INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MICROWAVE, NEGATIVE GRID
TYPE 8403

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein
shall consist of this document and the latest issue of MIL-PRF-1.

DESCRIPTION: Triode, planar, ceramic-metal.
See figure 1.
Mounting position: Any.
Weight: 2.5 ounces (71 grams) nominal.

ABSOLUTE RATINGS:

Parameter: Unit:	F1 GHz	Ef V	Eb kV dc	epy kv	Ec V dc	ib a	Ib mA dc	Ic mA dc	tp µs
Anode pulsed osc or amp:									
Maximum:	3.0	6.6	---	3.5	-150	3.0 3/	30	10	6
Minimum:	---	6.0 1/ 2/	---	---	---	---	---	---	---
Grid pulsed osc or amp:									
Maximum:	3.0	6.6	2.5	---	-150	3.0 3/	30	10	6
Minimum:	---	6.0	---	---	---	---	---	---	---
CW:									
Maximum:	2.5	6.6	---	---	-150	---	150	---	---
Minimum:	---	6.0	---	---	---	---	---	---	---
Test conditions:	---	6.3	1,000	---	Adj	---	100	---	---

ABSOLUTE RATINGS:

Parameter: Unit:	Pg W	tk sec	TE °C	T (anode shank) °C 5/	Du ---	Pp W	Barometric pressure, reduced mmHg
Anode pulsed osc or amp:							
Maximum:	2 4/	---	250	250	0.01	58	54
Minimum:	---	60	---	---	---	---	---
Grid pulsed osc or amp:							
Maximum:	2 4/	---	250	250	0.01	33	54
Minimum:	---	60	---	---	---	---	---
CW:							
Maximum:	2	---	250	250	---	100	---
Minimum:	---	60	---	---	---	---	---
Test conditions:	---	300	---	---	---	---	---

See footnotes at end of table I.

GENERAL:
Qualification - Not required.
This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.

TABLE I. Testing and inspection.

Inspection	Method MIL-STD-1311	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 1							
Pulsing emission	1231	6/	(eb = ec)/is = 10 a; tp = 3 μs (max); prr = 600 (max)	etd	---	200	v
Insulation of electrodes	1211	---	Eb = Ek = 0; Ec = -500 V dc	R	50	---	MegΩ
Heater current	1301	---		If	1.20	1.40	A
Electrode voltage (1) (grid)	1261	7/		Ec	-4.0	-9.0	V dc
Total grid current	1266	7/		Ic	---	-8.0	μA dc
Conformance inspection, part 2							
Electrode voltage (2) (grid cutoff)	1261	---	Ec/Ib = 1.0 mA dc; Eb = 1,000 V dc	Eco	---	-30	V dc
High voltage hold off	---	---	Eb = 2,500 V dc; Ec = -130 V dc	Ib	---	1.0	mA dc
Direct-interelectrode capacitance	1331	8/ 9/	No voltages applied	Cin Cgp Cout	7.5 2.95 ---	9.0 3.25 0.06	pF pF pF
Resonance	---	10/	No voltages applied; TA = 25°C ± 5°C	---	---	---	---
Power oscillation (1) (pulse)	1236	11/	F = 1.1 GHz ± 50 MHz; Ec = -80 V dc; Ebb = 3.0 kV dc; Ef = 6.3 V ac; ec = 105 v (grid pulse)	Po	2.0	---	W
Conformance inspection, part 3							
Life test	---	16/	Group C; heater standby; t = 500 hours; Ef = 6.3 V	---	---	---	---
Life-test (1) end points	---	16/		Δib	---	25	%
Barometric pressure, reduced	1002	13/	Pressure = 54 mmHg (max); voltage = 1,000 V ac; TA = 30°C ± 10°C	---	---	---	---

