

INCH-POUND

MIL-PRF-1/1712D
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 SUPERSEDING
 MIL-PRF-1/1712C
 20 April 1998

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, TRAVELING WAVE

TYPE D0D-039 *

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: Forward-wave amplifier, 2.9 to 3.1 GHz operation, 4 kw peak power output, cathode pulsed, periodic-permanent magnet focused.

ABSOLUTE RATINGS: 1/ 2/ 3/ 4/

Parameter:	Ef	If (surge)	ik	ek	Pd	Pp	Du	tp	tk	Alt (operating)
Unit:	V	A	a	kv	W	W	---	μs	sec	ft
Maximum:	6.6	10	2.1	-9.5	2	750	0.03	40	---	10,000
Minimum:	6.0	---	1.5	-8.5	---	---	0.007 5/	---	180	---

ABSOLUTE RATINGS: 1/ 2/ 3/ 4/

Parameter:	Coolant flow rate	Coolant inlet temp		Coolant pressure	Coolant pressure drop	TA	F
		Water	EG and W				
Unit:	GPM	°C	°C	psig	psig	°C	GHz
Maximum:	0.5	62	14	200	15	-54	F3
Minimum:	0.45	---	---	---	10	+65	F1

PHYSICAL CHARACTERISTICS:

Dimensions:	See figure 1	Marking:	4/
DC connectors:	See figure 1	Construction:	Metal and ceramic
RF connectors:	See figure 1	Weight:	11 pounds, (5 kg) maximum
Cooling:	Liquid 6/	Mounting position:	Any
Focusing:	Periodic permanent magnet	Shelf life guarantee:	7/

TEST CONDITIONS: 4/ 8/

Parameter:	Ef	Pd	σ'	Du	tp	tk	F	Frequency	
								F	GHz
Unit:	V	W	---	---	μs	sec	GHz	1	2.9
Tolerance:	---	max	min	---	±1	min	---	2	3.0
	6.3	0.7	1.1:1	0.03	37	180	F2	3	3.1

GENERAL:

Qualification: Required.

* Replaces Varian type VAS - 805T7, ITT Gilfillan Part or Identifying Number (PIN)s 145005-1, 145005-2, and tube type 8742.

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TABLE I. Testing and inspection.

Method	Requirement or test	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
	<u>Qualification inspection</u>						
1011	Humidity	<u>9/</u>	No voltages applied	---	---	---	---
1027	Temperature cycling (nonoperating)	<u>10/</u>	TA = -54°C to +75°C; 5 cycles	---	---	---	---
---	Vibration	<u>11/ 12/</u>		---	---	---	---
1042	Shock	<u>12/</u>	Test condition A; 6 shocks (see figure 1)	---	---	---	---
4258	Radio interference shielding	<u>13/</u>		---	---	1.0	mW/m ²
1136	Rough handling	<u>9/</u>		---	---	---	---
	<u>Conformance inspection, part I</u>	<u>14/</u>					
4289	Heater current (nonoperating)	---	Ef = 6.3 V	If	2.0	4.0	A
1256	Electrode current (cathode)	<u>15/</u>		ik	1.54	1.90	A
1261	Electrode voltage (cathode)	<u>5/</u>		ek	-8.5	-9.5	kv
4214	Cathode emission	<u>16/</u>	tk1 = 250; tk2 = 300	Δik	---	0.1	a
4253	Gain (large signal)	<u>17/</u>	F1 through F3	Gls	37.55	---	dB
4254	Saturated rf power output	<u>17/</u>	F1 through F3	po	4.0	---	kw
4253	Gain variation (large signal)	<u>17/ 18/</u>	F1 through F3	ΔGls	---	1.0	dB
4261	Spurious output or stability	<u>19/</u>		spo	---	-40	dB
---	Stability	<u>20/</u>	F1 through F3	---	---	---	---
4256	Input and output match (cold)	<u>21/</u>	F1 through F3	VSWR	---	2.2:1	---
4257	Amplifier insertion loss	---	F = F2	Li	50	---	dB
1155	Coolant pressure drop versus coolant flow	<u>6/</u>	Inlet temperature = 62°C (max); flow rate = 0.5 GPM	ΔP	10	15	psig
---	Coolant pressure	---		p	---	200	psig
	<u>Conformance inspection, part 2</u>						
4278	Phase shift	<u>22/</u>	Δek = ±50 v	Δθ/Δek	---	0.3	deg/v
1105	Permanence of marking	---		---	---	---	---

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Method	Requirement or test	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
---	<u>Conformance inspection, part 3</u> Life test	<u>7/ 8/</u>	Group D	t	1,000	---	hrs
---	Life-test end point:						
4254	Saturated rf power output	<u>3/ 17/ 23/</u>		po	3.6	---	kw

1/ In addition to the MIL-PRF-1 symbols, the following shall apply:

- EG and W Ethylene glycol and water
- GPM Gallons per minute
- P Pressure
- ppm Parts per million
- psig Pounds per square inch, gauge
- Δ ek Change in cathode pulse voltage
- Δ P Pressure drop
- $\Delta\theta$ Change in phase

2/ Cathode and one leg of heater shall be connected internally. The helix is operated at ground potential. All voltages are referred to ground except the heater potential which is referred to the cathode.

