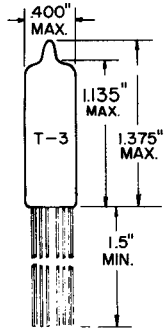
TUNG-SOL



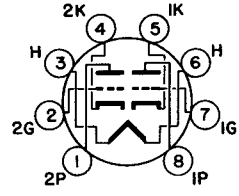
GLASS BULB
SUBMINIATURE BUTTON
8 PIN BASE E8-10
0.17" TINNED
FLEXIBLE LEADS
OUTLINE DRAWING
JEDEC 3-1

TWIN TRIODE

SUBMINIATURE TYPE

HEATER

ANY MOUNTING POSITION



BOTTOM VIEW
BASING DIAGRAM
JEDEC 8DG

THE 6111WA IS A HEATER-CATHODE TYPE MEDIUM-MU TWIN TRIODE CAPABLE OF OPERATION IN THE UHF REGION. IT IS OF SUBMINIATURE CONSTRUCTION AND DESIGNED FOR SERVICE WHERE SEVERE CONDITIONS OF HIGH TEMPERATURE AND MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED.

RATINGS
MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGUE TEST NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS
AND NORMAL OPERATION

	MIL-E-1 SYMBOL	DES. MIN.	NORM. TEST CONDITIONS NOTE 7	NORM. OPERATION NOTE 6	DES. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	V
PLATE VOLTAGE	Eb:	---	100	100	250	Vdc
PEAK PLATE VOLTAGE	eb:	---	---	---	360	v
GRID #1 VOLTAGE	Ec1:	-55	0	0	---	Vdc
PLATE DISSIPATION (PER PL.)	Pp/p:	---	---	0.85	0.95	W
GRID #1 CIRCUIT RESISTANCE	Rg/g:	---	---	1.0	1.1	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	100	+200	v
PLATE CURRENT (PER PLATE)	Ib/p:	0.5	---	8.5	22	mAdc
GRID CURRENT (PER GRID)	Ic/c:	---	---	---	5.5	mAdc
CATHODE RESISTANCE (PER UNIT)	Rk:	---	220	220	---	OHMS
TRANSCONDUCTANCE (PER PLATE)	Sm/p:	---	---	5000	---	μMHOS
AMPLIFICATION FACTOR	Mu/p:	---	---	20	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS, PART 1									
		COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES.							
HEATER CURRENT:	0.4	If:	285	---	---	---	315	---	mA
HEATER–CATHODE LEAKAGE (1):									
Ehk=+100 Vdc	0.4	Ihk(1):	---	---	---	---	3.5	---	μAdc
Ehk=-100 Vdc		Ihk(1):	---	---	---	---	3.5	---	μAdc
GRID CURRENT:									
Rg=1.0 MEG.	0.4	Ic(1):	---	---	---	---	-0.3	---	μAdc
PLATE CURRENT (1):	0.4	Ib(1):	6.0	7.5	8.5	9.5	11.0	2.8	mAdc
PLATE CURRENT (2):									
Ec1=-9.0 Vdc	0.4	Ib(2):	---	---	---	---	100	---	μAdc
TRANSCONDUCTANCE (1):	0.4	Sm(1):	4100	4650	→5000	5350	5900	1000	μMHOS
CONTINUITY AND SHORTS (INOPERATIVES): (NOTE 11)	0.4	---	---	---	---	---	---	---	---
MECHANICAL: ENVELOPE (8-1)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS, PART 2									
INSULATION OF ELECTRODES: Ef=6.3V									
Eg-all=-100 Vdc	2.5	Rg1-all:	250	---	---	---	---	---	MEG.
Ep-all=-300Vdc		Rp-all:	250	---	---	---	---	---	MEG.
PLATE CURRENT (1) DIFFERENCE BETWEEN SECTIONS:	2.5	Δib:	---	---	---	---	1.5	---	mAdc
TRANSCONDUCTANCE (2): Ef=5.7 V (NOTE 9)	2.5	Δ_{Ef}Sm(2):	---	---	---	---	10	---	PERCENT
GRID EMISSION: Ef=7.5 V; Rg/g=1.0 MEG.; Eb=250 Vdc; Rk/k=2900 OHMS PREHEAT 5 MIN. AT Ec1=0, TEST AT Ec1=-20 Vdc	6.5	Isc1:	---	---	---	---	-0.5	---	μAdc
AF NOISE: Esig=65 mVac; Rg1= 0.1 MEG.; Rp=0.01 MEG.; Rk=100 OHMS; Ck=1000μf UNITS CONNECTED IN PARALLEL	2.5	EB:	---	---	---	---	17	---	VU
AMPLIFICATION FACTOR:	6.5	Mu:	17	---	20	---	23	---	---
PULSE EMISSION (1): Eb=150 Vdc; Ec1 =-25 Vdc; tp=10 μsec; DUTY CYCLE= 1%; egk=+30 V; Rk/k=1.0 OHM; (NOTE 12)	2.5	ik:	320	---	---	---	---	---	ma
		Δ_{tp}ik:	---	---	---	---	10	---	PERCENT
PULSE EMISSION (2): Ef=5.9 V; Eb=150 Vdc; Ec1=-25 Vdc; tp=10μsec DUTY CYCLE =1%; egk=+30 V; Rk/k =1.0 OHM; (NOTE 12)	6.5	ik:	300	---	---	---	---	---	ma

