

ELECTRONIC TUBE REFERENCE

15P12

Power - Triode electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
TRIODE

Directly heated water-cooled triode designed specifically for industrial RF-heating equipment, using a thoriated-tungsten filament for substantial continuous high-frequency 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

SECTION1 Triode	
TRANSCONDUCTANCE	0.0033 S
AMPLIFICATION FACTOR	21
MAXIMUM PLATE VOLTAGE	7000 V
MAXIMUM PLATE DISSIPATION	650 W
MAXIMUM CATHODE CURRENT	3 A

15P12 — Water-Cooled Triode

A water-cooled power triode with a directly heated thoriated tungsten filament, designed primarily for industrial radio-frequency (r.f.) heating applications and high-power amplification.

Overview

The **15P12** is a heavy-duty, water-cooled triode featuring an external anode construction and a directly heated thoriated tungsten filament. It is engineered primarily for use in industrial radio-frequency heating

equipment, where robust thermal management and stable performance under fluctuating loads are critical. The tube is also rated for Class B1 audio amplification and Class C RF power amplification or oscillation.

The device is characterized by its high power handling capabilities, requiring active water cooling even under standby conditions (filament dissipation alone). It features a special base with heavy-duty pin connections, including dual grid pins to distribute high-frequency currents.

Construction and Cooling Requirements

The 15P12 is constructed with an external copper anode designed to be cooled by a continuous flow of water. The filament is a directly heated thoriated tungsten type, which provides high thermionic emission efficiency.

Cooling Specifications

Because of the high thermal dissipation of both the filament and the anode, active water cooling is mandatory under all operating conditions, including when only the filament is energized.

- **Minimum Water Flow:** 1 Litre per minute (L/min) for maximum anode dissipation.
- **Water Path:** Cold water must be fed into the lower end of the copper spiral surrounding the anode.
- **Maximum Water Outlet Temperature:** The temperature of the water exiting the top of the spiral must not exceed 60°C (with some general absolute limits specifying a maximum outlet temperature of 55°C under standard continuous ratings).
- **Hose Length:** The hoses connecting the water supply and the return to the valve must be at least 20 feet (approx. 6 meters) in length. Using hoses shorter than 20 feet results in a loss of RF power due to shunting effects through the water column.
- **Air Cooling:** In addition to water cooling, a low-velocity air blast directed at the filament and grid pins is recommended when operating the tube at full power at higher frequencies to prevent overheating of the glass-to-metal seals.

Physical Dimensions and Basing

The physical structure of the 15P12 is optimized for vertical mounting. While early tentative specifications suggested a vertical, base-down mounting position, the finalized operating instructions mandate that the tube be mounted vertically with the anode upwards.

Physical Dimensions

- **Maximum Overall Length:** 180 mm
- **Maximum Glass Diameter:** 80 mm
- **Anode Structure:** External copper spiral, with a nominal diameter of 19 mm at the top terminal (19 mm minimum).
- **Base Pins:** The base features heavy-duty pins, including 9 mm diameter pins for the filament connections.

- **Grid Connections:** The grid is connected to two separate pins (each 9 mm in diameter, spaced 20 mm apart). Under high-frequency operation, it is essential to make electrical connections to both grid pins simultaneously to distribute the RF current and prevent overheating of an individual pin or seal.

Inter-Electrode Capacitances

The internal capacitances of the triode structure are relatively low, enabling efficient operation up to its maximum rated frequency:

Parameter	Symbol	Value
Anode to Grid Capacitance	C_{a-g}	10.5 pF
Grid to Filament Capacitance	C_{g-f}	11.0 pF
Anode to Filament Capacitance	C_{a-f}	0.5 pF

Electrical Characteristics and Absolute Maximum Ratings

The 15P12 exhibits high transconductance and a moderate amplification factor, making it highly effective as an RF power amplifier or oscillator.

Typical Characteristics

Measured at an anode voltage (V_a) of 4.0 kV and an anode current (I_a) of 120 mA:

- **Mutual Conductance (g_m):** 3.3 mA/V
- **Amplification Factor (μ):** 21

Absolute Maximum Ratings

These limiting values must not be exceeded under any condition of service:

Rating	Symbol	Value
Filament Voltage	V_f	5.0 V
Filament Current	I_f	32.5 A
Maximum Anode Voltage	$V_{a(max)}$	7.0 kV
Maximum Anode Dissipation	$P_{a(max)}$	650 W
Maximum Peak Cathode Current	$i_{k(pk)max}$	3.0 A

Rating	Symbol	Value
Maximum Operating Frequency (Full Ratings)	f_{max}	60 MHz*

*Note: Although the tube is rated for up to 60 MHz at full ratings, the physical water connections limit the practical operating frequency to 10 MHz in standard installations.

Typical Operating Conditions

The 15P12 can be operated in several classes of service. Linear interpolation between the documented anode voltage steps is permissible.

Class B1 Audio Amplification (Push-Pull, Per Valve)

In Class B1 push-pull audio service, the tube operates with negative grid bias and no grid current:

- **Maximum Anode Voltage (V_a):** 6.0 kV
- **Anode Current (R.M.S.):** 0.3 A
- **Power Input (P_{in}):** 1.2 kW
- **Power Output (P_{out}):** 0.6 kW
- **Anode Dissipation (P_a):** 0.6 kW
- **Anode Efficiency:** 50%
- **Grid Bias Voltage (V_g):** -220 V
- **Peak Signal Voltage ($V_{sig(pk)}$):** 220 V

Class C RF Power Amplification or Oscillation (3-Phase Full-Wave Rectified or D.C.)

