

ELECTRONIC TUBE REFERENCE

CONSOLIDATED TECHNICAL DATA

16A5

Power - TV Vertical Output electronic tube

1 SECTION
CONSTRUCTION
PENTODE

Output pentode designed for television frame time-base output or audio-output service. Its power capability supports either vertical-deflection drive or conventional low-frequency load power.

GENERAL CHARACTERISTICS

BASE DESIGNATION	9BL	BASE PINS	9
NOMINAL HEATER	16.5 V / 300 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Pentode	
PLATE RESISTANCE	20000 Ω
TRANSCONDUCTANCE	0.009 S
MAXIMUM PLATE VOLTAGE	250 V
MAXIMUM SCREEN VOLTAGE	250 V
MAXIMUM PLATE DISSIPATION	9 W
MAXIMUM SCREEN DISSIPATION	2.5 W
MAXIMUM CATHODE CURRENT	75 mA
Published Ferranti ratings and characteristics promoted where applicable; additional operating and application data retained as parameters.	

16A5 — Indirectly Heated Output Pentode

The **16A5** is an indirectly heated output pentode designed primarily for use in television receivers as a frame time base output valve or as an audio (sound) output valve. It is specifically engineered for

operation in series heater chains.

Physical Characteristics, Heater, and Basing

The 16A5 is constructed with a T6 1/2 glass envelope and utilizes a small button Noval 9-pin (B9A) base. The physical dimensions of the tube are specified as follows:

Dimension	Metric Value	Imperial Value
Maximum Overall Length	78.5 mm	3 1/16 in.
Maximum Seated Height	71.5 mm	2 13/16 in.
Bulb Length (excluding tip)	—	2 7/16 in. ± 3/32 in.
Maximum Diameter	22.2 mm	7/8 in.

The tube can be mounted and operated in any position.

Heater Specifications

The cathode is a coated, unipotential type. The heater is designed for series-string operation with a constant current.

- **Heater Current:** 0.3 A (300 mA)
- **Heater Voltage:** 16.5 V
- **Calculated Heater Power:** 4.95 W (calculated as 16.5 V multiplied by 0.3 A)

Pin Connections

The 16A5 uses the JETEC 9BL basing arrangement. The pin assignments, viewed from the underside of the base, are:

Pin	Connection
Pin 1	Internal Connection (IC) / Not Connected (NC)
Pin 2	Control Grid (Grid No. 1)
Pin 3	Cathode, Suppressor Grid (Grid No. 3)
Pin 4	Heater
Pin 5	Heater
Pin 6	Internal Connection (IC)
Pin 7	Anode (Plate)
Pin 8	Internal Connection (IC)

Pin	Connection
Pin 9	Screen Grid (Grid No. 2)

Maximum Ratings

The maximum ratings of the 16A5 must be strictly observed to ensure reliable operation and longevity. These ratings represent the absolute limits of the device:

Parameter	Absolute Maximum Value
Maximum DC Supply Voltage	550 V
Maximum Anode Voltage (without current)	550 V
Maximum Anode Voltage	250 V
Maximum Peak Positive Anode Voltage	2.5 kV (2500 V)*
Maximum Peak Negative Anode Voltage	500 V
Maximum Average Anode Voltage	250 V
Maximum Anode Dissipation	9 W
Maximum Screen Grid (Grid No. 2) Voltage (without current)	550 V
Maximum Screen Grid (Grid No. 2) Voltage	250 V
Maximum Screen Grid (Grid No. 2) Dissipation	2.5 W
Maximum Cathode Current	75 mA
Maximum Heater-to-Cathode Voltage (Vh-k)	200 V
Maximum External Heater-to-Cathode Resistance (Rh-k)	20 kΩ (20,000 Ω)

* The maximum peak positive anode voltage rating of 2.5 kV is permitted only under pulsed conditions, with a maximum pulse duration of 10% of one cycle and a maximum absolute duration of 2 milliseconds.

Grid No. 1 Circuit Resistance Limits

The maximum allowable resistance in the control grid circuit depends on the biasing method and the specific application:

- **With Automatic Bias:** 1.0 MΩ
- **With Fixed Bias:** 0.4 MΩ
- **For Frame Output Operation:** 2.2 MΩ

Grid Current Starting Point

The control grid (Grid No. 1) voltage at which grid current begins (defined as a grid current of +0.3 μA) is -1.3 V.

Electrical Characteristics

The typical electrical characteristics of the 16A5 measured under static Class A conditions are outlined below:

Parameter	Operating Point A	Operating Point B
Anode Voltage	170 V	200 V
Screen Grid Voltage	170 V	200 V
Suppressor Grid Voltage	0 V	0 V
Control Grid Bias Voltage	-10.4 V	-13.9 V to -14.2 V
Anode Current	53 mA	45 mA
Screen Grid Current	10 mA	8.5 mA
Mutual Conductance (Transconductance)	9.0 mA/V (9,000 μmhos)	7.6 mA/V (7,600 μmhos)
Anode Impedance (Plate Resistance)	20 k Ω	24 k Ω
Inner Amplification Factor ($\mu\text{g1-g2}$)	10	10

Typical Operating Configurations

Frame Time Base Output

When utilized as a frame time base output valve, the circuit must be designed to accommodate manufacturing variations and tube aging over its operating life. The design should be centered around the following peak plate current limits:

- **At Anode Voltage of 50 V and Screen Voltage of 170 V:** The peak plate current should not exceed 90 mA (compared to 140 mA for an average new valve).
- **At Anode Voltage of 60 V and Screen Voltage of 200 V:** The peak plate current should not exceed 120 mA (compared to 175 mA for an average new valve).