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method MIL-STD-1311	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 3 - Continued							
Variable frequency vibration	1031	8/ 12/ 13/	F = 55 to 500 Hz; 15 G peak (min); Ec/Ib = 10 mA dc; Rp = 10,000 ohms; Ebb = 300 V dc	Ep	---	250	mV ac
Shock	1041	8/ 13/ 15/	60 G peak (min); duration = 11 ± 2 ms; no voltages applied	---	---	---	---
Torque	---	8/ 13/ 14/	No voltages applied	---	---	---	---
Shock and torque-test end point:	---						
Total grid current	1266	---		Ic	---	-10	μA dc
Power oscillation (2) (pulse)	1236	8/ 13/ 17/	F = 3.0 GHz (min); epy = 3.5 kv; Ec = -1.5 V dc (min); Rg/Ib = 15 mA(max); Ef = 5.8 V ac	Po	5.0	---	W
Power gain	---	8/ 13/ 18/	F = 1.1 GHz ± 50 MHz; Ebb = 2.2 kV dc (min); Ecc = -50 V dc; tp = 3 μs (min); Du = 0.002 (min); pd = 400 w	po	1.8	---	kw
Power oscillation	1236	8/ 13/ 19/	F = 2.5 GHz ± 100 MHz; Ef = 5.3 V ac; Eb = 1.0 kV dc; Ib = 150 mA	Po	22	---	W
Life test (2)	---	13/ 20/	Ef = 6.3 V ac; F = 5 kHz ± 10 percent; Ebb = 1.0 kV dc; Eg and Rk/Ik = 125 mA dc (min); Ic = 45 mA dc (min); TA = 250°C (min); t = 100 hours	---	---	---	---
Life-test (2) end point:	---						
Pulsing emission	1231	---	(eb = ec)/is = 8 a	etd	---	200	v

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

1/ The transit time heating effect of the cathode shall be compensated by a reduction in heater voltage after dynamic operation of the tubes has started. The back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage that will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ± 5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz.

2/ Where emphasis is placed on long and reliable life, the filament voltage can safely be lowered to 6.0 volts, provided the line voltage is regulated better than ± 2 percent.

3/ Regulation, or series-anode-supply impedance, or both, shall limit the instantaneous peak current, with the tube considered as a short circuit, to a maximum of 10 times the specified maximum current rating.

4/ The maximum instantaneous peak grid-cathode voltage shall be within the range of +250 to -750 volts.

5/ Sufficient conduction, convection, and forced air cooling shall be provided to limit the envelope and anode shank temperatures to the specified maximum value under all operating conditions. Reliability will be seriously impaired if this maximum is exceeded. Where emphasis is placed on long and reliable life, lower temperatures shall be used.

6/ All tests listed under conformance inspection, part 1, shall be performed at the conclusion of the holding period.

7/ Sufficient conduction, convection, and forced-air cooling shall be used in all electrical tests involving application of heater voltage to maintain the anode shank and seal temperatures within the specified maximum values.

8/ Other tube contact configuration may be used provided the tube contact area remains unchanged, and the socket, jig, or cavity gives equal performance. The socket, holding fixture, or cavity shall be rigidly secured to the test platform.

9/ Measure in socket in accordance with DSCC Drawing No. 68017.

10/ Grid-anode resonance. Cavity shall resonate at 4,980 MHz ± 10 MHz in accordance with DSCC Drawing No. 67032.

Grid-cathode resonance. Cavity shall resonate at 1,377 MHz ± 2 MHz in accordance with DSCC Drawing No. 67033.

When plotted on graphs of resonant frequency versus grid-anode capacitance and resonant frequency versus grid-cathode capacitance, the tube under test shall be represented by a point within a parallelogram whose four corners are located by the following points:

Points	Capacitance (pF)		Frequency (MHz)	
	Cgp	Cgk	Fgp	Fgk
1	2.95	7.0	1,465	1,461
2	2.95	7.0	1,425	1,421
3	3.25	9.0	1,380	1,440
4	3.25	9.0	1,340	1,400

11/ The applied voltage pulse shape shall be tp = 0.5 μs ± 10 percent, tr = 0.05 μs and tf = 0.1 μs maximum. The pulse repetition rate shall be adjusted so that Du = 0.001 ± 5 percent with the above specified pulse length. Test in cavity Microwave Control Corp. Model T-104, or equivalent. The cavity and circuit connections are shown on figures 2 and 3. The grid drive is measured with the heater and bias voltage ”on” and the anode voltage “off”. Under these conditions the peak positive voltage with respect to the cathode should be egk = 25 volts maximum.

TABLE I. Testing and inspection - Continued.

12/ The tube shall be mounted in socket in accordance with Drawing 276-JAN and vibrated with simple harmonic motion. The peak acceleration over the frequency range shall be within ± 20 percent of the reference acceleration at 100 Hz. The frequency shall vary from 55 to 500 Hz and return to 55 Hz with approximately logarithmic progression and shall require 4 minutes minimum, 6 minutes maximum to traverse the range. Each tube shall be vibrated for 30 minutes in each axis -X and +Z as shown on figure 1, except that if the cumulative result of test on 50 or more tubes of a construction show that more than 75 percent of the tubes have higher output voltage in one axis, subsequent measurements need to be taken only in the axis giving the higher reading. The voltages specified herein shall be applied to the tube during vibration. The value of the alternative voltage, Ep, produced across the resistor, Rp, as a result of vibration shall be measured with a suitable device. This device shall have an appropriate voltage range, shall have the ability to measure, with an error of less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 20,000 Hz. The value of the vibration output Ep, shall not exceed the limit specified herein at any point in the sweep frequency range during the last complete cycle of cycling vibration.