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→INDICATES A CHANGE.

TUNG-SOL

CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

IN THE FOLLOWING TEST EACH UNIT IS TESTED SEPARATELY

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 - CONT'D.									
HEATER-CATHODE LEAKAGE (2): Ef=-6.7 V(PIN 6 NEG.); Ehk=+100 Vdc;(CATHODE NEGATIVE); t=16 SEC. (NOTE 13)	6.5	Ihk(2):	---	---	---	---	1.0	---	μAdc
CAPACITANCE:		Cgp:	1.2	---	1.5	---	1.8	---	μμf
CAPACITANCE:		Cin:	1.4	---	1.9	---	2.4	---	μμf
CAPACITANCE (NOTE2)	6.5	Cout (UNIT #1)	0.20	---	0.28	---	0.36	---	μμf
CAPACITANCE		Cout (UNIT #2)	0.22	---	0.32	---	0.42	---	μμf
CAPACITANCE		Cgg:	---	---	---	---	0.011	---	μμf
CAPACITANCE:		Cpp:	---	---	---	---	0.50	---	μμf

MEASUREMENTS ACCEPTANCE TESTS, PART 2 cont'd.	ALLOWABLE DEF. PER CHARAC. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
OPERATION TIME: (NOTE 10)	---	---	4.0	t:	---	20	SEC.
LOW PRESSURE VOLTAGE BREAKDOWN: PRESSURE =21 ±3 mmHg; VOLTAGE = 300 Vac.	---	---	6.5	---	---	---	---
VIBRATION (2): F=40 cps; G=15; Rp= 10,000 OHMS	---	---	2.5	Ep:	---	20	mVac
VIBRATION (3): F=70-2000cps G=10; Rp=10,000 OHMS. POSITIONS X_1 AND X_2 ONLY.	---	---	6.5	ep:	---	125 PEAK TO PEAK	mv.
DEGRADATION RATE ACCEPTANCE TESTS							
SUBMINIATURE LEAD FATIGUE:	---	---	2.5	---	4.0	---	arcs
SHOCK (1): Ehk=+100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE = 30°; (NOTE 3)	---	---	20	---	---	---	---
FATIGUE (1): 96 HOURS; G=2.5; FIXED FREQUENCY; F=25 MIN., 60 MAX. (NOTE 5)	---	---	6.5	---	---	---	---
SHOCK (2): Ehk=100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE=120°+RUBBER PAD; t=10 MILLISECONDS; G=75; (NOTE 15)	---	---	20	---	---	---	---
FATIGUE (2): 6 HOURS; G=10; F=130-2000-130 cps (NOTE 14)	---	---	6.5	---	---	---	---
POST SHOCK TESTS (1) & (2) AND FATIGUE TESTS (1) & (2) END POINTS: VIBRATION (2): F=40cps; G=15; Rp= 10,000 OHMS			---	Ep:	---	80	mVac

