



ELECTRONIC TUBE REFERENCE

13E1

Power - Beam (NOT sweep) electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

BEAMPOWER

Low-impedance industrial beam tetrode with center-tapped heater, designed for general DC control applications and capable of triode-connected operation with high anode dissipation.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	7
NOMINAL HEATER	26 V / 1.3 A	PARALLEL HEATER	13 V / 2.6 A
HEATING	Indirect	SERIES OPERATION	Capable
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Beam Power	
PLATE RESISTANCE	130 Ω
TRANSCONDUCTANCE	0.035 S
AMPLIFICATION FACTOR	4.5
MAXIMUM PLATE VOLTAGE	800 V
MAXIMUM SCREEN VOLTAGE	300 V
MAXIMUM PLATE DISSIPATION	90 W
MAXIMUM SCREEN DISSIPATION	10 W
MAXIMUM GRID DISSIPATION	1 W
MAXIMUM CATHODE CURRENT	800 mA

13E1 — Low-Impedance Beam Tetrode

The **13E1** is an indirectly heated, low-impedance beam power tetrode designed primarily for general D.C. control applications. Manufactured by Associated Electrical Industries Limited (AEI) under the Ediswan

brand, this robust valve is characterized by its high current capability, low internal resistance, and high anode dissipation rating. It is highly suitable for triode-connected operation and is designed to be mounted vertically.

Construction, Physical Dimensions, and Base

The 13E1 is constructed with a clear glass envelope and is designed exclusively for vertical mounting to ensure proper thermal dissipation and structural alignment under operating conditions.

The physical dimensions and weight of the device are as follows:

- **Maximum Overall Length:** 166.0 mm
- **Maximum Seated Height:** 157.0 mm
- **Maximum Diameter:** 65.0 mm
- **Approximate Net Weight:** 6.0 oz
- **Approximate Packed Weight:** 30.0 oz

The tube utilizes a **B7A** seven-pin base. The manufacturer specifies the use of the Ediswan Clix valveholder, catalog number **VH117/701**.

Pin Connection Diagram

When viewed from the free end of the pins, the B7A base configuration is indexed by a boss and provides the following connections:

Pin Number	Electrode Connection	Symbol
Pin 1	Heater	h
Pin 2	Heater Centre Tap	h tap
Pin 3	Control Grid	g1
Pin 4	Cathode	k
Pin 5	Screen Grid	g2
Pin 6	Anode	a
Pin 7	Heater	h

Heater Configuration

The 13E1 features an indirectly heated cathode with a center-tapped heater. This configuration allows the heater to be operated in either a series or parallel arrangement, depending on the available supply voltage:

- **Series Connection:** The heater is operated at a nominal voltage of **26.0 V** with a current draw of **1.3 A**.

- **Parallel/Center-Tapped Connection:** By utilizing the center tap (Pin 2), the heater can be operated at a nominal voltage of **13.0 V** with a current draw of **2.6 A**.

Heater Power Calculation

For both configurations, the total power consumed by the heater is identical:

- Series: $26.0\text{ V} \times 1.3\text{ A} = \mathbf{33.8\text{ W}}$
- Parallel: $13.0\text{ V} \times 2.6\text{ A} = \mathbf{33.8\text{ W}}$

The maximum permissible D.C. voltage between the heater and the cathode ($V_{h-k(max)}$) is **300 V** with the heater negative with respect to the cathode.

Electrical Characteristics and Triode-Connected Operation

The 13E1 is designed to exhibit low impedance, which is particularly beneficial in D.C. control and regulator circuits. The manufacturer provides specific typical characteristics for the tube when it is triode-connected (with the screen grid connected to the anode).

At a typical operating point of $V_a = 150\text{ V}$ and an anode current of $I_a = 500\text{ mA}$, the triode-connected characteristics are:

- **Mutual Conductance (g_m):** 35 mA/V
- **Amplification Factor (μ_t):** 4.5
- **Anode Resistance ($r_{a(t)}$):** 130 Ω

Verification of Triode Relationship

The fundamental triode relationship can be verified using these typical parameters: $\mu \approx g_m \times r_a$ Using the published values as inputs: $0.035\text{ S} \times 130\text{ }\Omega = 4.55$ This calculated value of 4.55 closely aligns with the published amplification factor of 4.5, demonstrating the high transconductance and exceptionally low internal resistance of the triode-connected 13E1.

Absolute Maximum Ratings

All maximum ratings for the 13E1 are defined using the absolute maximum rating system, rather than design-center values. These limits must not be exceeded under any operating conditions.

