



ELECTRONIC TUBE REFERENCE

12E13

Power - Beam (NOT sweep) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

BEAMPOWER

Industrial beam tetrode designed for series- or parallel-regulator service in stabilized power supplies and also usable as a high-power AF output tube, with pairs delivering up to about 100 W continuously.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	8
NOMINAL HEATER	6.3 V / 1.6 A	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Beam Power	
PLATE RESISTANCE	12000 Ω
TRANSCONDUCTANCE	0.011 S
MAXIMUM PLATE VOLTAGE	600 V
MAXIMUM SCREEN VOLTAGE	600 V
MAXIMUM PLATE DISSIPATION	35 W
MAXIMUM SCREEN DISSIPATION	6 W
MAXIMUM CATHODE CURRENT	175 mA

12E13 — Beam Tetrode Vacuum Tube

An indirectly heated beam tetrode designed for series or parallel regulator service in stabilized power supply units and high-power audio frequency amplification.

Overview

The **12E13** is a high-power, indirectly heated beam tetrode manufactured by Associated Electrical Industries Limited (AEI) under the Ediswan brand. It is primarily engineered for demanding voltage regulation duties, serving as a series or parallel regulator valve in stabilized power supply units.

In addition to its regulator applications, the 12E13 is highly suitable for audio frequency (AF) power amplification. A push-pull pair of these valves can deliver up to 100 watts of continuous output power, and up to 150 watts under intermittent Class B operating conditions.

Construction, Mechanical Specifications, and Cooling

The 12E13 features a robust construction designed to handle significant thermal and electrical stress. It is housed in a glass envelope with an International Octal (IO8) base.

Physical Dimensions

- **Maximum Overall Length:** 125 mm
- **Maximum Seated Height:** 110 mm
- **Maximum Diameter:** 52 mm

Mounting and Thermal Management

The mounting position for the 12E13 is unrestricted, provided specific physical orientation and spacing requirements are met to ensure adequate cooling:

- **Horizontal Mounting:** If the valve is mounted horizontally, pins 4 and 8 must lie in a vertical plane. An inter-valve spacing of at least 4 inches (approximately 101.6 mm) must be maintained.
- **Vertical Mounting:** When mounting two or more valves vertically, pins 4 and 8 should preferably be aligned in a straight line.
- **Cooling Requirements:** Adequate free air circulation must be provided around the envelope. Under all operating conditions, the hottest part of the glass bulb must not exceed a maximum temperature of 250°C.

Heater and Pin Connections

The 12E13 utilizes an indirectly heated, unipotential cathode. The heater is designed for standard AC or DC parallel supply operation.

Heater Characteristics

- **Nominal Heater Voltage (V_h):** 6.3 V
- **Nominal Heater Current (I_h):** 1.6 A
- **Calculated Heater Power:** 10.08 W

Pinout Configuration

The International Octal (IO8) base connections, viewed from the free end of the pins, are assigned as follows:

Pin Number	Electrode Connection	Symbol
1	Internal Shield	s
2	Heater	h
3	Anode	a
4	Screen Grid (Grid 2)	<u>g2</u>
5	Control Grid (Grid 1)	g1
6	No Pin	NP
7	Heater	h
8	Cathode and Beam Plates	k, bp

Absolute Maximum Ratings

The maximum ratings for the 12E13 define the absolute limits for safe and reliable operation. These ratings must not be exceeded under any operating conditions.

Parameter	Symbol	Maximum Value
Anode Voltage	$V_a(max)$	600 V
Screen Voltage	$V_{[g2] (/tubes/G2)(max)}$	600 V
Anode + Screen Voltage (Triode Connection)	$V_a + [g2] (/tubes/G2)(max)$	600 V
Anode Dissipation	$P_a(max)$	35 W
Screen Dissipation	$P_{[g2] (/tubes/G2)(max)}$	6 W
Anode + Screen Dissipation (Triode Connection)	$P_a + [g2] (/tubes/G2)(max)$	40 W
Cathode Current	$I_k(max)$	175 mA
Heater-to-Cathode Voltage	$V_{h-k(max)}$	150 V
Grid-to-Cathode Resistance (Cathode Bias)	$R_{g1-k(max)}$	220 kΩ*

Parameter	Symbol	Maximum Value
Grid-to-Cathode Resistance (Fixed Bias)	$R_{g1-k(max)}$	100 kΩ*

Note: Grid-to-cathode resistance values are subject to a tolerance of $\pm 20\%$.

Electrical Characteristics

The electrical parameters of the 12E13 vary depending on whether the device is configured as a pentode (tetrode) or as a triode (with the screen grid strapped to the anode).