13/ This test shall be performed during initial production and then annually thereafter. In the event of failure, the test will be made as a part of conformance inspection, part 2. The annual sampling plan shall be reinstated after three consecutive samples have been accepted.

14/ Torque test shall be performed as follows:
a. The tube shall be held securely at the cathode connection. A force of 5 inch-pounds shall be applied to the heater cup without perceptible shock. This test may be made by applying the force at right angles to the inside of the cup at a point 0.109 ± 0.016 inch from the cathode end of the tube. An approved equivalent method may be used. The heater cup shall not loosen or short circuit on the cathode connection. This part of the test shall not be required if the space between the heater cup and the cathode sleeve is completely filled with insulating material.
b. A torque of 15 inch-pounds shall be applied between anode and cathode without shock.
c. A torque of 40 inch-pounds shall be applied between anode and grid without shock.

15/ Test in jig in accordance with Drawing 280-JAN. Each tube shall be subjected to a total of 15 shocks; that is, 5 shocks in each axis, +Y, +Z, and -Z, in any sequence, as shown on figure 1.

16/ At zero hours of life test, establish the drive conditions necessary to obtain a peak anode current of 3a (minimum) with an anode voltage of 1,000 V dc and a bias of -40 V dc. The pulse width of the modulator shall be 2 μs (minimum) and the duty cycle shall be 0.0025 (maximum). With the drive level determined at zero hours, check the anode current at the end of life. Maximum allowable drop in anode current shall be 25 percent.

17/ The applied voltage pulse shape shall be measured with a noninductive resistor of 1,150 ohms ± 2 percent inserted in place of the tube. The pulse shape shall be tp = 3.0 μs ± 10 percent, tr = 0.4 μs maximum, tf = 0.7 μs maximum. The pulse repetition rate shall be adjusted so that Du = 0.0025 ± 5 percent with the above measured pulse length. Test in cavity in accordance with Drawing 279-JAN. The heater contact of the cavity may be lengthened as required and the anode flange “M” removed to attain proper oscillation. The cavity shall be connected to a load and a VSWR of less than 1.5. The oscillator output coupling and the grid or cathode resistor may be adjusted for maximum power output.

18/ Test shall be conducted in power amplifier cavity as shown on figure 4. Driving power is defined as the net power delivered to the amplifier cavity input terminals and the reflected power shall be subtracted from the incident power to obtain the net driving power. The output tuning shall be adjusted for maximum power output.

19/ Test is to be made in cavity in accordance with Drawing 160-JAN. The position of the cathode line and the heater contact are changed to permit proper contact as required by the tube dimensions. The anode flange “M” may be removed to obtain proper oscillation. The cavity shall be connected to a standard load with a VSWR of less than 1.5. The output coupling from the oscillator and grid or cathode resistor or both may be adjusted for maximum power output.

20/ Test tubes in circuit in accordance with figure 5, or equivalent.