3/ The tube shall satisfy all requirements of this tube specification sheet (TSS) when tested in a line type modulator (figure 2 or equivalent), employing a pulse transformer (ITT Gilfillan PIN 160020, or equivalent). The line type test modulator shall utilize a pulse forming network whose impedance is within ± 10 percent of that shown on figure 2.

4/ A copy of the critical performance characteristics including operating voltages shall be shipped with each tube. The operating voltages shall also be clearly indicated on the tube label and on a small decal at the collector end of each tube. Each tube delivered on the contract shall operate optimally under a single combination of discrete voltages which fall within the ranges shown under absolute ratings. All operating requirements of this TSS shall be met under these specific voltages.

5/ The pulse duration (tp) shall be defined as the time interval between the first and the last instants at which the instantaneous amplitude reaches 90 percent of the peak pulse amplitude. The combination transition period of rise and fall times of the pulse, between the 30 and 90 percent amplitude points, shall not exceed 5.0 μ s with a duty cycle of 0.03.

6/ Distilled water with a maximum inlet temperature of +62°C shall be used with, (1) specific resistivity maintained greater than 0.5 megohm, (2) oxygen content maintained less than 0.5 ppm, (3) an organic filter, and (4) a 3 to 4 micron filter at ambient temperatures in excess of +4°C. A 60 percent ethylene glycol and 40 percent distilled water solution, by volume, with a maximum inlet temperature of +14°C, with the same resistivity, oxygen content, and filters shall be used at ambient temperatures of +4°C and lower.

7/ The tubes tested and acquired in accordance with this TSS shall be capable of shelf-life for a period of 12 months after date of shipment from the manufacturer's plant. Tubes placed in operation during this shelf-life period shall meet all requirements of this TSS. Tubes found to be defective, within the shelf-life period, shall be replaced by the manufacturer at no cost to the Government or its contractors.

8/ The tube shall be operated in the saturated mode. Test condition shall be defined as operation with power input of not more than 0.7 watt peak and the cathode operated at the optimum voltage.

TABLE I. Testing and inspection - Continued.

9/ After the performance of the humidity and rough handling tests, the tube shall be capable of passing the following conformance inspection tests:

<u>Method</u>	<u>Test</u>
4253	Gain (large signal)
4261	Spurious output or stability
4278	Phase shift

10/ At the conclusion of this test, the tube under test (TUT) shall be capable of satisfying the requirements of conformance inspection, parts 1, 2, and 3 tests.

11/ The tube shall be rigidly mounted to the vibration table and shall be vibrated in accordance with MIL-STD-167-1, type I, Environmental vibration, except the amplitudes shall be as indicated below. The detected output of the tube shall be displayed on an oscilloscope. Prior to vibration, the oscilloscope shall be calibrated in the dc mode, using slow sweep, by means of a precision attenuator. The face of the display tube shall be marked with lines corresponding to the saturated power output level, and to levels of ± 0.5 dB. The attenuator shall then be returned to the saturated power output level. The displayed variations attributable to vibration shall be within the calibration lines.

<u>Frequency</u>	<u>Amplitudes</u>
5 to 15 Hz	0.075 ± 0.012 (0.150 total displacement)
15 to 25 Hz	0.050 ± 0.008 (0.100 total displacement)
25 to 33 Hz	0.025 ± 0.004 (0.050 total displacement)

12/ The tube shall exhibit interruptions or discontinuities in power output and shall be capable of satisfying all conformance inspection tests without damage or failure before and after performance of the specified test.

13/ The power density shall be measured over the frequency range 0.8 to 12.9 GHz at a distance of 1 meter from the tube in the three principal planes for both horizontal and vertical polarization. The input signal level shall be the minimum required to saturate the tube over the frequency range F1 to F3.

14/ Unless otherwise specified, the acceptance level for all tests listed under conformance inspection, part 1, shall be 1.0, (see 24/).

