RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

5644

RELIABLE SUBMINIATURE VOLTAGE REGULATOR

The 5644 is a cold cathode, gas-filled diode of subminiature construction designed for service as a voltage regulator. It has an operating current range of 5 to 25 milliamperes over which it maintains a substantially constant operating voltage of approximately 90 volts. Three cathode leads are provided which may be used to disconnect the load when the tube is removed from the socket. This type is characterized by long life and it is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered, or welded directly to the terminals of circuit components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450	G
Uniform Acceleration (Centrifuge Test)	1000	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	220	°C
Altitude	80,000	Ft.

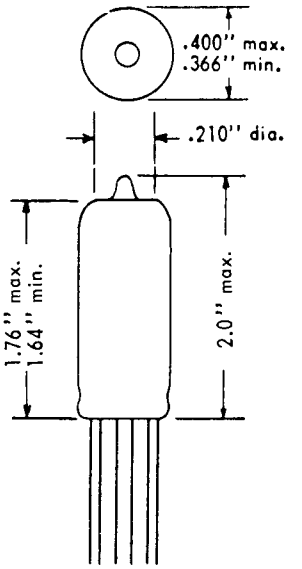
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Units
Supply Voltage	---	180	---	---	---	Vdc
Ionization Voltage (2) (Total Darkness) (5-25 mAdc)	Ez	---	125	---	175	Vdc
Ionization Voltage (1) (5-50 ft. Candles) (5-25 mAdc)	Ez	---	113	---	120	Vdc
Current Range	Ib	5	---	---	25	mAdc
Tube Voltage Drop (1) (25 mAdc)	Etd	85	90	---	105	Vdc
Operating Voltage	---	82	---	---	108	Vdc
Tube Voltage Drop (2) (5 mAdc)	Etd	85	89	---	105	Vdc
Regulation (25-5 mAdc)	Reg	---	1.0	---	±5.0	Vdc
Noise (25 mAdc)	Eb	---	---	---	15	mVac
Leakage	Ilb	---	---	---	10	μAdc

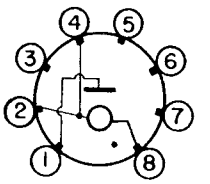
MECHANICAL DATA

ENVELOPE ..... Glass T-3
OUTLINE ..... JEDEC (3-4)
BASE: .. Subminiature 8-Pin with long leads (.017" +.002"-.001" Length =1.5" min.
BASING 4CN
CATHODE .... Glow Discharge
MOUNTING POSITION .... Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1 Plate
Pin 2 Cathode
Pin 3 No Connection
Pin 4 Cathode
Pin 5 No Connection
Pin 6 No Connection
Pin 7 No Connection
Pin 8 Cathode

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test – 450 G. 30° hammer angle in Navy High Impact Shock Machine. Sample subjected to five impact accelerations in each of four different positions.

Fatigue Test – 2.5 G. Sample subjected to vibrational acceleration of 2.5 G for 32 hours minimum in each of three different positions. The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability and freedom from inoperatives. Tubes are operated under the following conditions: Ebb/Ib = 25 mAdc; T_B = 220°C.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 220°C. under Survival Rate Life Test Conditions.

Altitude – Sample is subjected to pressure of 21 ± 2 mm Hg to evaluate flashover or corona at the press of the tube.

APPLICATION NOTES

Attention should be given to the specified minimum supply voltage to insure operation in darkness.

A series resistor must always be used with the 5644. The resistance value must be chosen so that the maximum current is not exceeded at the highest anode supply voltage and so that the minimum current rating is always exceeded at the lowest anode supply voltage.

When a shunt capacitor is used its maximum value should be limited to 0.1 μf. A large value may cause the tube to oscillate and this results in unstable performance.

Special attention should be given to the envelope temperature of the tubes. Reliability may be severely impaired if the maximum envelope temperature is exceeded.

Tube characteristics may deteriorate markedly if the tubes are stored at elevated ambient temperature without drawing current.

To insure minimum voltage drift, a warm-up period of 3 minutes should be allowed each time the equipment is turned on. After this time the bulb temperature should have reached equilibrium level.

The type 5644 should not be regarded as a source of standard voltage. Slow changes in voltage occur in this type during life and also during the first 15 minutes of operation following inactive periods.

ACCEPTANCE CRITERIA

The following tests shall be performed:

For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.

For miscellaneous requirements, see 3.6.

