bulb surface)	180 °C

Maximum Circuit Resistance

To ensure bias stability and prevent thermal runaway, the resistance in the Grid No. 1 circuit is restricted based on the biasing method:

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

Typical Operation and Class A1 Amplifier Characteristics

The 12CA5 is optimized to deliver high output power from low supply voltages. The typical operating conditions and electrical characteristics for Class A1 amplifier service are documented at two primary operating points:

Parameter	Operating Point A	Operating Point B
Plate Voltage	110 V	125 V
Grid No. 2 Voltage	110 V	125 V
Grid No. 1 Voltage	−4.0 V	−4.5 V
Peak AF Grid No. 1 Voltage	4.0 V	4.5 V
Zero-Signal Plate Current	32 mA	37 mA
Maximum-Signal Plate Current	31 mA	36 mA
Zero-Signal Grid No. 2 Current (Approx.)	3.5 mA	4.0 mA
Maximum-Signal Grid No. 2 Current (Approx.)	7.5 mA	11.0 mA
Plate Resistance (Approx.)	16,000 Ω	15,000 Ω
Transconductance	8,100 μmhos	9,200 μmhos
Load Resistance	3,500 Ω	4,500 Ω
Total Harmonic Distortion (Approx.)	5%	6%
Maximum-Signal Power Output	1.1 W	1.5 W

These operating points demonstrate the high sensitivity of the 12CA5: with a peak grid signal of only 4.5 V, the tube can deliver 1.5 W of audio output power into a 4,500 Ω load.

Operation and Plate Characteristics

The average plate characteristics curves plot plate current (I_b) and screen-grid current (I_{c2}) against plate voltage for various control-grid bias voltages (E_{c1} ($/tubes/C1$)) ranging from 0 V down to −10 V, with the screen grid (E_{c2}) held constant at 125 V.

The curves exhibit the typical knee characteristic of beam power tubes, where plate current rises rapidly at low plate voltages and then flattens out, becoming relatively independent of plate voltage over the normal operating range. This sharp knee allows for a wide plate-voltage swing, contributing to the tube's high efficiency and power output at low supply voltages.

The operation characteristics curves illustrate how power output, total harmonic distortion, plate current, and screen-grid (Grid No. 2) current vary as a function of load resistance under typical operating conditions (with $E_f = 12.6$ V, plate voltage = 125 V, screen voltage = 125 V, grid bias = −4.5 V, and an RMS signal voltage of 3.2 V):

- **Power Output:** Peaks near the recommended load resistance of 4,500 Ω , reaching approximately 1.5 W.
- **Total Harmonic Distortion:** Shows a minimum around 3,000 Ω (at approximately 5%) and rises to about 6% at 4,500 Ω , and up to 10% as the load resistance increases toward 7,000 Ω .
- **Plate Current:** Decreases steadily as load resistance increases, falling from over 45 mA at 1,000 Ω to under 30 mA at 7,000 Ω .
- **Grid No. 2 Current:** Increases with higher load resistance, rising from about 6 mA at 1,000 Ω to over 13 mA at 7,000 Ω .

Related Designations and Comparisons

The **12CA5** belongs to a family of identical beam power tubes that differ only in their heater configurations:

- **6CA5:** Designed for parallel heater circuits, requiring a **6.3 V** heater supply at **1.2 A**.
- **25CA5:** Designed for series-string circuits, requiring a **25 V** heater supply at **0.3 A**.

While the 12CA5 shares its internal structure, electrode geometry, and Class A1 typical operating characteristics with the [6CA5](#) and [25CA5](#), they are not direct drop-in replacements for one another due to these differing heater voltage and current requirements, as well as differences in their maximum heater-cathode voltage ratings.

Technical Summary

The **12CA5** is a **7-pin miniature beam power tube** designed for Class A1 audio power output service in series-string radio and television receivers. Operating with a **12.6 V, 0.6 A** heater with controlled warm-up characteristics, it delivers up to **1.5 W** of audio power from low supply voltages (110–125 V) with high sensitivity. Its physical construction, standardized 7CV pinout, and robust heater-to-cathode insulation make it highly optimized for compact, 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	110125 V	Typical operating conditions
Screen voltage	110126 V	Typical operating conditions
Plate current	3237 mA	Typical operating conditions



SOURCE OPERATING CONDITIONS

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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	125 V	ClassA1
Screen voltage	125 V	ClassA1
Grid 1 voltage	-4.5 V	ClassA1
Plate current	37 mA	ClassA1
Signal power output	1.5 W	ClassA1