In both cases, the control grid voltage is maintained at -1.0 V.

Class A Sound Output (Single Valve)

For single-ended Class A audio output service, the typical operating conditions are:

Parameter	Condition 1	Condition 2
Anode Voltage	170 V	200 V
Screen Grid Voltage	170 V	200 V
Grid No. 2 Series Resistor	0 Ω	680 Ω
Control Grid Bias Voltage	-10.4 V	-13.2 V to -13.9 V
Anode Load Resistor	3 k Ω	4 k Ω
Anode Current	53 mA	45 mA
Screen Grid Current	10 mA	8.5 mA
Input A.F. Voltage	6.0 V r.m.s.	7.0 V r.m.s.
Power Output (at 10% Distortion)	4.0 W	4.2 W
Input Voltage for 50 mW Output	0.5 V r.m.s.	0.55 V r.m.s.

Push-Pull Class AB Audio Amplifier (Two Valves)

For push-pull audio output configurations operating in Class AB (without grid No. 1 current), the typical operating parameters for two valves are:

Parameter	Condition 1	Condition 2
Anode Voltage	170 V	200 V
Screen Grid Voltage	170 V	200 V
Cathode Bias Resistor (R _k)	100 Ω	135 Ω
Optimum Load Resistance (Plate-to-Plate)	4 k Ω	4 k Ω
Input A.F. Voltage	0 to 2 x 9.3 V r.m.s.	0 to 2 x 13.5 V r.m.s.
Anode Current (Zero to Max Signal)	2 x 46 to 2 x 50 mA	2 x 45 to 2 x 52 mA
Screen Grid Current (Zero to Max Signal)	2 x 8.7 to 2 x 17 mA	2 x 8.5 to 2 x 19 mA
Power Output (at 5% Distortion)	9.0 W	12.0 W

Interelectrode Capacitances

The direct interelectrode capacitances of the 16A5, measured without an external shield, are:

- **Grid No. 1 to all other elements except plate (C_{in}):** 11.0 pF
- **Plate to all other elements except grid No. 1 (C_{out}):** 5.9 pF to 6.2 pF
- **Plate to Grid No. 1 (C_{a-g1}):** < 1.0 pF
- **Grid No. 1 to Heater (C_{g1-h}):** < 0.15 pF

Technical Summary

The **16A5** is a versatile, high-performance **indirectly heated output pentode** housed in a **Noval 9-pin (B9A)** envelope. Designed with a **16.5 V, 0.3 A** heater, it is optimized for series heater chains in television and audio equipment.

The tube is characterized by its dual-purpose design, serving efficiently as a **frame time base output valve** or as a **Class A or Class AB push-pull audio output valve**. With an anode dissipation rating of **9 W** and a peak positive anode voltage rating of **2.5 kV** under pulsed conditions, the 16A5 provides robust performance in demanding deflection circuits while delivering up to **12 W** of low-distortion audio power in push-pull configurations.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1961 Ferranti Technical Handbook

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

1961 FERRANTI TECHNICAL HANDBOOK

Section 1 · Pentode

APPLICATION

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Application	Frame time-base output / audio output	—

OTHER

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Peak positive anode voltage	2590 V	Pulse



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1999 Philips 0-D

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

1999 PHILIPS 0-D

Section 1 · Pentode

CAPACITANCE

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid 1 input capacitance	11 pF	—
Plate output capacitance	5.9 pF	—
Plate-grid 1 capacitance maximum	1 pF	—

OTHER

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum peak positive plate voltage	2500 V	PulseRated

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum peak negative plate voltage	500 V	—
Maximum average plate voltage	250 V	—
Maximum grid 2 operating voltage	250 V	—
Maximum heater-cathode voltage	200 V	—
Minimum external heater-cathode resistance	20000 ohm	—
Grid 1 bias	-10.4 V	ClassA;PlateVoltage=170V
Plate current	53 mA	ClassA;PlateVoltage=170V
Grid 2 current	10 mA	ClassA;PlateVoltage=170V
Load resistance	3000 ohm	ClassA;PlateVoltage=170V
Audio output at 10 percent distortion	4 W	ClassA;PlateVoltage=170V
Grid 1 bias	-13.9 V	ClassA;PlateVoltage=200V
Plate current	45 mA	ClassA;PlateVoltage=200V
Grid 2 current	8.5 mA	ClassA;PlateVoltage=200V
Load resistance	4000 ohm	ClassA;PlateVoltage=200V
Audio output at 10 percent distortion	4.2 W	ClassA;PlateVoltage=200V
Push-pull output	12 W	ClassA;PushPull;TwoTubes;PlateVoltage=200V;Distortion=5%
Frame-output recommended peak plate current	90 mA	PlateVoltage=50V;ScreenVoltage=170V
Frame-output recommended peak plate current	120 mA	PlateVoltage=60V;ScreenVoltage=200V
Maximum plate voltage without current	550 V	—
Maximum grid 2 voltage without current	550 V	—

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Transconductance	9000 μS	ClassA;PlateVoltage=170V
Plate resistance	20000 ohm	ClassA;PlateVoltage=170V
Transconductance	7600 μS	ClassA;PlateVoltage=200V
Plate resistance	24000 ohm	ClassA;PlateVoltage=200V