



TECHNICAL
INFORMATION
SERVICE

Technical Information

OB2WA

RELIABLE MINIATURE
VOLTAGE REGULATOR

The OB2WA is a cold cathode, gas-filled diode of miniature construction designed for service as a voltage regulator. It has an operating current range of 5 to 30 milliamperes over which it maintains a substantially constant operating voltage of 108 volts. Three cathode pins 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.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration	900	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	150	°C
Altitude	120,000	Ft.

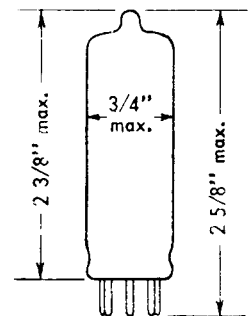
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Absolute Minimum	Normal Operation	Normal Test Conditions	Absolute Maximum	MIL-E-1 Units
Supply Voltage	---	130	---	---	---	Vdc
Ionization Voltage (Total Darkness)	Ez	---	123	---	130	Vdc
Ionization Voltage (5-50 ft. Candles)	Ez	---	118	---	130	Vdc
Current Range	I _b	5	---	---	30	mAdc
Tube Voltage Drop (30 mAdc)	E _{td}	105	109	---	111	Vdc
Tube Voltage Drop (20 mAdc)	E _{td}	105	108.5	---	111	Vdc
Tube Voltage Drop (5 mAdc)	E _{td}	105	108	---	111	Vdc
Regulation (5-30 mAdc)	---	---	±1	---	±2.5	Vdc
Noise (30 mAdc)	---	---	<1	---	5	mVac
Voltage Jump (6-10 mAdc)	---	---	<10	---	100	mVdc
Repeatability (10 mAdc)	---	---	300	---	600	mVdc
Leakage	---	---	<1	---	5	μAdc
Vibration	---	--	<10	---	100	mVac

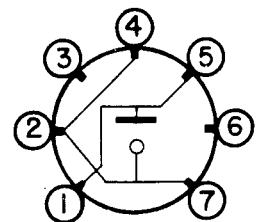
MECHANICAL DATA

ENVELOPEGlass T 5½
OUTLINEJEDEC (6-5)
BASE...7 Pin Miniature (E7-1)
BASING 5B0
CATHODE Glow Discharge
MOUNTING POSITION Any

PHYSICAL DIMENSIONS



BASING



BOTTOM VIEW

TERMINAL CONNECTIONS:

Lead 1 Anode
Lead 2 Cathode
Lead 3 Internal Connection
Lead 4 Cathode
Lead 5 Anode
Lead 6 Internal Connection
Lead 7 Cathode



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SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY

Randomly selected statistical samples are subjected to the following tests.

Shock Test —	900 G. 60° 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.
Stability Life Test —	Sample is operated for one hour to evaluate mechanical inoperatives and initial electrical stability ($\Delta E_{td} < 2.0$ Vdc max.).
Survival Rate Life Test —	Sample is operated one hundred hours to evaluate mechanical inoperatives and early life electrical stability ($\Delta E_{td} < 3.0$ Vdc max.)
Intermittent Life Test —	1000 hours. Sample is operated with minimum Envelope Temperature of 150°C.
Altitude —	Sample is subjected to pressure of 3.1 ± 0.2 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 OB2WA. The resistance value must be chosen so 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 μ f. 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.

