



ELECTRONIC TUBE REFERENCE

0E3

Voltage Regulator electronic tube

CONSOLIDATED TECHNICAL DATA

1 SECTION

CONSTRUCTION

VOLTAGEREGULATOR

Low-current cold-cathode gas regulator providing approximately 85 V stabilization at roughly 1–8 mA for low-power reference circuits.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	—
NOMINAL HEATER	— / —	PARALLEL HEATER	— / —
HEATING	Indirect; cold cathode	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION 1 Voltage Regulator	
REGULATOR VOLTAGE	85 V
MINIMUM REGULATOR CURRENT	4 mA
MAXIMUM REGULATOR CURRENT	4 mA
STARTING VOLTAGE	120 V
MAINTAINING VOLTAGE	85 V
Published ratings/characteristics promoted where applicable; additional values retained as parameters.	

0E3 — Cold Cathode Glow Discharge Voltage Reference Tube

The **0E3** (also designated as the **0E3/85A1**) is a cold cathode, glow discharge voltage reference tube designed for applications requiring exceptional voltage stability. It maintains a highly constant nominal D.C. operating voltage of **85 V** over an operating current range of **1 to 8 mA**. The electrical

characteristics of the device are independent of ambient temperature, making it highly reliable in varying environmental conditions.

The tube is particularly distinguished by its minimal voltage drift over its operating life and its tight tube-to-tube operating voltage tolerance. These properties make the 0E3 especially suited for use as a voltage reference in the D.C. power supplies of electronic equipment and in precision measuring circuits.

Construction and Physical Characteristics

The high stability of the 0E3 is achieved through specialized construction techniques and material selection. The cathode is constructed from **molybdenum**. To prevent contamination of the cathode surface by gaseous impurities released from the glass envelope over time, the inner surface of the glass bulb is coated with a layer of molybdenum. This internal coating serves three distinct functions:

1. It prevents glass impurities from reaching the cathode.
2. It acts as an electrical screen against external influences.
3. It functions as an active getter to maintain high vacuum purity.

The physical dimensions and mechanical specifications of the tube are as follows:

Physical Parameter	Specification
Bulb Type	Tubular
Maximum Overall Length	3-11/16 inches
Maximum Seated Height	2-1/2 inches
Maximum Diameter	1-1/8 inches
Mounting Position	Any

Base Configuration and Pinout

The 0E3 features a **3-pin lock-in (loctal)** base configuration. Although the base contains only three active pins, it is designed to fit a standard **loctal 8-pin socket**. The socket can be mounted in any orientation.

The electrical connections, viewed from the bottom of the base, are assigned as follows:

- **Pin 2:** Cathode
- **Pin 4:** Anode
- **Pin 8:** Internal Shield (Molybdenum bulb coating)

Electrical Characteristics and Ratings

The 0E3 operates under strict electrical limits to ensure its rated stability and lifetime. The absolute maximum ratings and typical operating characteristics include:

Absolute Maximum Ratings

- **Continuous D.C. Operating Current:** 8 mA maximum
- **Ambient Temperature Range:** -55 °C to +90 °C

Operating Characteristics

- **D.C. Starting Voltage:** 110 V (average), 120 V (maximum). A minimum supply voltage of 120 V must be provided to guarantee ignition throughout the tube's operating life.
- **D.C. Operating Voltage:** 83 V (minimum), 85 V (average), 87 V (maximum).
- **D.C. Operating Current Range:** 1 mA to 8 mA.
- **Voltage Regulation (1 mA to 8 mA):** 3.15 V maximum. This represents the change in operating voltage across the full current range.
- **Stability:** 0.1 V (average), 0.85 V (maximum). Stability is defined as the maximum voltage fluctuation in the operating voltage over a continuous period of 5,000 hours.

Application and Circuit Design Guidelines

To achieve the maximum performance and stability from the 0E3, several circuit design and installation guidelines must be followed:

Ignition and Series Resistance

A minimum D.C. anode supply voltage of **120 V** must always be available in the equipment design to ensure reliable ignition of the glow discharge throughout the lifetime of the tube.

Because the tube has a negative resistance characteristic during breakdown and operates as a shunt regulator, a **series resistor must always be used** in series with the anode. The value of this resistor must be chosen such that:

1. At the maximum expected anode supply voltage, the current through the 0E3 does not exceed the absolute maximum rating of **8 mA**.
2. At the minimum expected anode supply voltage, the current through the 0E3 remains above the minimum operating limit of **1 mA**.