TENTATIVE DATA

TUNG-SOL

CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC.		AQL	MIL-E-1	MIN	MAX	MIL-E-1
DEGRADATION RATE ACCEPTANCE TESTS (CONT'D.)	1st SAMP.	COMB. SAMP.	%				
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	7	μAdc
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:							
Ef=6.3 V	---	---	---	Δ_tSm(1).	---	15	PERCENT
GRID CURRENT (1):	---	---	---	Ic(1):	---	-1.0	μAdc
GLASS STRAIN (THERMAL SHOCK).	---	---	6.5	---	---	---	---
ACCEPTANCE LIFE TEST							
HEATER CYCLING LIFE TEST: Ef=7.0V; Eb=Ec=0V; Ehk=140 Vac; 1 MIN. ON, 4 MIN. OFF	---	---	1.0	---	2000	---	CYCLES
HEATER CYCLING LIFE TEST END POINTS:							
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
Ehk=-100 Vdc	---	---	---	Ihk(1):	---	7	μAdc
2 & 20 HOUR STABILITY LIFE TEST: TA=ROOM; Ehk=+200 Vdc; Rg/g= 1.0 MEG.	---	---	---	---	---	---	---
2 & 20 HOUR STABILITY LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 50 TUBES)	---	---	---	---	---	---	---
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:	---	---	1.0	Δ_tSm(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA = ROOM; Ehk=+200 Vdc; Rg/g =1.0 MEG.	---	---	---	---	---	---	---
100 HOUR SURVIVAL RATE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 200 TUBES)	---	---	---	---	---	---	---
CONTINUITY AND SHORTS (INOPERATIVES:	---	---	0.65	---	---	---	---
TRANSCONDUCTANCE (1):	---	---	1.0	Sm(1):	3750	---	μMHOS
200 HOUR INTERMITTENT LIFE TEST (1): Eb=250 Vdc Ec1=0 Vdc; Ehk=+200 Vdc; Rg/g=1.0 MEG.; Rk/k= 2900 OHMS; TA = ROOM							
200 INTERMITTENT LIFE TEST (1) END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic1:	---	-0.9	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
CHANGE IN TRANSCONDUCTANCE (1) OF INDIVIDUAL TUBES:	1	3	---	Δ_t Sm(1):	---	25	PERCENT

TUNG-SOL

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CHARACTERISTICS AND QUALITY CONTROL TESTS cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st COMB.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (cont'd.)							
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef}Sm(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES:							
g-all	1	3	---	Rg-all:	100	---	MEG.
p-all			---	Rp-all:	100	---	MEG.
TOTAL DEFECTIVES:	3	6	---	---	---	---	---
500 HOUR INTERMITTENT PULSE LIFE TEST: Eb=250 Vdc; Ec1=-25 Vdc; Rk/k=0; Rl/p=330 OHMS; tp=10 μsec; DUTY CYCLE = 1.0 %; egk=+ 30±1 VOLTS; TA = ROOM							
500 HOUR INTERMITTENT PULSE LIFE TEST END POINTS: (TYPICAL SAMPLSE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
PULSE EMISSION:	1	3	---	ik:	300	---	mA
CHANGE IN PULSE EMISSION OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δik:	---	-35	PERCENT
			---	Δik:	---	+50	PERCENT
TOTAL DEFECTIVES:	2	5	---	---	---	---	---
INTERMITTENT HIGH TEMPERATURE LIFE TEST (2): T BULB =220° C; Ehk=+200 Vdc; Rg/g=1.0 MEG.	---	---	---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST (2) END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)	---	---	---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-0.7	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE IN INDIVIDUAL TUBES FROM INITIAL:	1	3	---	$\Delta_t Sm(1)$:	---	20	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef}Sm(2)$:	---	15	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc

TUNG-SOL

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CHARACTERISTICS AND QUALITY CONTROL TEST cont'd.

IN THE FOLLOWING TEST, EACH UNIT IS TESTED SEPARATELY

TEST	ALLOW. DEF. PER CHARAC. 1st SAMP.	COMB. SAMP.	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS (cont'd.)							
INSULATION OF ELECTRODES:							
g-all:	1	3	---	Rg-all:	50	---	MEG.
p-all:			---	Rp-all:	50	---	MEG.
TRANSCONDUCTANCE (1) AVERAGE CHANGE:	---	---	---	$\underset{\Delta_t Sm:}{Avg}$	---	15	PERCENT
TOTAL DEFECTIVES	3	6	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE = 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)							
INOPERATIVES:	1	3	---	---	---	---	---
GRID CURRENT (1):	1	3	---	Ic(1):	---	-1.0	μAdc
HEATER CURRENT:	1	3	---	If:	276	328	mA
TRANSCONDUCTANCE (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	$\Delta_t Sm(1)$:	---	25	PERCENT
TRANSCONDUCTANCE (2): (NOTE 9)	1	3	---	$\Delta_{Ef} Sm(2)$:	---	20	PERCENT
HEATER-CATHODE LEAKAGE (1):							
Ehk=+100 Vdc	1	3	---	Ihk(1):	---	10	μAdc
Ehk=-100 Vdc			---	Ihk(1):	---	10	μAdc
INSULATION OF ELECTRODES:							
g-all:	2	5	---	Rg-all:	25	---	MEG.
p-all:			---	Rp-all:	25	---	MEG.
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

NOTES

1. CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1, "INSPECTION INSTRUCTIONS FOR ELECTRON TUBES," AND MIL-STD-105A.
2. WITHOUT SHIELD.
3. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.
4. CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.
5. TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

CONTINUED ON FOLLOWING PAGE

NOTES CONT'D.

6. THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

7. THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.

8. FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ± 5% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

9. CHANGE OF TRANSCONDUCTANCE FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef=6.3 V TO THAT VALUE MEASURED AT Ef=5.7V.

10. OPERATION TIME IS THE TIME IN SECONDS REQUIRED FOR THE PLATE CURRENT TO ATTAIN A VALUE WITHIN ± 10% OF THE THREE (3) MINUTE PLATE CURRENT (1) VALUE MEASURED AT PLATE CURRENT (1) TEST CONDITIONS. NO PREHEATING BEFORE THIS TEST IS ALLOWED. A COLD TUBE MUST BE USED.

11. DURING BOTH CONTINUITY AND SHORT TESTING, THE TUBE UNDER TEST SHALL BE TAPPED AT LEAST THREE TIMES IN EACH OF TWO PLANES 90° APART WITH A TAPPER WHICH SHALL BE ADJUSTED TO GIVE AN IMPULSE OF APPROXIMATELY ONE HALF SINE WAVE OF 300 ± 50 MICROSECONDS DURATION AND HAVING A MINIMUM AVERAGE AMPLITUDE OF 80 G'S PEAK ACCELERATION AS MEASURED WITH A GULTON A-305 ACCELEROMETER AND KA-1 KIT. THE SHORTS DETECTING EQUIPMENT SHALL BE A DEVICE CAPABLE OF DETECTING AS SHORTS, THE FOLLOWING INTERELEMENT RESISTANCES OF THE GIVEN TIME DURATION.

DURATION	SENSITIVITY
PERMANENT	600,000 OHMS
500 MICRO SECONDS	500,000 OHMS
100 MICRO SECONDS	100,000 OHMS
60 MICRO SECONDS	1,000 OHMS

TUBES WHICH GIVE AN INDICATION OF ONE OR MORE OF THE FOLLOWING SHALL BE REJECTED AS INOPERABLE:

A. EITHER A PERMANENT OR TAP SHORT AT ANY TIME DURING THE TAPPING PROCEDURE

B. ANY OPEN CIRCUIT

C. ANY LEAKS

12. PEAK CATHODE CURRENT SHALL BE MEASURED BY MEANS OF A HIGH IMPEDANCE OSCILLOSCOPE OR EQUIPMENT DEVICE CONNECTED ACROSS A 1.0 ± 1% CATHODE RESISTOR. THE SPECIFIED LIMIT REFERS TO THE MAXIMUMS OF THE PULSE COMPLITUDE. THE VARIATION OF THE OUTPUT PULSE AMPLITUDE BETWEEN 20% t_p AND 80% t_p SHALL NOT EXCEED THE SPECIFIED LIMIT.

13. HEATER-CATHODE LEAKAGE (2) IS PERFORMED AS FOLLOWS:

A. PREHEAT TUBES FOR 10 SECONDS WITH Ef = 10.5V

B. TEST IMMEDIATELY BY THE APPLICATIONS OF THE SPECIFIED TEST CONDITIONS OF THIS TEST

C. AFTER 16 SECONDS READ HEATER-CATHODE LEAKAGE OF EACH SECTION.

14 THE TUBES SHALL BE RIGIDLY MOUNTED ON A TABLE VIBRATING WITH SIMPLE HARMONIC MOTION. THE TUBES SHALL BE VIBRATED FOR A TOTAL OF 6 HOURS, 2 HOURS IN EACH OF THREE POSITIONS, X1, X2 AND Y1. ONLY RATED HEATED VOLTAGE SHALL BE APPLIED. TUBES WHICH SHOW ONE OR MORE OF THE FOLLOWING DEFECTS SHALL BE CONSIDERED FAILURES.

A. TUBES WHICH SHOW PERMANENT OR TAP SHORTS OR OPEN CIRCUITS FOLLOWING FATIGUE TEST, WHEN TESTED AS SPECIFIED IN 4.7.2 AND 4.7.3

B. TUBES WHICH DO NOT COMPLY WITH POST FATIGUE LIMITS, THIS IS A DESTRUCTIVE TEST

15 THE PROVISIONS OF PARAGRAPH 4.9.20.5 OF SPECIFICATION MIL-E-1 SHALL APPLY, EXCEPT FOR TEST CONDITIONS LISTED FOR SHOCK TEST (2).

TENTATIVE DATA