



ELECTRONIC TUBE REFERENCE

14D12

Power - Triode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

TRIODE

Directly heated graphite-anode radiation-cooled triode for RF heating, modulation, and transmitting service, using a thoriated-tungsten filament for substantial industrial RF power.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	—
NOMINAL HEATER	5 V / 32.5 A	PARALLEL HEATER	— / —
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Triode	
PLATE RESISTANCE	6100 Ω
TRANSCONDUCTANCE	0.0036 S
AMPLIFICATION FACTOR	22
MAXIMUM PLATE VOLTAGE	6000 V
MAXIMUM PLATE DISSIPATION	500 W
MAXIMUM GRID DISSIPATION	50 W
MAXIMUM CATHODE CURRENT	3 A

14D12 — Radiation Cooled Power Triode

A heavy-duty, radiation-cooled triode featuring a graphite anode and a directly heated thoriated tungsten filament, designed for radio frequency heating, modulating, and transmitting applications.

Overview

The **14D12** is a high-power, radiation-cooled triode manufactured by Associated Electrical Industries Limited (AEI), Radio Components Department. It is engineered specifically for demanding industrial and communication roles, including r.f. heating, modulator service, and radio transmitters. The design incorporates a robust graphite anode capable of high thermal dissipation and a directly heated thoriated tungsten filament. The tube is rated for operation up to a maximum frequency of 60 Mc/s and can handle anode voltages up to 6.0 kV.

Mechanical Construction and Installation

The 14D12 features a large glass envelope designed to withstand high operating temperatures. Its physical dimensions and mechanical specifications are as follows:

- **Maximum Overall Height:** 240 mm
- **Bulb Height (excluding pins and top cap):** 190 ± 5 mm
- **Maximum Bulb Diameter:** 130 mm
- **Top Cap (Anode):** Diameter of 9.5 ± 0.1 mm, with a minimum height of 17 mm
- **Base:** Special base with four pins, each having a diameter of 9 mm. The pins have a minimum length of 18 mm and a nominal length of 23 mm.
- **Pin Layout and Spacing:** The base contains two filament pins (f) and two grid pins (g). The pins are arranged symmetrically with a horizontal spacing of 20 mm from the center axis and a vertical spacing of 15 mm from the center axis.

For reliable operation, the tube must be mounted **vertically with the anode pointing upwards**. All electrical connections must make excellent contact to prevent localized overheating of the pins and glass-to-metal seals, which is a particular risk when carrying high r.f. currents. When operating at higher frequencies, it is essential to connect both grid pins in parallel to distribute the r.f. current and reduce the electrical load on each individual pin. The tube must also be protected from excessive vibration and mechanical shock.

Filament and Cooling Requirements

The directly heated thoriated tungsten filament is designed for high emission stability and is suitable for direct switching.

- **Nominal Filament Voltage:** $5.0 \text{ V} \pm 5\%$
- **Approximate Filament Current:** 32.5 A
- **Calculated Filament Power:** 162.5 W (calculated as $5.0 \text{ V} \times 32.5 \text{ A}$)

Cooling is critical to the operation of the 14D12. Except when only the filament is dissipated, a low-velocity forced air blast is required under all conditions of valve service. An air flow of 50 cu. ft./min. directed vertically upwards onto the grid and filament pins is sufficient to maintain safe operating temperatures. The anode connector must also be designed to facilitate heat dissipation, keeping the anode seal temperature below its maximum limit.

- **Maximum Bulb Temperature:** 250 °C

- **Maximum Seal Temperature:** 200 °C

Electrical Characteristics and Maximum Ratings

The absolute maximum ratings represent the limiting values for safe operation of the 14D12:

- **Maximum Anode Voltage ($V_a(max)$):** 6.0 kV
- **Maximum D.C. Grid Voltage ($V_g(max)$):** -1000 V
- **Maximum Anode Dissipation ($P_a(max)$):** 500 W (at this maximum level, the graphite anode runs bright red at approximately 870 °C, as measured by a pyrometer)
- **Maximum Grid Dissipation ($P_g(max)$):** 50 W
- **Maximum Peak Cathode Current ($i_{k(pk)max}$):** 3.0 A
- **Maximum Operating Frequency (f_{max}):** 60 Mc/s

Inter-Electrode Capacitances

- **Anode to Grid (C_{a-g}):** 6.0 pF
- **Grid to Filament (C_{g-f}):** 11 pF
- **Anode to Filament (C_{a-f}):** 0.4 pF

Typical Static Characteristics

Measured at an anode voltage of 4.0 kV and an anode current of 120 mA:

- **Mutual Conductance (g_m):** 3.6 mA/V
- **Amplification Factor (μ):** 22
- **Anode Resistance (r_a):** 6.1 kΩ (defined as $\delta v_a / \delta i_a$)

Typical Operating Conditions

The 14D12 can be configured for Class C r.f. power amplification, Class C self-oscillation, and Class B1 push-pull audio amplification.