Environmental and Shielding Considerations

- **Thermal Management:** To retain the maximum constancy of the operating voltage, the tube should be mounted in a location where it is isolated from excessive heat generated by adjacent components, such as power tubes or high-wattage resistors.
- **Electromagnetic Shielding:** When the 0E3 is operated in the presence of strong radio frequency (R.F.) or magnetic fields, external shielding should be utilized to prevent interference from degrading the voltage stability.
- **Warm-up Period:** A warm-up period of **3 minutes** must be allowed each time the equipment is energized to allow the tube to reach thermal equilibrium and minimize initial voltage drift.

Noise Characteristics

The nature of a gas discharge tube inherently introduces electrical noise. Under typical operating conditions with a tube current of **4 mA** and a series resistor of **10,000 ohms**, the root-mean-square (R.M.S.) noise voltage is **80 microvolts** over a frequency range of **30 to 10,000 cycles per second (c/s)**.

The noise voltage behaves according to the following relationships:

- It increases proportionally to the square root of the series resistance.
- It increases slightly as the operating current is reduced below 4 mA.
- The noise energy is distributed fairly uniformly across the 30 to 10,000 c/s frequency spectrum.

Polarity Caution

The 0E3 is highly sensitive to the polarity of the applied voltage. If the tube is operated with **reverse polarity** for even a few seconds, its stability will be seriously impaired. Once damaged by reverse polarity, the tube may require several hundred hours of operation in the correct direction before it recovers its original performance characteristics. Circuit polarity must be thoroughly verified before inserting the tube into its socket, especially in mass-production environments where wiring faults can rapidly ruin multiple devices.

Practical Reference Circuit

For high-precision electrical measurements, an extremely stable reference voltage can be established by cascading multiple 0E3 tubes to isolate the output stage from supply voltage fluctuations.

A representative three-tube stabilizing circuit utilizes three 0E3 devices (T_1 , T_2 , and T_3) configured as follows:

- The input D.C. supply voltage (E_{bb}) is nominally **275 V**.
- A series resistor R_1 of **0.1 megohm** is connected between the supply and the junction of T_1 and T_2 .
- A resistor R_4 of **1 megohm** is placed in parallel with T_2 .
- The current flowing through the primary reference tube (T_3) is stabilized by the pre-regulating action of T_1 and T_2 .
- The output reference voltage (E_o) is developed across a load resistor R_3 connected in shunt with T_3 .

In this configuration, when the main supply voltage (E_{bb}) fluctuates by $\pm 10\%$, the maximum voltage fluctuation across the reference tube T_3 does not exceed **40 millivolts (0.05%)**, with an average fluctuation of approximately **15 millivolts**.

Voltage-Current Characteristic Curve

The relationship between the plate voltage and plate current of the 0E3 is non-linear but highly reproducible. When current is increased from the minimum operating limit:

- At **1 mA**, the plate voltage is at its minimum value of approximately **84.1 V**.

- Between **1 mA and 2 mA**, the voltage remains nearly flat, rising slightly to **84.2 V**.
- From **2 mA to 8 mA**, the plate voltage increases in a highly linear fashion, reaching approximately **84.8 V at 4 mA**, **85.5 V at 6 mA**, and **86.2 V** at the maximum rating of **8 mA**.

This predictable voltage-current slope defines the regulation characteristic of the tube, showing a total variation of approximately 2.1 V over the active 1 to 8 mA operating range, well within the maximum limit of 3.15 V.

Technical Summary

The **0E3** is a specialized, cold cathode, gas-discharge voltage reference tube featuring a 3-pin loctal base and a molybdenum-coated envelope. It provides a stable **85 V** reference source with an operating current range of **1 to 8 mA**. With its temperature-independent operation, low noise, and long-term stability (less than 0.85 V drift over 5,000 hours), it is an exceptional choice for precision power supplies and calibration circuits. Proper implementation requires strict adherence to polarity, a minimum 120 V ignition supply, and a 3-minute warm-up period.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1953 Amperex

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

1953 AMPEREX

Section 1 · Voltage Regulator

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Operating voltage	83–87 V	—
Operating current	1–8 mA	—