

ELECTRONIC TUBE REFERENCE

CONSOLIDATED TECHNICAL DATA
2 SECTIONS
CONSTRUCTION
BEAMPOWER-PENTODE

12AE10

Power - Beam (NOT sweep) electronic tube

Combination tube integrating a beam-power audio output section with a dual-control pentode, allowing power amplification and small-signal receiver functions in one envelope.

GENERAL CHARACTERISTICS

BASE DESIGNATION	12EZ	BASE PINS	12
NOMINAL HEATER	12.6 V / 450 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Dissimilar

12EZ - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN1 – Pin 1	–	H – Heater	CONNECTED • verified
PIN2 – Pin 2	B	K – Cathode	CONNECTED • verified
PIN2 – Pin 2	B	SH – Internal Shield	CONNECTED • verified
PIN2	–	IS – Internal Screen	CONNECTED
PIN3 – Pin 3	B	G1 – Control Grid	CONNECTED • verified
PIN4 – Pin 4	–	–	NC • verified
PIN5 – Pin 5	B	G3 – Suppressor Grid	CONNECTED • verified
PIN6 – Pin 6	B	G2 – Screen Grid	CONNECTED • verified

TERMINAL	SECTION	ELEMENT	STATUS
PIN7 – Pin 7	B	P – Plate (Anode)	CONNECTED · verified
PIN8 – Pin 8	A	G1 – Control Grid	CONNECTED · verified
PIN9 – Pin 9	A	BP – Beam-Forming Plate	CONNECTED · verified
PIN9	A	G3 – Suppressor Grid	CONNECTED
PIN9 – Pin 9	A	K – Cathode	CONNECTED · verified
PIN10 – Pin 10	A	G2 – Screen Grid	CONNECTED · verified
PIN11 – Pin 11	A	P – Plate (Anode)	CONNECTED · verified
PIN12 – Pin 12	–	H – Heater	CONNECTED · verified

SECTION RATINGS

SECTION1 Beam Power	
PLATE RESISTANCE	33000 Ω
TRANSCONDUCTANCE	0.0056 S
MAXIMUM PLATE VOLTAGE	165 V
MAXIMUM SCREEN VOLTAGE	150 V
MAXIMUM PLATE DISSIPATION	6 W
MAXIMUM SCREEN DISSIPATION	1.25 W
MAXIMUM CATHODE CURRENT	60 A
<i>Power-pentode section.</i>	

SECTION2 Pentode	
PLATE RESISTANCE	150000 Ω
TRANSCONDUCTANCE	0.0004 S
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM SCREEN VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	1.7 W
MAXIMUM SCREEN DISSIPATION	1.1 W
<i>Dual-control pentode section; grid-3 transconductance 400 uS.</i>	

12AE10 — Compactron Dissimilar Double Pentode

An indirectly heated, dissimilar double pentode vacuum tube of the compactron design, combining a sharp-cutoff dual-control pentode and a power pentode in a single envelope for television receiver applications.

Overview

The **12AE10** is a multi-unit vacuum tube of the compactron (duodecar) type, designed specifically for use in television receivers. It contains two highly dissimilar pentode sections within a single T-9 glass envelope: a power pentode (Section 1) and a sharp-cutoff, dual-control pentode (Section 2). This combination allows the tube to serve a dual role, where the sharp-cutoff pentode functions as an FM detector and the power pentode operates as the audio-frequency (AF) power output amplifier.

Construction, Physical Dimensions, and Heater

The 12AE10 features coated unipotential cathodes for both sections. The tube is housed in a T-9 glass envelope with an E12-70 button 12-pin base, requiring a standard duodecar 12-contact socket. It is designed to operate in any mounting position.

The physical dimensions of the envelope are as follows:

- **Maximum Diameter:** 1.188 inches
- **Minimum Diameter:** 1.062 inches
- **Maximum Over-all Length:** 2.625 inches
- **Maximum Seated Height:** 2.250 inches
- **Minimum Seated Height:** 2.000 inches

The heater is designed for series or parallel AC/DC operation with controlled warm-up characteristics, making it suitable for television receivers with series-connected heater strings.

