



ELECTRONIC TUBE REFERENCE

1788

Rectifier - Half Wave electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION
CONSTRUCTION
RECTIFIER

Philips directly heated gas-filled industrial half-wave rectifier for charging lead-acid batteries, providing approximately 5 A DC output and high peak-current capability.

GENERAL CHARACTERISTICS

BASE DESIGNATION	GOLIATH	BASE PINS	—
NOMINAL HEATER	1.9 V / 11 A	PARALLEL HEATER	— / —
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Common cathode	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Rectifier	
PEAK INVERSE VOLTAGE	300 V
NOMINAL OUTPUT CURRENT	5 A
PEAK FORWARD CURRENT	30 A
FORWARD VOLTAGE DROP	9 V
WARM-UP TIME	120 s
<i>Directly heated gas-filled rectifier with mercury-vapour/gas filling for battery charging up to 36 lead-acid cells.</i>	

1788 — Double-Anode Mercury Vapour and Gas-Filled Rectifying Valve

Overview

The **1788** is a heavy-duty, double-anode rectifying valve containing both mercury vapour and gas filling. It is designed specifically for high-current rectification applications, most notably in battery chargers. A single 1788 valve is capable of delivering up to 10 A of charging current, making it suitable for charging banks of up to 36 lead-acid (Pb) cells.

The tube features a robust mechanical construction, utilizing a GOLIATH base and top-mounted anode terminals to handle high currents and voltages safely. Its operation relies on a low-voltage, high-current directly heated filament and requires careful thermal and electrical management, including a dedicated pre-heating schedule and a specific screen connection.

Mechanical and Physical Specifications

The 1788 is constructed with a large glass bulb envelope to facilitate heat dissipation during high-power operation. The physical dimensions and installation requirements are as follows:

- **Mounting Position:** The valve must be mounted strictly in a vertical position, with the base pointing down. This orientation is critical to ensure the proper distribution and condensation of the mercury vapour during operation.
- **Dimensions:** The envelope has a maximum overall height of 284 mm and a maximum diameter of 94 mm.
- **Weight:** The net weight of the valve is 350 g, while its shipping weight is 3000 g, reflecting the substantial protective packaging required for transport.
- **Base and Socket:** The tube is equipped with a GOLIATH base and is designed to fit a type 65909 BG/01 socket.
- **Electrode Connections:**
 - **Anodes:** The two anodes are connected via two top terminals of M6 size.
 - **Screen:** The screen (*s*) is connected via a side terminal of M4 size, which has a maximum projection of 13 mm.

Filament and Pre-heating Requirements

The 1788 utilizes an oxide-coated, directly heated filament designed for alternating current (A.C.) operation. Due to the high-current nature of the tube, the filament demands a substantial current supply at a very low voltage:

Parameter	Value
Filament Voltage (<i>V_f</i>)	1.9 V (A.C.)

Parameter	Value
Filament Current (I_f)	11 A

Pre-heating Schedule

Because the 1788 is a mercury vapour and gas-filled tube, the filament must be pre-heated before anode voltage is applied. This ensures that the mercury is sufficiently vaporized and the cathode reaches its proper operating temperature, preventing damage to the oxide coating from ion bombardment.

- **Standard Pre-heating Time (T_w):** A minimum of 2 minutes is recommended under normal operating conditions.
- **Urgent Operation:** In urgent cases, the pre-heating time can be reduced to a minimum of 1 minute. A type [4152](#) time delay switch may be integrated into the control circuitry to automate this delay.
- **Post-Transport / Long Interruption:** After transport or a long period of service interruption, the valve must be pre-heated for at least 5 minutes to ensure all condensed mercury is cleared from the electrodes.

Electrical Characteristics and Operating Limits

The electrical behavior of the 1788 is characterized by a low internal voltage drop once the arc is established, which is typical of gas and mercury vapour rectifiers.

Typical Characteristics

- **Ignition Voltage (V_{ign}):** 22 V (the minimum voltage required to initiate conduction).
- **Arc Voltage (V_{arc}):** 9 V (the constant voltage drop across the tube during conduction).

Limiting Values (Absolute / Design-Maximum)

To ensure reliable operation and prevent premature valve failure, the following limiting values must not be exceeded:

Parameter	Limit Value
Maximum Transformer Voltage (V_{tr})	95 V_{eff} (applicable for "Circuit a")
Minimum Transformer Voltage (V_{tr})	20 V_{eff} (applicable for "Circuit a")
Maximum Peak Inverse Anode Voltage (V_{ainvp})	300 V
Maximum Continuous Anode Current (I_a)	5 A
Maximum Peak Anode Current (I_{ap})	30 A
Minimum Surge Limiting Resistance (R_t)	0.3 Ω

Parameter	Limit Value
Mercury Condensation Temperature (t_{Hg})	30 to 80 $^{\circ}\text{C}$

The minimum surge limiting resistance of $0.3\ \Omega$ is a critical circuit requirement to protect the anodes from excessive current surges during start-up or transient conditions. Additionally, the mercury condensation temperature must be maintained strictly within the 30 to 80 $^{\circ}\text{C}$ range to ensure stable gas pressure and prevent arc-back or failure to ignite.

Circuit and Application Requirements

In practical applications, the 1788 requires specific external circuitry to function correctly and safely.

Screen Connection

The screen (s) must not be left floating. It is a strict operational requirement that the screen terminal (M4 side terminal) be connected directly to the cathode via a **10 k Ω , 0.5 W resistor**. This resistor limits the screen current and stabilizes the internal potential of the tube during the ignition and conduction phases.

Battery Charging Service

When configured as a full-wave rectifier using both anodes, the 1788 is capable of delivering a maximum charging current of 10 A per valve. This high current capacity allows the system to charge up to 36 lead-acid (Pb) cells connected in series. The transformer voltage must be selected within the specified 20 to 95 V_{eff} range to match the battery bank voltage while respecting the maximum peak inverse voltage of 300 V.

Technical Summary

The **1788** is a specialized double-anode mercury vapour and gas-filled rectifying valve designed for high-current battery charging applications. It features a GOLIATH base, top-mounted M6 anode terminals, and an M4 side screen terminal. The valve operates with a 1.9 V, 11 A directly heated filament and requires a strict pre-heating routine (typically 2 minutes) to safeguard its oxide-coated cathode. With an ignition voltage of 22 V and a low arc drop of 9 V, the 1788 efficiently handles continuous anode currents up to 5 A per anode (10 A total per valve) and peak currents up to 30 A, under a maximum peak inverse voltage of 300 V. Safe operation requires a minimum surge limiting resistance of $0.3\ \Omega$, a screen-to-cathode connection via a 10 k Ω resistor, and a controlled mercury condensation temperature between 30 and 80 $^{\circ}\text{C}$.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1963 Philips Electron Tubes Handbook V3

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

1963 PHILIPS ELECTRON TUBES HANDBOOK V3

Section 1 · Rectifier

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Arc voltage drop	9 V	GasFilled

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum peak inverse anode voltage	300 V	—
Maximum average anode current	5 A	—
Maximum peak anode current	30 A	—
Application	battery charging up to 36 lead-acid cells	—
Heater voltage	1.9 V	DirectAC
Heater current	11 A	DirectAC



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

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum RMS anode supply voltage	95 V	—
Minimum RMS anode supply voltage	20 V	—
Maximum average anode current per anode	5 A	—
Permitted mercury/ambient temperature	30–80 degC	—
DC output current	10 A	—

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