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS					Units
						Min	Lal	Typical	Ual	Max	
	QUALIFICATION APPROVAL TESTS										
3.1	Qualification Approval:	Required for JAN Marking	---	---	---	---	---	---	---	---	---
---	Cathode	Glow Discharge	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections		---	---	---	---	---	---	---	---	---
	MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 1										
4.13.1	× Ionization Voltage(1):	Ebb/Ib = 5–25mAdc; Illumination = 5–50 ft candles	0.65	II	Ez	---	---	113	---	120	Vdc
4.13.2	Tube Voltage Drop(1)	Ebb/Ib = 25 mAdc	0.65	II	Etd	85	---	90	---	105	Vdc
4.13.2	Tube Voltage Drop(2)	Ebb/Ib = 5 mAdc	0.65	II	Etd	85	---	89	---	105	Vdc
4.13.2.1	Regulation:	(1) Etd–(2) (Etd)	0.65	II	Reg.	---	---	1	---	±5.0	Vdc
4.7.5	Continuity and Shorts (Inoperatives)		0.4	II	---	---	---	---	---	---	---
4.9.1	Mechanical production tests	Envelope Outline No 8–5	---	---	---	---	---	---	---	---	---
	MEASUREMENTS ACCEPTANCE TEST, PART 2										
4.13.4.3	Noise test	Ebb/Ib = 25 mAdc	2.5	I	Eb:	---	---	<2	---	15	mVac
4.13.4.2	Oscillation test	Esig = 15 mVac; Ebb/Ib = 5–25 mAdc	2.5	I	---	---	---	---	---	---	---
4.13.1	Ionization Voltage(2):	Ebb/Ib = 5–25 mAdc Note 3	6.5	Code F	Ez	---	---	125	---	175	Vdc
4.13.3	Leakage Current	Eb = 50 Vdc	6.5	Code F	Llb	---	---	<1	---	10	μAdc
4.9.20.3	Vibration Note 2,6	No Voltages	10			---	---	---	---	---	---
	DEGRADATION RATE ACCEPTANCE TESTS, NOTE 7										
4.9.5.3	Subminiature Lead Fatigue	Note 4	2.5	Code G	---	4	---	---	---	---	arcs
4.9.20.5	Shock test	Hammer Angle = 30° Note 5	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G = 2.5; Fixed Freq.; F = 25 min., 60 max.	6.5	Note 6	---	---	---	---	---	---	---
---	Post Shock and Fatigue Test End Points:		---	---	---	---	---	---	---	---	---
		Ionization Voltage(1)	---	---	Ez	---	---	113	---	130	Vdc
		Tube Voltage Drop(1)	---	---	Etd	82	---	90	---	108	Vdc
		Tube Voltage Drop(2)	---	---	Etd	82	---	89	---	108	Vdc
		Regulation	---	---	Reg.	---	---	1	---	±5	Vdc
---	Glass Strain	Note 8	2.5	I	---	---	---	---	---	---	---

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS		Units
					1st sample	Combined sample		Min	Max	
ACCEPTANCE LIFE TESTS, NOTE 7										
	Survival Rate Life Test	Intermittent Life Test, Conditions or Equivalent, Note 10, TA = Room	---	II	---	---	---	---	---	---
4.11.4	Survival Rate Life Test End Points	Continuity and Shorts (In-operatives)	0.65	---	---	---	---	---	---	---

MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or	Allowable defectives per characteristic		Sym.	LIMITS			Units
					1st sample	Combined sample		Min	Typical	Max.	
4.11.5	Intermittent Life Test	Ebb/Ib = 25 mAdc T Envelope = 220 °C min.; Notes 11, 12	---	---	---	---	---	---	---	---	---
4.11.4	Intermittent Life Test End Points (500 hours)	Note 13									
		Inoperatives; Note 14	---	---	1	3	---	---	---	---	---
		Regulation	---	---	1	3	Reg	---	2	5.0	Vdc
		Tube Voltage Drop (1)	---	---	1	3	Etd	82	91	108	Vdc
		Tube Voltage Drop (2)	---	---	1	3	Etd	82	89	108	Vdc
		Ionization Voltage (1)	---	---	1	3	Ez	---	113	125	Vdc
		Total Defectives	---	---	4	8	---	---	---	---	---
4.11.5	Information Life Test:	Intermittent Life Test Conditions: Notes 12, 9	---	---	---	---	---	---	---	---	---
4.11.4	Information Life Test End Points: (1000 hours)	Note 9	---	---	---	---	---	---	---	---	---
	PACKAGING REQUIREMENTS										
4.9.18.1.4	Container Drop:	(d) Package Group 1; Container Size D									

Note 1: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical, shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 2: Post Shock and Fatigue Test End Points shall apply.

Note 3: Conditions for this test shall be those of Ionization Voltage (1) except testing shall be done in total darkness and the tube shall not have conducted or been exposed to light for at least 24 hours prior to testing. The tube shall fire within 20 seconds maximum.

Note 4: When a manufacturer submits tubes for Qualification Approval, five (5) extra tubes shall be submitted for lead fatigue testing. These may be electrical rejects.

Note 5: Leads may be clipped for application of voltages during impact.

Note 6: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. MIL–STD–105, sample size code letter F shall apply.

Note 7: Destructive Tests:

Tubes subject to the following destructive tests are not to be accepted under this specification.

4.9.5.3	Subminiature Lead Fatigue
4.9.20.5	Shock
4.9.20.6	Fatigue
4.11.5	Intermittent Life Test

Note 8: Glass strain procedures – All tubes subjected to this test shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperatures. The entire tube shall be immersed in water at not less than 97°C for 15 seconds and immediately thereafter immersed in water at not more than 5°C for 5 seconds. The volume of water shall be large enough that the water temperature will not be appreciably affected by the test. The holder shall be in accordance with Drawing #245–JAN, and the tubes shall be immersed quickly. The tubes shall be so placed in the water that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5-second submersion period the tubes shall be removed and allowed to return to room temperature on a wooden surface. After drying at room temperature for a period of 48 hours, the tubes shall be inspected and rejected for evidence of air leaks (see 4.7.6). Electrical rejects, other than inoperatives, may be used in the performance of this test.

Note 9: Information life test shall be conducted on a minimum of one sample of ten tubes each month of production. This sample shall be selected as the first ten serially marked, noninoperative tubes from a completed Intermittent Life Test sample. This life test shall be classified as a destructive test. Read at 1000 hours. On Information Life Tests, read same characteristics as Intermittent Life Test. Limits do not apply. This test shall not be a basis for lot acceptance. Six copies of these data will be forwarded to the Armed Services Electron Tube Committee.

Note 10: *Survival-rate life test.* See 20.2.5.2 to 20.2.5.2.4, inclusive, of Appendix C.

Note 11: *Intermittent life tests.* See 20.2.5.3 of Appendix C.

Note 12: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or small diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope.

Note 13: *Order for evaluation of life-test defects.* See 4.11.3.1.2.

Note 14: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: discontinuity (see 4.7.1), shorts (see 4.7.2) air leaks (see 4.7.6).