

ELECTRONIC TUBE REFERENCE

0C3

Voltage Regulator electronic tube

CONSOLIDATED TECHNICAL DATA
1 SECTION
CONSTRUCTION
VOLTAGEREGULATOR

Cold-cathode gas voltage regulator providing approximately 105 V stabilization for shunt-regulated supplies and reference-voltage circuits.

GENERAL CHARACTERISTICS

BASE DESIGNATION	4AJ	BASE PINS	8
NOMINAL HEATER	– / –	PARALLEL HEATER	– / –
HEATING	Indirect; cold cathode	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

4AJ - TERMINAL PINOUT

TERMINAL	SECTION	ELEMENT	STATUS
PIN2 – K	A	K – Cathode	CONNECTED
PIN5 – P	A	P – Plate (Anode)	CONNECTED

SECTION RATINGS

SECTION1 Voltage Regulator	
REGULATOR VOLTAGE	105 V
MINIMUM REGULATOR CURRENT	5 mA
MAXIMUM REGULATOR CURRENT	40 mA
STARTING VOLTAGE	135 V
MAINTAINING VOLTAGE	105 V
DYNAMIC IMPEDANCE	100 Ω
Published electrical ratings and characteristics promoted from the approved source.	

0C3 — Cold-Cathode Glow-Discharge Voltage Regulator

The **0C3** (also designated as **0C3**, **0C3/VR105**, **GL-0C3**, and **0C3-W**) is a cold-cathode, gas-discharge diode designed for voltage regulator applications. It is engineered to maintain a stable DC output voltage across a load, independent of variations in load current and moderate fluctuations in line voltage. The tube operates on the principle of a uniform glow discharge covering the cathode surface, where the voltage drop across the tube remains substantially constant within its rated current range. In addition to voltage regulation, the 0C3 can be utilized in relaxation oscillator circuits and for spark-over protection.

Construction and Physical Characteristics

The 0C3 is constructed with two active electrodes—an anode and a cold cathode—enclosed in a glass envelope containing a partial atmosphere of inert gas. The emission of electrons is achieved without a heater; instead, a high potential gradient at the cold cathode surface pulls electrons from the cathode. To facilitate this process, the cathode may be coated with a material possessing a low work function.

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

Physical Parameter	Value
Envelope Style	ST-12 Glass Bulb
Base	Small shell octal 6-pin (B6-3 / 4AJ)
Maximum Overall Length	4 1/8 inches
Maximum Seated Height	3 9/16 inches
Maximum Diameter	1 9/16 inches
Net Weight (Approximate)	1.3 to 2 ounces
Shipping Weight (Approximate)	3 pounds
Mounting Position	Any

Pinout and Internal Jumper

The 0C3 uses a 6-pin octal base configuration. The pin connections, viewed from the bottom of the base, are:

- **Pin 1:** No Connection (NC)
- **Pin 2:** Cathode (K)
- **Pin 3:** Internal Jumper
- **Pin 5:** Anode (P)
- **Pin 7:** Internal Jumper

- **Pin 8:** No Connection (NC)

The internal jumper wire directly connects Pin 3 and Pin 7. This jumper is typically wired in series with the primary winding of the power supply transformer. When the 0C3 is removed from its socket, this connection is broken, automatically shutting off the power supply to protect associated equipment and prevent high unregulated voltages from damaging the circuit.

Electrical Characteristics and Operating Conditions

The 0C3 is characterized by a nominal operating voltage (anode voltage drop) of approximately 105 to 108 volts. To initiate the glow discharge, a starting voltage (breakdown voltage) must be applied.

Key Electrical Parameters

- **DC Anode Supply Voltage (Minimum):** 133 V. This is the minimum voltage that the supply must be capable of delivering to guarantee reliable starting (ionization) of the tube throughout its operating life.
- **DC Starting Voltage (Approximate):** 115 V (with a bogey value of 115 V and a maximum breakdown limit of 133 V).
- **DC Operating Voltage (Anode Voltage Drop):** Typically 105 V to 108 V. Under standard operating conditions, the voltage drop is specified as 103 V minimum, 108 V bogey, and 116 V maximum.
- **DC Cathode Current Range (Continuous):**
 - **Minimum:** 5.0 mA. Operating below this limit can cause erratic regulation.
 - **Maximum:** 40 mA. Operating above this limit results in shortened tube life and poor regulation.
- **Regulation:**
 - **5 to 30 mA Range:** Typically 1.0 V.
 - **5 to 40 mA Range:** Typically 2.0 V (with a maximum limit of 4.0 V).
- **Ambient Temperature Range:** -55 °C to +90 °C.

Transient and Starting Ratings

- **Maximum Average Starting Current:** 100 mA.
- **Maximum Averaging Time:** 10 seconds. This rating allows for a temporary surge of current (up to 100 mA) during the initial 5 to 10 seconds when associated equipment is warming up and not yet drawing its normal plate current. This starting period must be followed by a steady-state operating period of at least several minutes.