Heater Parameter	Value
Heater Voltage (AC or DC)	12.6 V
Heater Current	0.45 ± 0.03 A
Average Warm-up Time	11 seconds

The heater-cathode insulation is rated to withstand significant potential differences between the heater and the cathode for both sections:

- **Heater Positive with respect to Cathode:**
 - Maximum DC Component: 100 V
 - Maximum Total DC and Peak: 200 V
- **Heater Negative with respect to Cathode:**
 - Maximum Total DC and Peak: 200 V

Terminal Connections and Basing

The 12AE10 utilizes the **12EZ** basing configuration. The 12 pins of the duodecar base provide independent connections to the electrodes of both sections, with Section 2 sharing its cathode connection with an internal shield.

Pin Number	Connection
1	Heater
2	Cathode (Section 2) and Internal Shield
3	Grid Number 1 (Section 2)
4	No Connection
5	Grid Number 3 (Suppressor) (Section 2)
6	Grid Number 2 (Screen) (Section 2)
7	Plate (Section 2)
8	Grid Number 1 (Section 1)
9	Cathode and Beam Plates (Section 1)
10	Grid Number 2 (Screen) (Section 1)
11	Plate (Section 1)
12	Heater

Direct Interelectrode Capacitances

The direct interelectrode capacitances of the 12AE10 are measured without an external shield. The independent construction of the two sections minimizes capacitive coupling between them.

Section 1 (Power Pentode / Beam Power Unit)

- **Grid-Number 1 to Plate (1g1 to 1p):** 0.2 pF
- **Input (1g1 to h + 1k + 2k + 1g2 + b.p. + i.s.):** 9.5 pF
- **Output (1p to h + 1k + 2k + 1g2 + b.p. + i.s.):** 10 pF

Section 2 (Sharp-Cutoff Pentode)

- **Grid-Number 1 to Plate (2g1 to 2p):** 0.036 pF
- **Grid-Number 3 to Plate (2g3 to 2p):** 3.2 pF
- **Grid-Number 1 to All Except Plate (2g1 to h + 2k + 2g2 + 2g3 + i.s.):** 6.5 pF
- **Grid-Number 3 to All (2g3 to h + 2k + 2g1 + 2g2 + 2p + i.s.):** 8.0 pF
- **Grid-Number 1 to Grid-Number 3 (2g1 to 2g3):** 0.14 pF

Inter-Section Coupling

- **Plate (Section 1) to Plate (Section 2) (1p to 2p):** 0.15 pF

Section 1: Beam Power Unit (Power Pentode) Characteristics

Section 1 is designed to operate as a Class A1 audio-frequency power amplifier. It features high power sensitivity and is capable of delivering sufficient output to drive a television receiver's loudspeaker.

Maximum Ratings (Design-Maximum Values)

- **Plate Voltage:** 165 V
- **Screen Voltage (Grid-No. 2):** 150 V
- **Plate Dissipation:** 6.0 W
- **Screen Dissipation (Grid-No. 2 Input):** 1.25 W
- **DC Cathode Current:** 60 mA
- **Grid-No. 1 Circuit Resistance (Cathode Bias):** 1.0 M

Typical Operation and Electrical Characteristics

Under typical Class A1 operating conditions, Section 1 exhibits the following performance:

Parameter	Value
Plate Voltage	145 V

Parameter	Value
Screen Voltage (Grid-No. 2)	110 V
Grid-No. 1 (Control-Grid) Voltage	-7.0 V
Peak AF Grid-No. 1 Voltage	7.0 V
Zero-Signal Plate Current	34 mA
Maximum-Signal Plate Current	39 mA
Zero-Signal Screen Current	6.5 mA
Maximum-Signal Screen Current	9.3 mA
Plate Resistance (Approximate)	33,000 _Ω
Transconductance	5,600 _μ mhos
Load Resistance	2,500 _Ω
Total Harmonic Distortion (Approximate)	12%
Maximum-Signal Power Output	1.45 W

Section 2: Sharp-Cutoff Pentode Unit Characteristics

Section 2 is a dual-control, sharp-cutoff pentode designed primarily for FM detector service. It features independent control grids (Grid No. 1 and Grid No. 3) that allow dual-signal modulation or gated detection.

