



ELECTRONIC TUBE REFERENCE

12E12

Power - Tetrode (NOT beam) (over 1000V 100W) electronic tube

CONSOLIDATED TECHNICAL
DATA

1 SECTION
CONSTRUCTION
TETRODE

Screen-grid tetrode intended for receiver voltage amplification, detector, oscillator, or general Class-A service as documented by the manufacturer.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	4
NOMINAL HEATER	26 V / 1.6 A	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Tetrode	
MAXIMUM PLATE VOLTAGE	11000 V
MAXIMUM SCREEN VOLTAGE	1350 V
MAXIMUM PLATE DISSIPATION	60 W
MAXIMUM SCREEN DISSIPATION	8 W
MAXIMUM GRID DISSIPATION	3 W
MAXIMUM CATHODE CURRENT	150 mA

12E12 — Pulse Modulator Tetrode

The **12E12** is a high-voltage, indirectly heated pulse modulator tetrode designed specifically for use in radar equipment. It is engineered to handle high peak currents and high anode voltages under pulsed operating conditions, featuring a maximum anode dissipation of 60 watts and a maximum peak anode current of 15 amperes.

Overview and Applications

The 12E12 is classified as a tentative design for pulse modulator service. Its primary application is in radar transmitters, where it serves as a series modulator or switch tube to control high-power radio-frequency oscillators or amplifiers. The tube's design incorporates an indirectly heated cathode capable of delivering substantial peak emission, combined with a robust electrode structure that can withstand severe electrical stresses during short-duration pulses.

Mechanical Specifications and Pinout

The 12E12 is constructed with a glass envelope, a top cap anode connection, and a specialized four-pin base.

Physical Dimensions and Mounting

- **Maximum Overall Length:** 150 mm
- **Maximum Seated Height:** 142 mm
- **Maximum Diameter:** 65 mm
- **Approximate Net Weight:** 5.75 ounces (5¾ oz)
- **Approximate Packed Weight:** 24 ounces
- **Top Cap Designation:** CT3
- **Base Designation:** B4A

The physical design permits mounting in either a vertical or horizontal position. If mounted horizontally, the tube must be oriented so that the plane of the grids is vertical. The maximum eccentricity of the bulb with respect to the center line of the base is 35.8 mm.

Pin Connections

The B4A base connections, viewed from the free end of the pins, are assigned as follows:

Pin Number	Electrode Connection	Symbol
Pin 1	Heater	h
Pin 2	Screen Grid (Grid No. 2)	<u>g2</u>
Pin 3	Control Grid (Grid No. 1)	g1
Pin 4	Heater, Cathode	h, k
Top Cap	Anode	a

Heater and Cathode Characteristics

The 12E12 utilizes an indirectly heated, unipotential cathode. Due to the high peak currents drawn during pulse operation, strict thermal management of the cathode is required.

- **Nominal Heater Voltage:** 26 V
- **Nominal Heater Current:** 1.6 A
- **Calculated Heater Power:** 41.6 W (derived from 26 V * 1.6 A)
- **Minimum Cathode Heating Time:** 3 minutes

To prevent damage to the emissive surface of the cathode, a minimum preheating time of three minutes must elapse after the heater is energized before any cathode current is drawn.

Absolute Maximum Ratings

All maximum ratings specified for the 12E12 are absolute values, not design-center limits. Operating the tube beyond these limits can cause permanent damage or severely reduce its operating life.

Parameter	Symbol	Absolute Maximum Value
Maximum Anode Voltage	Va(max)	11.0 kV
Maximum Screen Grid Operating Voltage	Vg2(max)	1.25 kV
Maximum Screen Grid Voltage (Ia = 0)	Vg2(max)	1.35 kV
Maximum Control Grid Voltage (Negative)	-Vg1(max)	-1,000 V
Maximum Control Grid Voltage (Positive Peak)	+Vg1(pk)max	300 V
Maximum Anode Dissipation	Pa(max)	60 W
Maximum Screen Dissipation	Pg2(max)	8 W
Maximum Grid 1 Dissipation	Pg1(max)	3 W
Maximum Peak Anode Current	Ia(pk)max	15 A
Maximum Grid 1 Series Resistance	Rg1	100 k
Minimum Screen Grid Series Resistance	Rg2	20 k

The screen grid must be decoupled to earth (ground) using a suitable condenser when operating near these limits.

Pulse Modulator Operating Constraints

The 12E12 operates under strict pulse-width and duty-cycle limitations to prevent thermal runaway and electrode degradation.