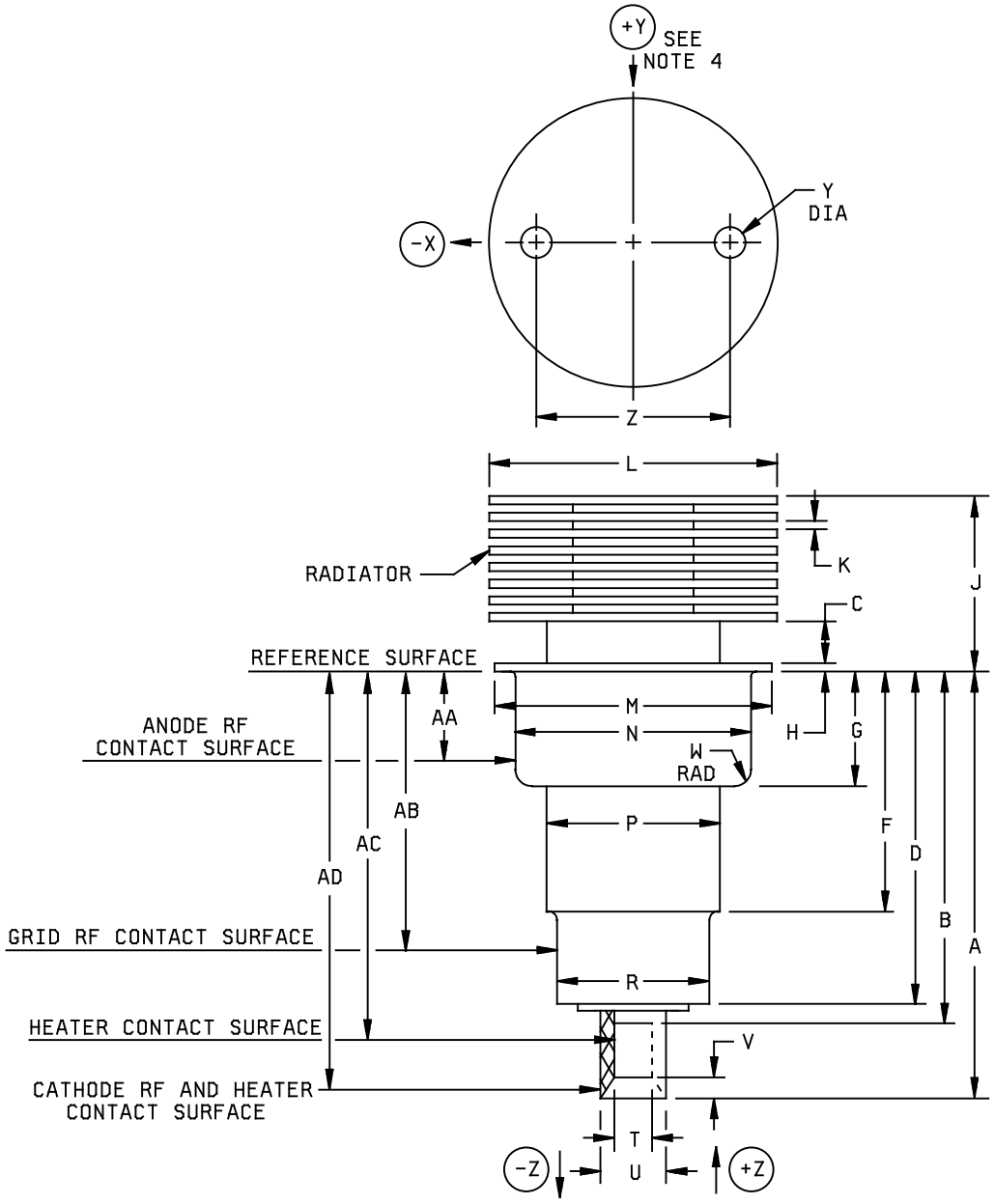


FIGURE 1. Outline drawing of electron tube type 8403.

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
Conformance inspection, part 2					
A	1.500	1.560	38.10	39.62	
B	---	1.214	---	30.84	
D	1.125	1.165	28.58	29.59	
F	.800	.840	20.32	21.34	
G	.462	.477	11.73	12.12	
N	1.025	1.035	26.04	26.29	2
R	.655	.665	16.64	16.89	2
T	.213	.223	5.41	5.66	
U	.315	.325	8.00	8.26	3
Conformance inspection, part 3 (see note 1)					
C	.125	.185	3.18	4.70	
H	---	.040	---	1.02	
J	.766	.826	19.46	20.98	
K	.025	.046	0.64	1.17	
L	1.234	1.264	31.34	32.11	
M	1.180	1.195	29.97	30.35	
P	.752	.792	19.10	20.12	
V	---	.086	---	2.18	
W	---	.100	---	2.54	
Y	.105	.145	2.67	3.68	
Z	.650	.850	16.51	21.59	

Ltr	Dimensions for electrode contact surfaces			
	Inches		Millimeters	
	Min	Max	Min	Max
AA	.035	.361	0.89	9.17
AB	1.021	1.101	25.93	27.97
AC	1.219	1.413	30.96	35.89
AD	1.160	1.500	29.46	38.10

NOTES:

1. Dimensions shall be checked during the initial production and annually thereafter. In the event of failure, the test will be made as a part of conformance inspection, part 2. Annual sampling plan shall be reinstated after three consecutive samples have been accepted.

2. The total indicated runout of the anode and grid contact surfaces with respect to the cathode contact surface will not exceed .020 inch (0.51 mm).

3. Tht total indicated runout of the cathode contact surface with respect to the heater contact surface will not exceed .012 inch (0.30 mm).