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



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

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1971 RCA HB3 Binder 5 of 7

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

1971 RCA HB3 BINDER 5 OF 7

Section 1 · Beam Power

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Voltage	12.6 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Current	600 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Warm-up time (Average)	11	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Grid No.1 to plate	5	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
grid No. 2, and heater – published value 1	2	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
grid No. 2, and heater – published value 2	15	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
grid No. 2, and heater – published value 1	2	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
grid No. 2, and heater – published value 2	9	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Pin i-Cathode,	4	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Grid No.3	5	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Pin 2 -Grid No.1 – published value 1	2	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Pin 2 -Grid No.1 – published value 2	6	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Pin 3 –Heater – published value 1	3	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Pin 3 –Heater – published value 2	7	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Plate Voltage – published value 1	110 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Plate Voltage – published value 2	125 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Grid-No.2 Voltage – published value 1	110 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Grid-No.2 Voltage – published value 2	125 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid-No.1 Voltage – published value 1	4 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Grid-No.1 Voltage – published value 2	4.5 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Peak AF Grid-No.i Voltage – published value 1	4 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Peak AF Grid-No.i Voltage – published value 2	4.5 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Zero-Signal Plate Current – published value 1	32 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Zero-Signal Plate Current – published value 2	37 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Zero-Signal Grid-No.2 Current – published value 1	3.5 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Zero-Signal Grid-No.2 Current – published value 2	4 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Plate Resistance (Approx.) – published value 1	16000 ohm	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Plate Resistance (Approx.) – published value 2	15000 ohm	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Transconductance – published value 1	8100	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance – published value 2	9200	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Load Resistance – published value 1	3500 ohm	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Load Resistance – published value 2	4500 ohm	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Ep=12.6 VOLTS – published value 1	12.6 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Ep=12.6 VOLTS – published value 2	2 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Ep=12.6 VOLTS – published value 3	125 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
PLATE (Ib)OR GRID-N-'2 (IC2)MILLIAMPE RES	2 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Eq=12.6 VOLTS PLATE VOLTS=125 – published value 1	12.6 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Eq=12.6 VOLTS PLATE VOLTS=125 – published value 2	125 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Eq=12.6 VOLTS PLATE VOLTS=125 – published value 3	125 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Heater voltage	12.6 V	Nominal heater rating
Heater current	600 mA	Nominal heater rating

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
PLATE VOLTAGE	130 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
GRID-No.2 (SCREEN) VOLTAGE	130 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Positive bias value	0 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
PLATE DISSIPATION	5 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
GRID-No.2 INPUT – published value 1	1 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
GRID-No.2 INPUT – published value 2	4 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Heater negative with respect to cathode	200 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Heater positive with respect to cathode	200 V	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Max.–Signal Plate Current – published value 1	31 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Max.–Signal Plate Current – published value 2	36 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Max.–Signal Grid-No.2 Current – published value 1	7.5 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Max.–Signal Grid–No.2 Current – published value 2	11 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Max.–Signal Power Output – published value 1	1.1 W	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Max.–Signal Power Output – published value 2	1.5 W	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
For fixed–bias operation – published value 1	0 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
For fixed–bias operation – published value 2	1 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
For cathode–bias operation – published value 1	0 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
For cathode–bias operation – published value 2	5 mA	Published value from the filename-designated RCA datasheet block; multiple numbers on one row represent separate limits or heater arrangements.
Maximum screen dissipation/input	1.4 W	PublishedOn12VSheet



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
per Plate 150 200	240 Ω	Published in approved 12CA5 target entry; Section1
For dc output current of	150 mA	Published in approved 12CA5 target entry; Section1
For dc output current of 150 mA 245 293	347 V	Published in approved 12CA5 target entry; Section1
Heater Voltage (ac/dc) 6.3	126 V	Published in approved 12CA5 target entry; Section1
Heater Current 1.2	600 mA	Published in approved 12CA5 target entry; Section1
Heater Warm-up Time (Average)	11 seconds	Published in approved 12CA5 target entry; Section1
Plate Voltage	130 V	Published in approved 12CA5 target entry; Section1
Grid-No.2 (Screen-Grid) Voltage	130 V	Published in approved 12CA5 target entry; Section1
Grid-No.1 (Control-Grid) Voltage, Positive-bias value	0 V	Published in approved 12CA5 target entry; Section1
Plate Dissipation	5 W	Published in approved 12CA5 target entry; Section1
Grid-No. 2 Input	1.4 W	Published in approved 12CA5 target entry; Section1
Plate Voltage 110	125 V	Published in approved 12CA5 target entry; Section1
Grid-No.2 Voltage 110	125 V	Published in approved 12CA5 target entry; Section1
Grid-No.1 (Control-Grid) Voltage	-4.5 V	Published in approved 12CA5 target entry; Section1
Peak AF Grid-No.1 Voltage 4	4.5 V	Published in approved 12CA5 target entry; Section1
Zero-Signal Plate Current 32	37 mA	Published in approved 12CA5 target entry; Section1
Maximum-Signal Plate Current 31	36 mA	Published in approved 12CA5 target entry; Section1
Zero-Signal Grid-No.2 Current (Approx.) 3.5	4 mA	Published in approved 12CA5 target entry; Section1

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum-Signal Grid-No.2 Current (Approx.) 7.5	11 mA	Published in approved 12CA5 target entry; Section1
Plate Resistance (Approx.) 16000	15000 Ω	Published in approved 12CA5 target entry; Section1
Transconductance 8100	9200 μS	Published in approved 12CA5 target entry; Section1
Load Resistance 3500	4500 Ω	Published in approved 12CA5 target entry; Section1
Total Harmonic Distortion 5	6 %	Published in approved 12CA5 target entry; Section1
Maximum-Signal Power Output 1.1	1.5 W	Published in approved 12CA5 target entry; Section1
For fixed-bias operation	0.1 MΩ	Published in approved 12CA5 target entry; Section1
For cathode-bias operation	0.5 MΩ	Published in approved 12CA5 target entry; Section1
length,	4 %	Published in approved 12CA5 target entry; Section1
Heater Voltage (ac/dc)	6.3 V	Published in approved 12CA5 target entry; Section1
Heater Current	1.5 A	Published in approved 12CA5 target entry; Section1

TUBE TINKER

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