15/ The cathode current shall be measured at the optimum cathode voltage (label value) with a pi (rf) of 0.7 watt maximum, and shall be such that the effective beam Z is within 4,987 to 5,513 ohms.

16/ The change in cathode current (Δik) shall be the difference between ik_1 and ik_2 (corresponding to tk_1 and tk_2) and shall not exceed the maximum specified.

17/ A swept-frequency technique may be used for this measurement at intervals not to exceed 20 MHz intervals.

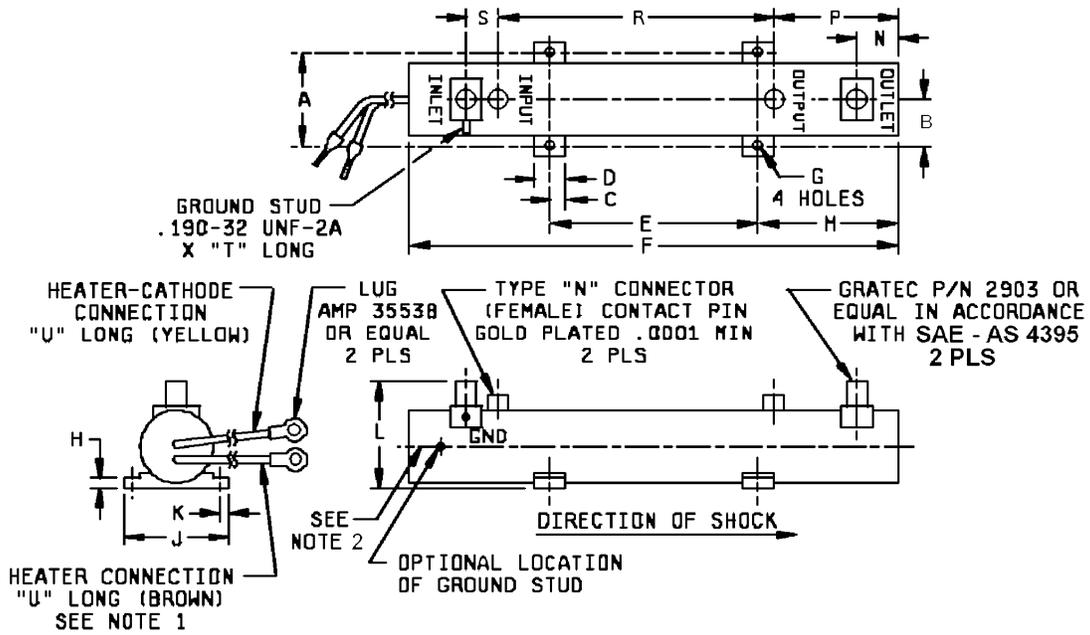
18/ The gain variation (large signal) shall be the difference between the maximum gain and the minimum gain at the specified test frequencies.

19/ The input of the tube shall be terminated with a matched load, and the output shall be connected to a +10 dB directional coupler. The signal from the arm of the coupler shall pass through two filters connected in series (a high pass with a cutoff at 2.7 GHz and a low pass with a cutoff at 3.3 GHz), into a crystal detector. The output of the coupler shall be connected through a 3-dB attenuator to a variable-phase short circuit. The spurious power output shall be the maximum signal detected at the crystal as the phase of the short is varied through the one-wave length at 3 GHz.

20/ The tube shall be stable when operating at the optimum voltage given on the test data sheet for the specific tube, and for all cathode currents within ± 5 percent of that cathode current shown on the data sheet. In addition, with an input VSWR of 1.5 or less, the tube shall be capable of driving a mismatched load of 1.5:1.

TABLE I. Testing and inspection - Continued.

- 21/ The VSWR and frequency at both input and output shall be measured and recorded at the point of maximum VSWR in the frequency band. The tube shall operate with an input/output impedance of 50 ohms.
- 22/ The cathode voltage shall be varied within the values specified. The $\Delta\theta/\Delta E_k$ measurement is the difference between the phase shifts through the tube at the two cathode voltage extremes divided by the change in voltage.
- 23/ The end of life point shall be defined as that point in time when the power output is reduced to less than 3.6 kw peak anywhere between 2.9 and 3.1 GHz with the tube operated at the recommended cathode voltage, working into a matched load (50 ohms) having a VSWR of 1.1:1 or less, and driven with a fixed input power of 0.7 watt maximum.
- 24/ This specification sheet uses accept on zero defect sampling plan in accordance with MIL-PRF-1, table III.



NOTES:

1. Heater leads shall be Surpremant type SE-HV(30) 1927A(90) brown and yellow or ITT ETD P/N's 282359 (brown) and 282360 (yellow), or equivalent for use with terminal AMP 35538, or equal.
2. Heater leads omitted for clarity.