Duty Cycle and Peak Current Limits

The maximum peak anode current of 15 amperes is permitted only when the duty cycle does not exceed 0.001 (0.1%). For peak currents exceeding 5 amperes, the product of the peak current (in amperes) and the pulse duration (in microseconds) must not exceed 30:

$$\text{Peak Current (A)} * \text{Pulse Duration (s)} \leq 30$$

For peak currents below 5 amperes, the current-time product limit still applies, but the maximum duty cycle is primarily restricted by the absolute maximum anode dissipation of 60 watts.

Pulse Duration and Repetition

The tube is restricted to short-duration pulse trains. It must not operate for longer than 5 microseconds in any 100-microsecond period, establishing a maximum short-term pulse duty factor of 5%.

Inter-electrode Capacitances

The internal capacitances of the 12E12 determine its input loading and the rise/fall times of the modulated pulses:

- **Anode to Grid 1 (Maximum):** 2.0 pF (ca-g1)
- **Cathode to Grid 1:** 37 pF (cg-k)
- **Anode to Cathode:** 7.5 pF (ca-k)

Typical Series Modulator Operation

In a typical series modulator application, the 12E12 is configured to switch high-voltage pulses into an 800-ohm load. The operating parameters are defined as follows:

- **Anode Voltage Supply (Va(b)):** 9.5 kV
- **Screen Voltage (Vg2):** 1.2 kV
- **Grid No. 1 Bias (-Vg1):** -800 V
- **Grid No. 1 Pulse (+Vg1):** 1,020 V
- **Anode Current Pulse (Ia(pk)):** 10 A
- **Anode Load (Ra):** 800,
- **Pulse Duration (tp):** 2, s
- **Pulse Repetition Frequency (P.R.F.):** 500 p/s

Performance Calculations

From these typical operating conditions, several key performance metrics can be calculated:

1. **Output Voltage (Vout):** $V_{out} = I_a(pk) * R_a = 10 \text{ A} * 800_{\Omega} = 8,000 \text{ V} = 8 \text{ kV}$ This matches the specified output voltage of 8 kV.
2. **Peak Pulse Power Output (Pout(pk)):** $P_{out(pk)} = I_a(pk)^2 * R_a = (10 \text{ A})^2 * 800_{\Omega} = 80,000 \text{ W} = 80 \text{ kW}$ This matches the specified peak pulse power output of 80 kW.
3. **Peak Pulse Power Input (Pin(pk)):** The specified peak pulse power input is 100 kW. The difference between the peak input power and peak output power is dissipated by the anode during the pulse:
 $P_{diss(pk)} = P_{in(pk)} - P_{out(pk)} = 100 \text{ kW} - 80 \text{ kW} = 20 \text{ kW}$
4. **Duty Cycle (D):** $D = t_p * P.R.F. = 2_{\mu s} * 500 \text{ s}^{-1} = 0.001$ This operating duty cycle of 0.001 is at the absolute maximum limit for peak currents up to 15 A.
5. **Average Anode Dissipation (Pa(avg)):** $P_{a(avg)} = P_{diss(pk)} * D = 20 \text{ kW} * 0.001 = 20 \text{ W}$ This average dissipation of 20 watts is well within the absolute maximum rating of 60 watts.
6. **Current-Time Product:** Current-Time Product = $10 \text{ A} * 2_{\mu s} = 20 \text{ A}\cdot\text{s}$ This is safely below the maximum limit of 30 A·s required for peak currents exceeding 5 amperes.

Technical Summary

The **12E12** is a specialized, high-power pulse modulator tetrode designed for radar applications. It features a 26 V, 1.6 A heater and requires a minimum cathode preheating time of three minutes. With an absolute maximum anode voltage rating of 11.0 kV and a peak anode current capability of 15 A, it is optimized for high-voltage switching. The tube is housed in a glass envelope with a CT3 top cap and a B4A four-pin base, and it must be operated within strict pulse-width, duty-cycle, and current-time product limits to ensure reliable performance.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1960 Mazda

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

1960 MAZDA

Section 1 · Tetrode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
No-current maximum screen voltage	1350 V	—
Maximum negative control-grid voltage	-1000 V	—
Maximum positive peak control-grid voltage	300 V	—
Maximum peak anode current	15 A	—
Maximum pulse duration	5 us	—
Maximum duty cycle	0.001	—



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 · Tetrode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum control-grid negative voltage	-1000 V	—
Maximum positive peak control-grid voltage	300 V	—
Maximum peak anode current	15 A	Pulse

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum screen-grid voltage at zero anode current	1.35 kV	—



SOURCE DATA APPENDIX

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 · Tetrode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum control-grid negative voltage	-1000 V	—
Maximum positive peak control-grid voltage	300 V	—
Maximum peak anode current	15 A	Pulse
Maximum screen-grid voltage at zero anode current	1.35 kV	—