Pentode Connection Characteristics

Measured at $V_a = 250$ V, $V_{[g2] (/tubes/G2)} = 250$ V, and $I_a = 140$ mA:

- **Mutual Conductance (g_m):** 11 mA/V
- **Anode Impedance (r_a):** 12 kΩ
- **Inner Amplification Factor (μ_{g1-g2}):** 8

Triode Connection Characteristics

Measured with screen grid connected to anode at $V_a, [g2] (/tubes/G2) = 250$ V and $I_a = 160$ mA:

- **Mutual Conductance (g_m):** 12 mA/V
- **Anode Impedance (r_a):** 670 Ω
- **Amplification Factor (μ):** 8

Inter-Electrode Capacitances

- **Input Capacitance (Grid 1 to Earth):** 16 pF
- **Output Capacitance (Anode to Earth):** 12 pF
- **Feedback Capacitance (Anode to Grid 1):** 1.2 pF

Typical Operating Configurations

The 12E13 can be operated in several push-pull configurations to achieve high-fidelity audio output.

Push-Pull Ultra-Linear (Cathode Bias)

This configuration utilizes screen grid taps positioned at 40% on the output transformer.

- **Supply Voltage ($V_{a(b)}$):** 500 V
- **Anode Voltage (V_a):** 425 V
- **Screen Voltage ($V_{[g2] (/tubes/G2)}$):** 425 V

- **Quiescent Anode + Screen Current ($I_{a+[g2] (/tubes/G2)(o)}$):** $2 \times 87 \text{ mA}$
- **Maximum Signal Anode + Screen Current ($I_{a+[g2] (/tubes/G2)(max sig)}$):** $2 \times 100 \text{ mA}$
- **Quiescent Anode + Screen Dissipation ($P_{a+[g2] (/tubes/G2)(o)}$):** $2 \times 40 \text{ W}$
- **Maximum Signal Anode + Screen Dissipation ($P_{a+[g2] (/tubes/G2)(max sig)}$):** $2 \times 18 \text{ W}$
- **Approximate Grid Bias (V_{g1}):** -50 V
- **Cathode Bias Resistance (R_k):** $2 \times 525 \Omega \pm 5\%$ (*separate bias resistors are essential*)
- **Grid-to-Grid Input Voltage ($V_{in(g-g)}$):** 90 V
- **Anode-to-Anode Load Resistance ($R_{L(a-a)}$):** 6 k Ω
- **Output Impedance (Z_{out}):** 4.5 k Ω
- **Power Output (P_{out}):** 50 W
- **Total Harmonic Distortion (D):** 1% (*for an average matched pair*)
- **Intermodulation Distortion:** 5% (*for an average matched pair*)

Push-Pull Ultra-Linear (Fixed Bias)

For maximum power output in ultra-linear mode, a fixed bias arrangement can be used.

- **Supply Voltage ($V_{a(b)}$):** 560 V
- **Anode Voltage (V_a):** 550 V
- **Screen Voltage ($V_{[g2] (/tubes/G2)}$):** 550 V
- **Quiescent Anode + Screen Current ($I_{a+[g2] (/tubes/G2)(o)}$):** $2 \times 50 \text{ mA}$
- **Maximum Signal Anode + Screen Current ($I_{a+[g2] (/tubes/G2)(max sig)}$):** $2 \times 150 \text{ mA}$
- **Quiescent Anode + Screen Dissipation ($P_{a+[g2] (/tubes/G2)(o)}$):** $2 \times 30 \text{ W}$
- **Maximum Signal Anode + Screen Dissipation ($P_{a+[g2] (/tubes/G2)(max)}$):** $2 \times 33 \text{ W}$
- **Approximate Grid Bias (V_{g1}):** -80 V (*a negative bias adjustment range of $70 \text{ V} \pm 25\%$ is recommended*)
- **Grid-to-Grid Input Voltage ($V_{in(g-g)}$):** 120 V
- **Anode-to-Anode Load Resistance ($R_{L(a-a)}$):** 4.5 k Ω
- **Output Impedance (Z_{out}):** 6.5 k Ω
- **Power Output (P_{out}):** 100 W
- **Total Harmonic Distortion (D):** 3% to 6% (*distortion varies depending on the degree of valve matching*)
- **Intermodulation Distortion:** 12%

Push-Pull Triode Connection (Cathode Bias)

When configured as a triode-connected push-pull amplifier, the 12E13 provides lower output impedance and highly linear performance.