Theory of Operation and Circuit Applications

Glow Discharge vs. Arc Discharge

Two types of discharge are possible in a glow tube. A glow discharge, which is a uniform glow covering all or part of the cathode surface, occurs when the current carried by the tube is low. Under these conditions, the tube drop is essentially independent of the current. This is the condition under which the 0C3

normally operates. The exact voltage drop across the tube depends upon the electrode spacing and the type and amount of gas used.

If the current through the tube is increased beyond a certain point, the tube will go into an arc discharge. Under these conditions, a cathode spot rather than a uniform cathode glow appears on the cathode, and the tube drop decreases to a rather low value (10 to 20 volts). The 0C3 must not be operated so that an arc discharge takes place, as the life of the tube will be materially shortened.

Voltage Regulator Circuits

The primary application of the 0C3 is as a shunt voltage regulator. In a typical configuration, a series resistor is placed between the unregulated DC source and the anode of the 0C3. The load is connected in parallel with the 0C3 (across the cathode and anode). The series resistor must be of a value that will limit the current through the glow tube to the maximum rated current under continuous (steady-state) operating conditions. It is also desirable to furnish a high enough voltage from the DC supply so that the current through the glow tube does not drop below the minimum rating.

Series Connection for Higher Voltages

Glow tubes may be used in series to provide higher regulated voltages than are available from one tube. These tubes need not be the same type; the only requirement is that the current must be limited so that it falls within the operating range of the combination. For example, if a GL-OA3 (which has a 40 mA maximum current) and a GL-OB3 (which has a 30 mA maximum current) are used in series, the current through the series combination must be limited to 30 milliamperes maximum.

Parallel Operation

Operation of glow tubes in parallel is not recommended.

Relaxation Oscillators

A second application of the glow tube is the relaxation oscillator. In this type of circuit, a current charges a capacitor. In parallel with the capacitor is a glow tube, which will break down when the voltage on the capacitor reaches the voltage breakdown point of the glow tube. The frequency of this action may be varied by changing the capacitance or type of glow tube.

Installation and Operating Considerations

To ensure stable and reliable performance, several practical factors must be observed during installation and operation:

- **Series Resistance:** Sufficient resistance must always be used in series with each of these tubes to limit the current through the tube to the maximum rated value under continuous (steady-state) operating conditions. Unless this precaution is observed, tube performance will be impaired.
- **Regulation Drift and History:** In voltage-regulator tubes of the glow-discharge type, regulation is somewhat dependent on past operating conditions. For example, the regulation value of a tube operated for a protracted period at 5 milliamperes and then changed to 35 milliamperes may be

somewhat different from the value that will be obtained after a long period of operation at 35 milliamperes. Likewise, the regulation value may change somewhat after a long idle period.

Technical Summary

The **0C3** is an octal, cold-cathode, glow-discharge voltage regulator designed to provide a stable DC voltage source of approximately 105 to 108 volts. Operating over a continuous current range of 5.0 to 40 mA, it features a built-in safety jumper to protect associated circuitry upon tube removal. With its ability to be stacked in series for higher voltage requirements or configured as a relaxation oscillator, the 0C3 is a highly reliable component for analog power regulation and voltage stabilization.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1950 General Electric Transmitting Types

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

1950 GENERAL ELECTRIC TRANSMITTING TYPES

Section 1 · Voltage Regulator

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum average starting current	100 mA	10 second averaging time



SOURCE OPERATING CONDITIONS

1953 RFT Rundfunk Technik

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

1953 RFT RUNDFUNK TECHNIK

Section 1 · Voltage Regulator

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
RegulatorVoltage	108 V	—
RegulatorCurrentMinimum	5 mA	—
RegulatorCurrentMaximum	40 mA	—
RegulatorStartingVoltage	133 V	—
RegulatorMaintainingVoltage	108 V	—
RegulatorDynamicImpedance	100 ohm	—



195X General Electric Essential Characteristics

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

195X GENERAL ELECTRIC ESSENTIAL CHARACTERISTICS

Section 1 · Voltage Regulator

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Minimum anode supply voltage	133 V	VoltageRegulatorService
Maximum operating current	40 mA	VoltageRegulatorService

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Minimum operating current	5 mA	VoltageRegulatorService
Operating voltage	105 V	VoltageRegulatorService
Ionization voltage	115 V	VoltageRegulatorService
Regulation	2 V	5 to 40 mA



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

195X Raytheon Special Purpose Tubes

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

195X RAYTHEON SPECIAL PURPOSE TUBES

Section 1 · Voltage Regulator

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Operating voltage	105 V	—
Maximum regulation	4 V	5to40mA

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Minimum operating current	5 mA	—

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum operating current	40 mA	—
Minimum starting-voltage supply	133 V	—


SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

1961 Tung Sol

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

1961 TUNG SOL

Section 1 · Voltage Regulator

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Regulation	1 V	5 to 30 mA


SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1966 Tung Sol Electronic Tubes 1 of 4

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

1966 TUNG SOL ELECTRONIC TUBES 1 OF 4

Section 1 · Voltage Regulator

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC operating voltage	105 V	—
DC operating current minimum	5— mA	—
DC operating current maximum	—40 mA	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
DC starting voltage	135 V	Approximate
Voltage regulation	—5 V	Ia=5-40mA