4. -X, +Y, +Z, -Z indicate direction of the applied shock and vibration in relation to the tube configuration.

FIGURE 1. Outline drawing of electron tube type 8403 - Continued.

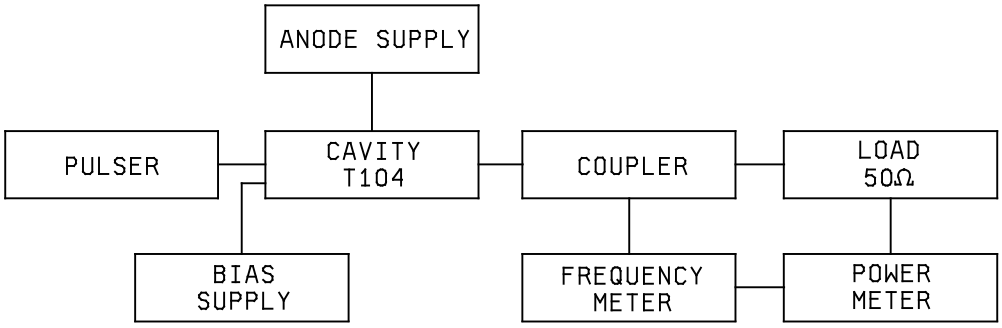


FIGURE 2. Test cavity hook-up.

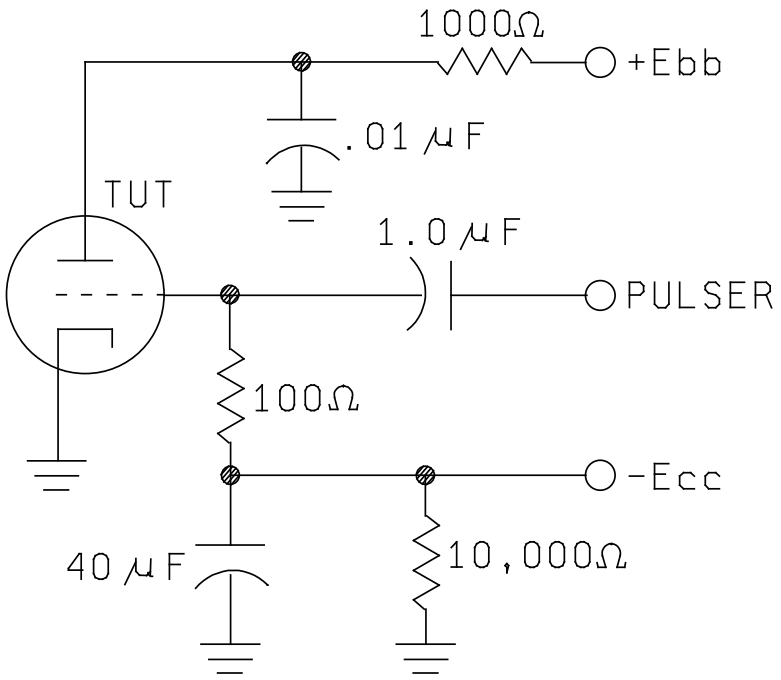
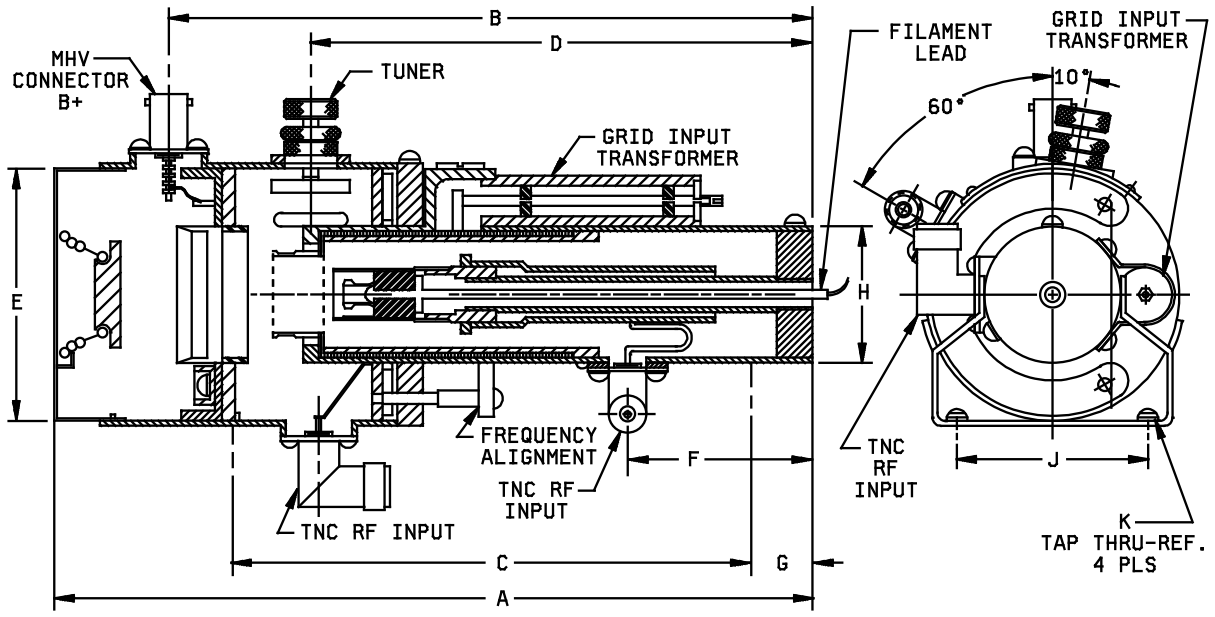