Typical Class A1 Characteristics

When operated as a Class A1 amplifier, Section 2 exhibits the following typical characteristics:

- **Plate Voltage:** 150 V
- **Grid-No. 3 (Suppressor-Grid) Voltage:** 0 V
- **Grid-No. 2 (Screen-Grid) Voltage:** 100 V
- **Cathode-Bias Resistor:** 560_Ω
- **Plate Resistance (Approximate):** 0.15 M_Ω
- **Grid-No. 1 Transconductance:** 1,000 _μmhos
- **Grid-No. 3 Transconductance:** 400 _μmhos
- **Plate Current:** 1.3 mA
- **Grid-No. 2 Current:** 2.0 mA
- **Grid-No. 1 Cutoff Voltage** (for I_b = 10 _μA): -4.5 V (approximate)
- **Grid-No. 3 Cutoff Voltage** (for I_b = 10 _μA): -4.5 V (approximate)

Maximum Ratings for FM Detector Service (Design-Maximum Values)

- **Plate Voltage:** 330 V
- **Grid-No. 3 Voltage:** 28 V
- **Grid-No. 2 Supply Voltage:** 330 V
- **Grid-No. 1 Voltage (Positive-bias value):** 0 V
- **Plate Dissipation:** 1.7 W
- **Grid-No. 2 Input (Screen Dissipation):** 1.1 W
- **Grid-No. 2 Voltage:** Subject to the limits defined by the screen rating boundary curve.

Analysis of Operating Curves and Permissible Operation

The electrical behavior of the 12AE10 is further defined by its characteristic curves, which illustrate the relationships between electrode voltages and currents.

- **Section 1 Plate Characteristics:** The plate current (I_b) curves plotted against plate voltage show a typical beam power pentode knee. At a screen voltage (E_{c2}) of 110 V, the plate current rises rapidly below 50 V and flattens out across the 100 V to 500 V range. The curves for grid-number 1 bias (E_{c1}) from 0 V down to -20 V demonstrate smooth control, with the typical operating point of -7.0 V positioning the tube in a highly linear region for audio amplification.
- **Section 1 Transfer Characteristics:** The transfer curves show plate and screen currents as a function of Grid-No. 1 voltage for various screen voltages (from 25 V up to 150 V). These curves illustrate that the cutoff voltage shifts more negative as screen voltage increases, with a sharp cutoff characteristic maintained across all operating conditions.
- **Section 2 Screen Rating Chart:** For the sharp-cutoff pentode (Section 2), screen dissipation must be carefully managed. The permissible operating area is bounded by a maximum screen dissipation of 1.1 W at screen voltages up to approximately 180 V. Above 180 V, the maximum allowable screen dissipation decreases along a continuous curve down to 0 W at a screen voltage of 330 V.
- **Section 2 Plate and Transfer Characteristics:** The plate characteristics of Section 2 demonstrate the dual-control nature of the unit. Varying the Grid-No. 3 voltage from +3.0 V down to -5.0 V significantly modulates the plate current, showing that Grid No. 3 acts as an effective control element alongside Grid No. 1. The transfer curves of Section 2 show that both Grid No. 1 and Grid No. 3 exhibit sharp-cutoff characteristics, with plate current approaching zero near -4.5 V on either grid.

Technical Summary

The **12AE10** is a versatile compactron double pentode that combines a **6-watt power pentode** and a **sharp-cutoff, dual-control pentode** in a single T-9 envelope. Utilizing a **12.6 V, 0.45 A** heater and a **12-pin duodecar base (12EZ)**, it provides a highly integrated solution for television receiver designs. By consolidating the FM detector and the audio power output stage into a single envelope, the 12AE10 reduces component count and chassis space while maintaining excellent performance in both high-sensitivity detection and low-distortion audio amplification.



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	145 V	ClassA
Screen Voltage	110 V	ClassA
Plate Resistance	33000 ohm	ClassA
Transconductance	5600 uS	ClassA
Zero-Signal Plate Current	34 mA	ClassA
Maximum-Signal Plate Current	39 mA	ClassA
Zero-Signal Screen Current	6.5 mA	ClassA
Maximum-Signal Screen Current	9.3 mA	ClassA

1968 GENERAL ELECTRIC CO

Section 2 · Pentode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid Number 3 Transconductance	400 uS	DualControlPentode



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
Plate voltage	145 V	ClassA
Screen-grid voltage	110 V	ClassA
Control-grid voltage	-7 V	ClassA
Zero-signal plate current	34 mA	ClassA
Maximum-signal plate current	39 mA	ClassA
Load resistance	2500 ohm	ClassA
Maximum-signal power output	1.45 W	ClassA

1975 RCA RC30

Section 2 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	150 V	ClassA
Screen-grid voltage	100 V	ClassA
Cathode-bias resistor	560 ohm	ClassA
Plate current	1.3 mA	ClassA
Screen-grid current	2 mA	ClassA

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