Class C R.F. Power Amplifier (Unmodulated or FM)

Operating with a continuous d.c. anode supply:

Parameter	Condition 1	Condition 2	Condition 3
D.C. Anode Voltage (V_a)	4.0 kV	5.0 kV	6.0 kV
D.C. Grid Voltage (V_g)	-280 V	-400 V	-500 V
Peak R.F. Drive Voltage	570 V	690 V	790 V

Parameter	Condition 1	Condition 2	Condition 3
D.C. Anode Current (I_a)	585 mA	530 mA	500 mA
D.C. Grid Current (I_g)	175 mA	155 mA	145 mA
Driving Power	90 W	100 W	110 W
Power Output (P_{out})	1.8 kW	2.2 kW	2.5 kW

Class C Self-Oscillator (D.C. or 3-Phase Full-Wave Rectified Supply)

Operating at a maximum frequency of 60 Mc/s:

Parameter	Condition 1	Condition 2	Condition 3
D.C. Anode Voltage (V_a)	4.0 kV	5.0 kV	6.0 kV
D.C. Anode Current (I_a)	585 mA	530 mA	500 mA
D.C. Grid Current (I_g)	175 mA	155 mA	145 mA
Grid Resistance (R_g)	1.6 k Ω	2.6 k Ω	3.4 k Ω
Power Input (P_{in})	2.3 kW	2.6 kW	3.0 kW
Power Output (P_{out})	1.7 kW	2.0 kW	2.4 kW
Power Output (at 85% transfer efficiency)	1.45 kW	1.75 kW	2.0 kW
Maximum Anode Dissipation ($P_{a(max)}$)	500 W	500 W	500 W
Grid Dissipation (P_g)	45 W	40 W	35 W

Class C Self-Oscillator (Alternative Power Supplies)

Operating at a maximum frequency of 60 Mc/s with single-phase full-wave rectified (unsmoothed) or pure a.c. anode supplies:

Parameter	Single-Phase Rectified	A.C. Anode Supply
A.C. Anode Voltage (r.m.s.) ($V_a(r.m.s.)$)	4.25 kV	4.25 kV

Parameter	Single-Phase Rectified	A.C. Anode Supply
Mean Anode Voltage ($V_a(av)$)	3.8 kV	1.9 kV
Anode Current (D.C. or Mean)	405 mA	290 mA
Grid Current (D.C. or Mean)	105 mA	62 mA
Grid Resistance (R_g)	2.0 k Ω	325 Ω
Power Input (P_{in})	1.9 kW	1.4 kW
Power Output (P_{out})	1.4 kW	0.8 kW
Power Output (at 85% transfer efficiency)	1.2 kW	0.7 kW
Maximum Anode Dissipation ($P_{a(max)}$)	500 W	500 W
Grid Dissipation (P_g)	20 W	15 W

Class B1 Audio Amplification (Push-Pull Operation)

Typical operating conditions per valve in push-pull service:

- **Anode Voltage (V_a):** 6.0 kV
- **A.C. Anode Current (r.m.s.) ($I_a(r.m.s.)$):** 0.25 A
- **Power Input (P_{in}):** 1.0 kW
- **Power Output (P_{out}):** 0.5 kW
- **Anode Dissipation (P_a):** 0.5 kW
- **Anode Efficiency:** 50% (calculated as P_{out}/P_{in})
- **Bias Signal (V_g):** -220 V
- **Peak Signal Voltage ($V_{sig(pk)}$):** 220 V

Operational Guidelines and Protection

Because the typical operating conditions utilize some or all of the maximum ratings of the 14D12, close control of operating parameters is necessary. Linear interpolation between the listed anode voltage steps is admissible.

In Class C self-oscillator service, precautions must be taken against excessive mains voltage variations. It is highly recommended to include current overload trips in both the anode and grid circuits, as well as an under-current trip in the grid circuit to protect the tube from runaway conditions.

For industrial r.f. heating applications, where loads fluctuate widely and mains regulation may be poor, some reductions in operating conditions are usually necessary to accommodate these variations safely.

Constant Current Characteristics

The constant current characteristics of the 14D12 map the relationship between grid voltage and anode voltage. The grid voltage ranges from -400 V to +600 V, while the anode voltage extends up to 8 kV.

- **Constant Anode Current Contours:** Plotted from 0.01 A up to 4.0 A, showing the triode's conduction behavior across its operating envelope.
- **Constant Grid Current Contours:** Plotted from 0.05 A up to 1.3 A, illustrating grid current behavior under positive grid drive conditions.
- $V_a = V_g$ **Contour:** Clearly demarcates the boundary where grid voltage equals anode voltage, which is critical for determining the limits of linear grid drive.

Technical Summary

The **14D12** is a high-power, radiation-cooled triode featuring a graphite anode and a directly heated thoriated tungsten filament. Operating with a nominal 5.0 V, 32.5 A filament supply, it is capable of handling up to 6.0 kV on the anode and dissipating up to 500 W. With a maximum operating frequency of 60 Mc/s, it is highly suited for industrial r.f. heating, modulation, and transmission. Proper installation requires vertical mounting, forced-air cooling of 50 cu. ft./min. directed at the base pins, and parallel connection of both grid pins at high frequencies.



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 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum d.c. grid voltage	1000 V	—
Maximum operating frequency	60 MHz	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode-grid capacitance	6 pF	—



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 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum d.c. grid voltage	1000 V	—
Maximum operating frequency	60 MHz	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode-grid capacitance	6 pF	—

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