Parameter	Operating Point A	Operating Point B
Supply Voltage ($V_{a(b)}$)	400 V	485 V
Anode Voltage (V_a)	350 V	425 V
Screen Voltage (V_{g2}) (/tubes/G2))	350 V	425 V
Quiescent Anode + Screen Current (I_{a+g2}) (/tubes/G2)(o))	$2 \times 67 \text{ mA}$	$2 \times 85 \text{ mA}$
Max Signal Anode + Screen Current (I_{a+g2}) (/tubes/G2)(max))	$2 \times 72 \text{ mA}$	$2 \times 90 \text{ mA}$
Quiescent Anode + Screen Dissipation (P_{a+g2}) (/tubes/G2)(o))	$2 \times 24 \text{ W}$	$2 \times 40 \text{ W}$
Approximate Grid Bias (V_{g1})	-38 V	-48 V
Cathode Bias Resistance (R_k)	$2 \times 525 \text{ } \Omega \pm 5\%$	$2 \times 525 \text{ } \Omega \pm 5\%$
Grid-to-Grid Input Voltage ($V_{in(g-g)}$)	60 V	70 V
Anode-to-Anode Load Resistance ($R_{L(a-a)}$)	4 k Ω	4 k Ω
Output Impedance (Z_{out})	2.5 k Ω	2.5 k Ω
Power Output (P_{out})	15 W	27 W
Total Harmonic Distortion (D)	1% to 3%**	1% to 3%**
Intermodulation Distortion	6%	6%

*Note: Separate cathode bias resistors are essential for each valve. *Note: Distortion figures vary according to the degree of valve matching.*

Characteristic Curves and Design Interpretation

The family of characteristic curves for the 12E13 illustrates its high current capability and linear performance across various operating modes.

Anode Current vs. Anode Voltage (I_a/V_a)

- **At $V_{g1} = 0$ V:** The curves show anode and screen currents for screen voltages (V_{g2})(/tubes/G2) ranging from 100 V to 300 V. At higher screen voltages, the anode current rises rapidly at low anode voltages, demonstrating low knee voltage characteristics. The 35-watt anode dissipation limit ($P_a = 35$ W) forms a clear boundary curve, restricting safe continuous operation at high voltage and current combinations.
- **At Fixed Screen Voltages (V_{g2})(/tubes/G2) = 100 V, 200 V, 300 V):** The curves display the standard tetrode characteristics with flat, pentode-like plateaus across a wide range of anode voltages. The control grid voltage (V_{g1}) steps demonstrate excellent transconductance and linear spacing, which minimizes odd-order harmonic distortion in amplifier designs.

Triode Connection Curves

In the triode-connected configuration, the I_a/V_a curves exhibit a steep, highly linear slope, reflecting the low anode impedance ($r_a = 670 \Omega$). The curves are plotted for grid bias values from 0 V down to -80 V. The triode-connected anode dissipation limit is extended to 40 watts ($P_a = 40$ W), allowing for robust Class A and Class AB designs.

Ultra-Linear Connection Curves

Operating with a supply voltage (V_b) of 425 V and 40% screen grid taps on the output transformer, the curves show a hybrid characteristic. This configuration combines the high power efficiency of the tetrode connection with the low output impedance and low distortion of the triode connection.

Technical Summary

The **12E13** is a high-performance, indirectly heated beam tetrode designed for heavy-duty voltage regulation and high-power audio amplification. Operating with a **6.3 V, 1.6 A** heater, it features a maximum anode dissipation of **35 W** (extendable to **40 W** in triode connection) and a maximum cathode current of **175 mA**.

With its International Octal (IO8) base, robust thermal design, and versatile operating modes—including standard tetrode, triode-connected, and 40% tapped ultra-linear configurations—the 12E13 provides circuit designers with a reliable, high-power solution for stabilized power supplies and high-fidelity push-pull amplifiers capable of delivering up to 100 watts of output power.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1961 AEI Industrial Valves

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

1961 AEI INDUSTRIAL VALVES

Section 1 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum anode plus screen voltage	600 V	TriodeConnection
Maximum anode plus screen dissipation	40 W	TriodeConnection
Maximum heater-cathode voltage	150 V	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Triode-connected amplification factor	8	TriodeConnection
Triode-connected anode resistance	670 ohm	TriodeConnection



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1961 Associated Electrical Industries

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

1961 ASSOCIATED ELECTRICAL INDUSTRIES

Section 1 · Beam Power

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum anode plus screen voltage	600 V	TriodeConnection

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum anode plus screen dissipation	40 W	TriodeConnection
Maximum heater-cathode voltage	150 V	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Triode-connected amplification factor	8	TriodeConnection
Triode-connected anode resistance	670 ohm	TriodeConnection

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