For Class C telegraphy or self-excited oscillator service powered by a 3-phase full-wave rectified supply or pure D.C., three typical operating points are established:

Parameter	4.0 kV Point	5.0 kV Point	6.0 kV Point
Anode Voltage (V_a)	4.0 kV	5.0 kV	6.0 kV
Grid Bias Voltage (V_g)	-220 V	-300 V	-400 V
Positive Grid Voltage (V_{sig})	280 V	280 V	280 V
Grid Resistor (R_g)	1.75 k Ω	1.9 k Ω	3.1 k Ω
Mean Anode Current ($I_{a(av)}$)	620 mA	600 mA	550 mA

Parameter	4.0 kV Point	5.0 kV Point	6.0 kV Point
Mean Grid Current ($I_{g(av)}$)	130 mA	160 mA	130 mA
Peak Cathode Current ($i_{k(pk)}$)	3.0 A	3.0 A	3.0 A
Peak Anode Current ($i_{a(pk)}$)	2.0 A	2.0 A	2.0 A
Peak Grid Current ($i_{g(pk)}$)	1.0 A	1.0 A	1.0 A
Anode Dissipation (P_a)	630 W	640 W	650 W
Grid Drive Power	60 W	85 W	85 W
Grid Dissipation (P_g)	28 W	38 W	30 W
Anode Efficiency	75%	78%	80%
Power Output (Amplifier)	1.8 kW	2.3 kW	2.65 kW
Power Output (Oscillator, 100% transfer)	1.7 kW	2.2 kW	2.6 kW
Power Output (Oscillator, 85% transfer)	1.5 kW	1.9 kW	2.2 kW

Class C RF Power Amplification or Oscillation (Single-Phase Full-Wave Rectified, No Smoothing)

When operated with an unsmoothed single-phase full-wave rectified supply, the typical operating parameters are:

- **Anode Voltage (V_a):** 3.8 kV Mean (4.25 kV R.M.S., 6.0 kV Peak)
- **Grid Bias Voltage (V_g):** -140 V
- **Positive Grid Voltage (V_{sig}):** 184 V
- **Grid Resistor (R_g):** 1.6 k Ω
- **Mean Anode Current ($I_{a(av)}$):** 460 mA
- **Mean Grid Current ($I_{g(av)}$):** 89 mA
- **Peak Cathode Current ($i_{k(pk)}$):** 3.0 A (with 1.9 A Mean, 2.1 A R.M.S.)
- **Peak Anode Current ($i_{a(pk)}$):** 1.4 A

- **Peak Grid Current ($i_{g(pk)}$):** 0.5 A
- **Anode Dissipation (P_a):** 650 W
- **Grid Drive Power:** 23 W
- **Grid Dissipation (P_g):** 7 W
- **Anode Efficiency:** 70%
- **Power Output (Amplifier):** 1.5 kW
- **Power Output (Oscillator, 100% transfer):** 1.5 kW
- **Power Output (Oscillator, 85% transfer):** 1.3 kW

Installation and Operating Guidelines

To ensure reliable operation and prevent premature failure of the 15P12, several practical installation and operational guidelines must be followed:

1. **Mechanical Protection:** The valve must be protected against excessive vibration and mechanical shock.
2. **Electrical Contacts:** All electrical connections to the pins and seals must make excellent contact. Poor contact can lead to localized RF heating, which may damage the glass-to-metal seals.
3. **Grid Pin Strapping:** At high frequencies, both grid pins must be connected in parallel. This reduces the current density through each individual pin, preventing thermal stress.
4. **Protection Circuitry:**
 - In Class C Self-Oscillator service, precautions must be taken to protect the tube against excessive mains voltage variations.
 - Current overload trips should be integrated into both the anode and grid circuits.
 - An under-current trip must be included in the grid circuit to protect the tube from excessive anode dissipation if grid drive is lost.
5. **Industrial RF Heating Considerations:** In industrial environments, where load impedance fluctuates widely and mains voltage regulation may be poor, it is common practice to reduce the operating conditions below the maximum ratings. This provides a safety margin to accommodate fluctuating loads and mains variations.

Technical Summary

The **15P12** is a high-power, water-cooled triode featuring a directly heated thoriated tungsten filament and an external anode. Operating with a nominal **5.0 V, 32.5 A** filament supply, the tube is capable of handling up to **7.0 kV** on the anode and dissipating up to **650 W** continuously when cooled with a minimum water flow of **1 L/min**.

With an amplification factor of **21** and a mutual conductance of **3.3 mA/V**, the 15P12 is highly optimized for Class C RF power amplification and oscillation in industrial heating equipment, delivering up to **2.65 kW** of output power under optimal Class C conditions. Proper installation requires vertical mounting with the anode upwards, dual-pin grid connections at high frequencies, and robust water and air cooling systems to protect the tube's glass-to-metal seals.



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 operating frequency	60 MHz	WaterConnectionsLimit10MHz

COOLING		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Minimum water flow at maximum dissipation	1 gal/min	—
Maximum water outlet temperature	55 degC	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode-grid capacitance	10.5 pF	—
Grid-filament capacitance	11 pF	—
Anode-filament capacitance	0.5 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

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum operating frequency	60 MHz	WaterConnectionsLimit10MHz

COOLING		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Minimum water flow at maximum dissipation	1 gal/min	—
Maximum water outlet temperature	55 degC	—

CAPACITANCE		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Anode-grid capacitance	10.5 pF	—
Grid-filament capacitance	11 pF	—
Anode-filament capacitance	0.5 pF	—

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