Ltr	Dimensions			
	Inches		mm	
	Min	Max	Min	Max
A	3.365	3.385	85.47	85.98
B	1.630	1.750	41.40	44.45
C	.440	.560	11.18	14.22
D	.940	1.060	23.88	26.92
E	7.802	7.822	198.17	198.68
F	17.500	18.000	444.50	457.20
G	.271	.291	6.88	7.39
H	.350	.410	8.89	10.41
J	3.850	3.910	97.79	99.31
K	---	.250	---	6.35
L	---	4.250	---	107.95
M	4.438	5.500	112.73	139.70
N	.812	1.500	20.62	38.10
P	2.312	3.750	58.72	95.25
R	10.438	11.000	265.13	279.40
S	1.250	1.875	31.75	47.63
T	.26	.500	6.60	12.70
U	19.70	20.30	500.38	515.62

FIGURE 1. Outline drawing of electron tube type DOD-039.

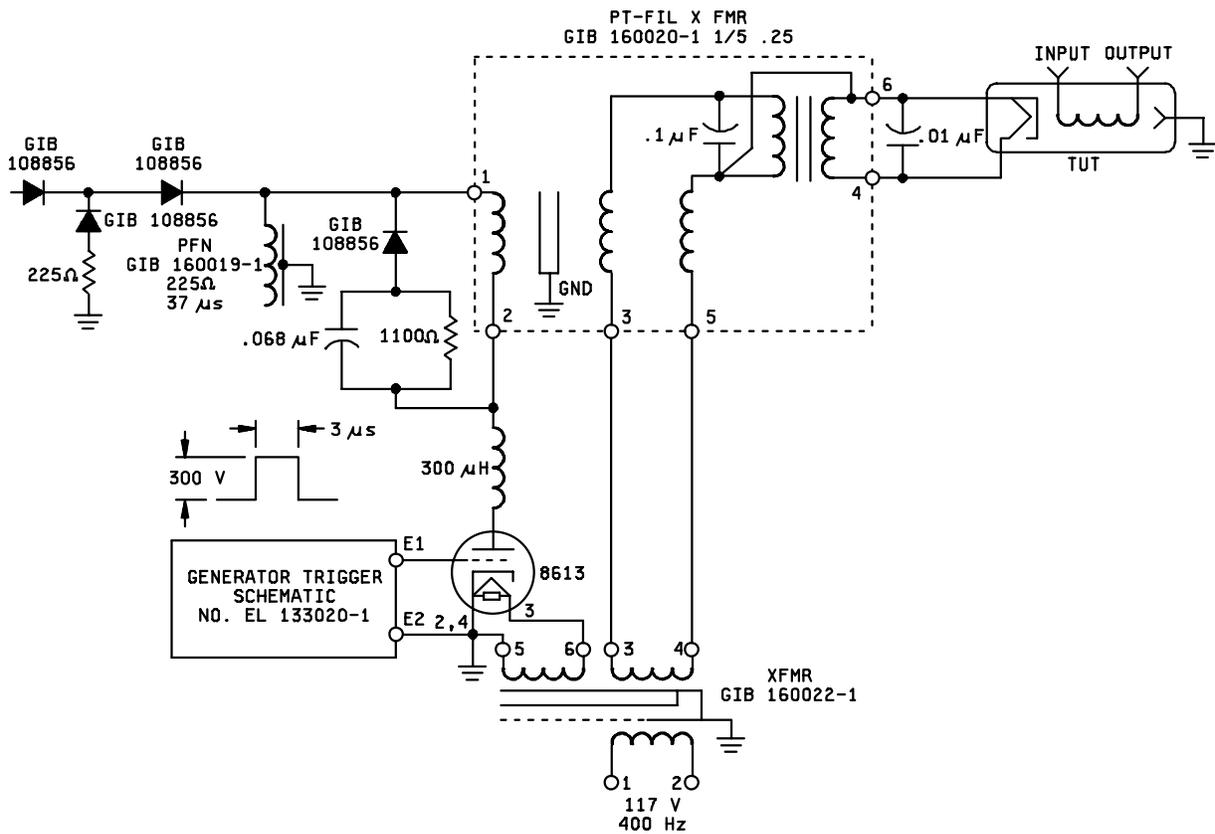


FIGURE 2. Test circuit for electron tube type DOD-039.

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Custodians:

Army - CR
Navy - EC
DLA - CC

Preparing activity:

DLA - CC

(Project 5960-3667)

Review activities:

Navy - AS, CG, MC, OS