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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					
						Min	Lal	Typical	Ual	Max	Units
QUALIFICATION APPROVAL TESTS											
3.1	Qualification Approval:	Required for JAN Marking	---	---	---	---	---	---	---	---	---
---	Cathode	Glow Discharge	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	E7-1	---	---	---	---	---	---	---	---	---
4.9.20.3	Vibration (1):	R _p = 10,000; Ebb/Ib = 20 mAdc	---	---	Ep	---	---	< 10	---	100	mVac
MEASUREMENTS ACCEPTANCE TESTS, PART 1, NOTE 1											
4.13.1	x Ionization Voltage(1):	Ebb/= 5-30 mAdc; Illumination= 5-50 ft candles	0.25	II	Ez	---	---	118	---	130	Vdc
4.13.2	Tube Voltage Drop (1)	Ebb/Ib= 30 mAdc	0.25	II	Etd	105	---	109	---	111	Vdc
4.13.2	Tube Voltage Drop (2)	Ebb/Ib= 5 mAdc	0.25	II	Etd	105	---	108	---	111	Vdc
4.13.2.1	Regulation:	(1) Etd-(2)(Etd)	0.25	II	Reg.	---	---	± 1	---	± 2.5	Vdc
4.7.5	Continuity and Shorts (Inoperatives)		0.25	II	---	---	---	---	---	---	---
4.9.1	Mechanical production tests	Envelope Outline No 6-5	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TEST, PART 2											
4.13.4.3	Noise test	Ebb/Ib= 30 mAdc	1.0	I	Eb:	---	---	< 1	---	5	mVac
4.13.4.2	Oscillation test	Esig= 100 mVac; Ebb/Ib= 5-30 mAdc	1.0	I	---	---	---	---	---	---	---
---	Voltage Jump	Ebb/Ib= 6-10 mAdc; Note 2	2.5	Code G	Jump	---	---	< 10	---	100	mVdc
4.13.1	Ionization Voltage (2):	Note 3	2.5	Code G	Ez	---	---	123	---	130	Vdc
4.13.3	Leakage Current	Eb= 50 Vdc; R _p = 3000	2.5	Code G	Llb	---	---	< 1	---	5	μAdc
4.13.2	Tube Voltage Drop (3)	Ebb/Ib= 20 mAdc	2.5	Code G	Etd	105	---	108	---	111	Vdc
---	Repeatability	Ebb/Ib= 10 mAdc; Note 4	2.5	Code G	Etd	---	---	300	---	600	mVdc
---	Low Pressure Voltage Breakdown:	Note 5	6.5	Note 6	---	---	---	---	---	---	---
4.9.19.1	Vibration (2)	R _p = 10,000; Ebb/Ib= 20 mAdc	2.5	Code G	Ep	---	---	< 10	---	100	mVac
DEGRADATION RATE ACCEPTANCE TESTS, NOTE 7											
4.9.20.5	Shock test	Hammer Angle= 60°	---	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue test	G=2.5; Fixed Freq.; F=25 min., 60 max.	2.5	Note 6	---	---	---	---	---	---	---
---	Post Shock and Fatigue Test End Points:	Vibration (2)	---	---	Ez	---	---	---	---	100	mVac
		Ionization Voltage (1)	---	---	Ez	---	---	122	---	130	Vdc
		Tube Voltage Drop (1)	---	---	Etd	103	---	109	---	113	Vdc
		Tube Voltage Drop (2)	---	---	Etd	103	---	108	---	113	Vdc
		Regulation	---	---	Reg	---	---	1	---	± 3	Vdc



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MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS					
						Min	Lal	Typical	Ual	Max	Units
4.9.6.1	Miniature Tube Base Strain:		---	---	---	---	---	---	---	---	---
----	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										
4.11.3.1	Stability Life Test (1 hour)	Ebb/Ib=20 mAdc; TA=Room; Note 9	1.0	Code I	---	---	---	---	---	---
4.11.4	Stability Life Test End Points	Change in Tube Voltage Drop (3) of individual tubes	---	---	---	---	$\Delta_t E_{td}$	---	2	Vdc
4.11.3.1	Survival Rate Life Test (100 hours)	Stability Life Test Conditions or E- quivalent, Note 10	---	II	---	---	---	---	---	---
4.11.4	Survival Rate Life Test End Points	Continuity and Shorts (Inoperatives)	0.65	---	---	---	---	---	---	---
		Change in Tube Voltage Drop (3) of individual tubes	1.0	---	---	---	$\Delta_t E_{td}$	---	3	Vdc