FIGURE 3. Test circuit.



Ltr	Dimensions	
	Inches	Millimeters
	Nominal	Nominal
A	6.97	177.04
B	5.72	145.29
C	4.72	119.89
D	4.56	115.82
E	2.50 O.D.	63.50 O.D.
F	1.56	39.62
G	.62	15.75
H	1.25 O.D.	31.75 O.D.
J	1.88	47.75
K	No. 4-40 NC-2B	No. 4-40 NC-2B

NOTES:
1. Dimensions are in inches.
2. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
3. Unless otherwise specified, tolerance is ± .02 inch (0.51 mm).
4. All dimensions are for reference only.

FIGURE 4. Pulse amplifier cavity.

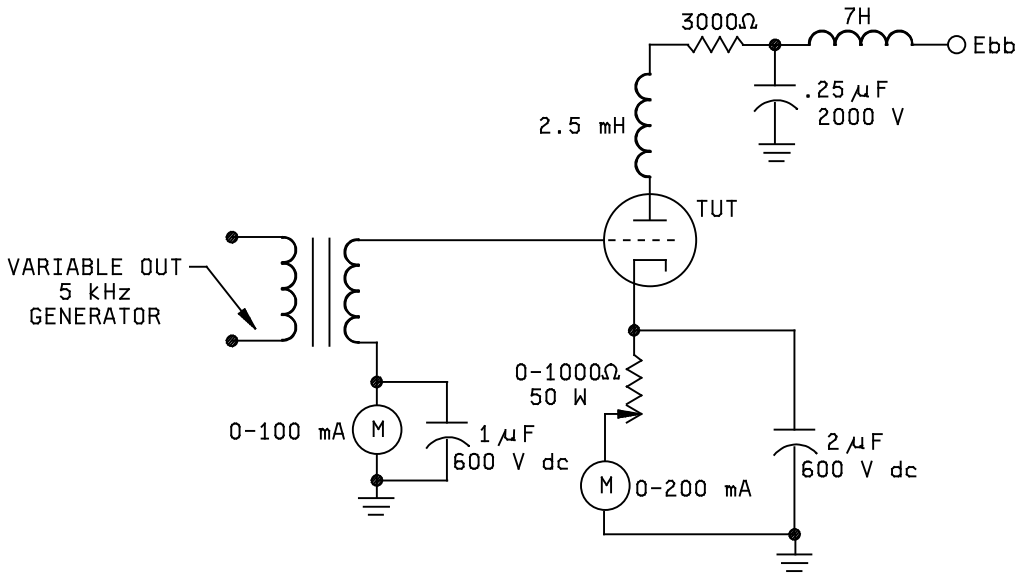


FIGURE 5. 5 kHz life-test circuit.

Referenced documents. In addition to MIL-PRF-1, this specification sheet references:

MIL-STD-1311	Drawing 160-JAN
DSCC Drawing No. 68017	Drawing 276-JAN
DSCC Drawing No. 67032	Drawing 279-JAN
DSCC Drawing No. 67033	Drawing 280-JAN

NOTE:
1) To obtain copies of JAN drawings, please send a request via email to TubesAmps@dla.mil.
2) To view DSCC Drawings, visit the DLA Land and Maritime Military Specifications website (http://www.landandmaritime.dla.mil/Programs/MilSpec/).

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