Parameter	Symbol	Continuous Rating	Series Pulse Rating
Maximum Anode Voltage	$V_{a(max)}$	800 V	1500 V
Maximum Screen Grid Voltage	$V_{[g2](/tubes/G2)(max)}$	300 V	—

Parameter	Symbol	Continuous Rating	Series Pulse Rating
Maximum Control Grid Voltage	$V_{g1(max)}$	-100 V	—
Maximum Anode Dissipation	$P_a(max)$	90 W	—
Maximum Screen Grid Dissipation	$P_{[g2](/tubes/G2)(max)}$	10 W	—
Maximum Anode + Screen Dissipation (Triode)	$P_{a+[g2](/tubes/G2)(max)}$	95 W	—
Maximum Control Grid Dissipation	$P_{g1(max)}$	1 W	—
Maximum Cathode Current	$I_k(max)$	800 mA	5000 mA
Maximum Heater-to-Cathode Voltage (Heater -ve)	$V_{h-k(max)}$	300 V D.C.	—

Series Pulse Rating Conditions

The 13E1 is capable of handling high-voltage and high-current pulses under strictly controlled conditions:

- The maximum peak anode voltage during pulsed operation is **1500 V**.
- The maximum peak cathode current during pulsed operation is **5000 mA** (5.0 A).
- For peak currents exceeding **2 A**, the product of the peak current (in amperes) and the pulse duration (in microseconds) must not exceed **10 amp-microseconds**.
- The valve must not operate for longer than **5 microseconds** in any **100 microsecond** period. This represents a maximum duty cycle of: $\frac{5 \mu s}{100 \mu s} \times 100\% = 5\%$

Inter-Electrode Capacitances

The direct inter-electrode capacitances of the 13E1, measured without an external shield, are:

- **Control Grid to Earth (C_{in}):** 56 pF
- **Anode to Earth (C_{out}):** 20.4 pF
- **Anode to Control Grid (C_{a-g1}):** 1.3 pF

These capacitances reflect the physical size of the electrode structures required to support the high current and power dissipation ratings of the tube.

Analysis of Characteristic Curves

The published characteristic curves for the 13E1 are obtained using short-duration pulses to prevent exceeding the thermal dissipation limits of the tube during measurement.

Anode Current vs. Control Grid Voltage (I_a/V_{g1})

At a constant anode voltage (V_a) of 600 V, the anode current is plotted against control grid voltage for screen grid voltages ($V_{[g2]}/(tubes/G2)$) ranging from 50 V to 300 V. The curves show that:

- With $V_{[g2]}/(tubes/G2) = 300$ V, the anode current reaches approximately 3000 mA (3.0 A) as the control grid voltage approaches 0 V.
- The cutoff voltage varies significantly with screen voltage, ranging from approximately -30 V when $V_{[g2]}/(tubes/G2) = 50$ V to nearly -100 V when $V_{[g2]}/(tubes/G2) = 300$ V.

Screen Current vs. Control Grid Voltage (I_{g2}/V_{g1})

Under the same $V_a = 600$ V pulsed conditions, the screen grid current ($I_{[g2]}/(tubes/G2)$) is plotted. At $V_{[g2]}/(tubes/G2) = 300$ V and $V_{g1} = 0$ V, the screen current rises to approximately 175 mA, illustrating the partition of current between the anode and screen grid at low bias levels.

Triode-Connected Characteristics (I_a/V_{g1})

When the 13E1 is triode-connected, the anode current curves are plotted for anode voltages (V_a) of 50 V, 100 V, 150 V, 200 V, and 300 V.

- At $V_a = 300$ V and $V_{g1} = 0$ V, the peak pulsed anode current exceeds 2500 mA (2.5 A).
- A boundary line representing the maximum triode-connected continuous dissipation limit of $P_a = 95$ W is superimposed on these curves, indicating the safe continuous operating region. For example, at $V_a = 200$ V, the continuous current must be kept below 475 mA to remain within the 95 W limit (calculated as $95 \text{ W}/200 \text{ V} = 0.475 \text{ A}$).

Anode Current vs. Anode Voltage (I_a/V_a)

With the screen grid voltage held constant at $V_{[g2]}/(tubes/G2) = 100$ V, the family of curves for $V_{g1} = 0$ V, -2 V, -4 V, and -8 V demonstrates classic beam tetrode behavior:

- The curves exhibit a very sharp "knee" at low anode voltages (below 50 V), above which the anode current remains relatively constant as anode voltage increases. This flat characteristic indicates a very high dynamic anode resistance in tetrode mode.
- At $V_{g1} = 0$ V and $V_a = 800$ V, the anode current is approximately 840 mA.

Technical Summary

The **13E1** is a high-power, low-impedance beam tetrode designed by AEI (Ediswan) for demanding D.C. control and series regulator applications. It features a flexible center-tapped heater supporting **13.0 V / 2.6 A** or **26.0 V / 1.3 A** operation, a clear glass envelope, and a **B7A** base.

With an absolute maximum anode dissipation of **90 W** (or **95 W** in triode connection) and a continuous cathode current rating of **800 mA**, the 13E1 is capable of handling substantial power. In pulsed applications, it can withstand anode voltages up to **1500 V** and peak cathode currents up to **5000 mA**, subject to strict duty cycle and duration limits. When triode-connected, it exhibits an exceptionally high mutual conductance of **35 mA/V** and a low anode resistance of **130 Ω** , making it an exceptionally efficient control element.



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 voltage pulse	1500 V	SeriesPulse
Maximum cathode current pulse	5 A	SeriesPulse
Maximum anode plus screen dissipation	95 W	TriodeConnection
Maximum heater-cathode voltage	300 V	HeaterNegative



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

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PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum anode voltage pulse	1500 V	SeriesPulse
Maximum cathode current pulse	5 A	SeriesPulse
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