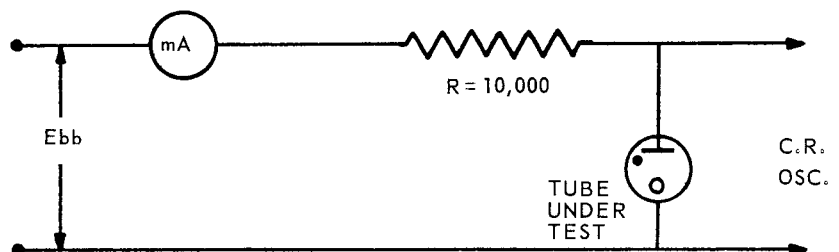
MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS			Units
					1st sample	Combined sample		Min	Typ-ical	Max.	
4.11.5	Intermittent Life Test	Stability Life Test Conditions or E-equivalent; T _{En-velope} =150°C min.; Notes 11, 12	---	---	---	---	---	---	---	---	---
4.11.4	Intermittent Life Test End Points (500 hours)	Note 13 Inoperatives; Note 14	---	---	1	3	---	---	---	---	---
		Regulation	---	---	1	3	Reg	---	±1.0	±3	Vdc
		Tube Voltage Drop (1)	---	---	1	3	Etd	103	109	113	Vdc
		Tube Voltage Drop (2)	---	---	1	3	Etd	103	108.5	113	Vdc
		Tube Voltage Drop (3)	---	---	1	3	Etd	103	108	113	Vdc
		Change in Tube Voltage Drop (3) of individual tubes	---	---	1	3	$\Delta_t E_{td}$	---	---	4.0	Vdc
		Ionization Voltage (1)	---	---	1	3	Ez	---	---	130	Vdc
		Total Defectives	---	---	4	8	---	---	---	---	---

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MIL-E-1 Ref.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable defectives per characteristic		Sym.	LIMITS			Units
					1st sample	Combined sample		Min	Typ- ical	Max	
4.11.4	Intermittent Life Test End Points (1000 hours)	Note 13	---	---	2	5	---	---	---	---	---
		Inoperatives; Note 14	---	---	2	5	Reg	---	± 1.0	± 4	Vdc
		Regulation	---	---	2	5	Etd	103	109	116	Vdc
		Tube Voltage Drop (1)	---	---	2	5	Etd	103	108.5	116	Vdc
		Tube Voltage Drop (2)	---	---	2	5	Etd	103	108	116	Vdc
		Tube Voltage Drop (3)	---	---	2	5	Δ_t Etd	---	---	5.0	Vdc
		Change in Tube Voltage Drop (3) of individual tubes	---	---	2	5	Ez	---	122	130	Vdc
		Ionization Volt- age (1)	---	---	5	10	---	---	---	---	
		Total Defectives	---	---	5	10	---	---	---	---	
PACKAGING REQUIREMENTS											
4.9.18.1.4	Container Drop:	(d) Package Group 1; Container Size C									

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: Vary current from 6 mA_{dc} to 10 mA_{dc} and back (by adjusting Ebb slowly). Sudden voltage jumps registered on the oscilloscope shall be not greater than the specified value.



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: The tube shall be tested in the following manner.

- The voltage drop shall be read at 10 mA_{dc} drain.
- The tube shall be turned off for one (1) minute.
- The tube shall be re-started and operated at the same current.
- Etd shall be read after one (1) minute of operation.
- The on-off cycle shall be repeated a minimum of five (5) times. The maximum difference in tube voltage drop shall be taken as the measure of repeatability.

Note 5: Place tube under test in a Bell jar with pressure maintained at 3.1 ± 0.2 mm Hg. Apply a potential of 200 Vdc to the Vdc to the K and A terminals through a variable series resistor. Adjust resistor to give a current of 20.0 mA_{dc}. There shall be no evidence of flashover or corona at the pins of the tube.



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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.

4.9.20.5	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: *Stability life test.* See 20.2.5.1 of Appendix C.

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).