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C (SP6-D)

TUBE SPECIFICATIONS
 TUBE TEST SPECIFICATIONS
 TUBE TEST METHOD SPECIFICATIONS

Continuous Wave Magnetron

2 M 1 6 7 B - M 1 5 C (SP6-D)

All the specification sheet except outline drawing in the tube specification must comply with these spec. No. 8062107 TS , 8062107 TTS , 8062107 TTMS for 2M167B-M15C(SP6-D).

We, the undersigned, approve these specifications as specified herein.

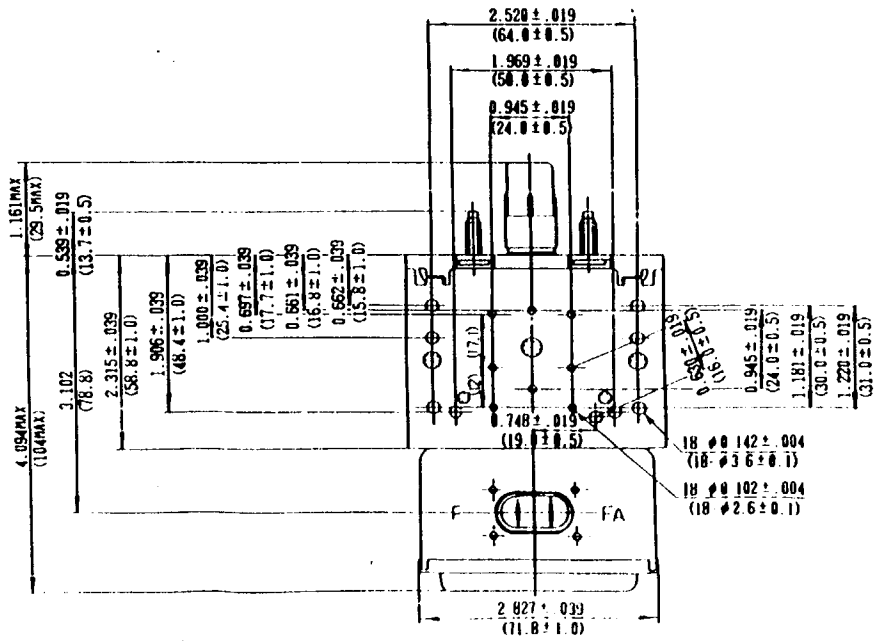
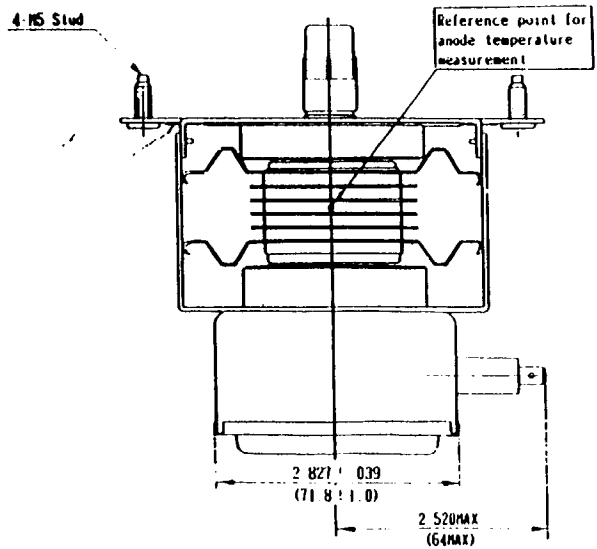
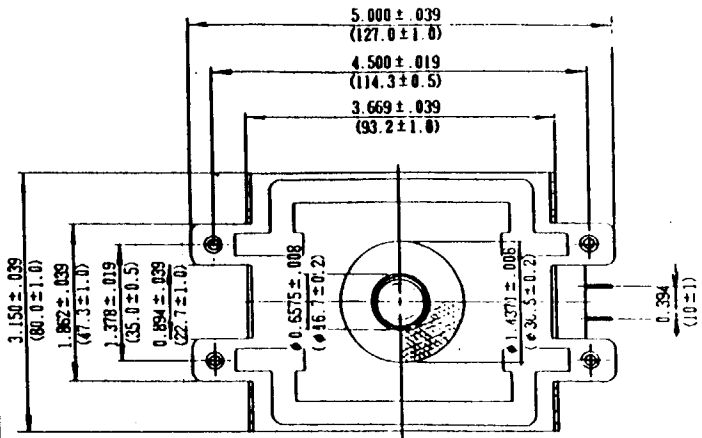
Firm Name _____

by *Bernard Fudoni*

Date 12/7/89

Compiled *J. Aoki* Approved *R. Nakas*

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TUBE SPECIFICATION

Continuous Wave Magnetron

2 M 1 6 7 B

Matsushita 2M167B is a forced air-cooling packaged type magnetron with high efficiency ceramic permanent magnets, designed especially for domestic microwave ovens. The magnetron, which operates at a fixed frequency of 2455 MHz, delivers an r-f output power of 900 W into a matched load at an efficiency of approximately 73 %. Cooling direction is transverse. The construction meets I.E.C. safety standard (pub. 335-25) with sufficient clearance and creepage distance.

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GENERAL DATA

Electrical

Filament: Thoriated tungsten coil, directly heated by a.c.
(50 Hz or 60 Hz) or d.c.

Filament voltage 3.3 V

Filament current at Ef= 3.3 V and ebm=0 KV .. 10 A

Cold filament resistance 49 m ohm

Preheating time 0 sec. Min.

Filament potential Negative with respect to ground

Frequency 2455 MHz

Mechanical

Outside dimensions See Fig. 1

Electrode connection FASTON Tabs (Note 1)

Mounting position (Note 2) Any

R-F output (Note 3) Probe

R-F coupler (Note 4) See Fig. 2

Filter circuit (Note 5) Integrated in the tube

Net weight Approx. 0.9 Kgs.

Forced-air cooling

Cooling direction Transverse

Cooling performance See Fig. 3 and 4

Magnetic field

Magnets magnets, packaged

Influence of nearby ferromagnetic material Any piece of ferromagnetic material should be kept away from magnets installed in the magnetron.

ABSOLUTE MAXIMUM RATINGS

	Min.	Max.	Unit
Filament voltage	2.8	3.75	V
preheating time	0	--	sec.
Peak anode voltage in operation	--	4.5	KV
Mean anode current	--	350	mA dc
Peak anode current	--	1.2	A
Mean anode input power	--	1.4	KW
Load V.S.W.R. (Note 6)	--	4	
Breakdown voltage at Ef= 0 V	--	10	KV peak
Anode temperature at the point indicated on the OUTLINE DRAWING (Note 7)	--	240	°C
Ambient temperature for storage	-30	+60	°C

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TYPICAL CHARACTERISTICS :

Measured under matched load condotions (V.S.W.R.=1.1 : 1) and unfiltered single phase full-wave rectification for anode supply.

Frequency	2455	MHz
Filament voltage (Note 8).....	3.3	V
Preheating time	3	sec.
Peak anode voltage	4.1	KV
Mean anode current	300	mA dc
Mean output power into matched load	900	W
Efficiency	73	%
Oven output power (Note 9).....	720	W
Quantity of forced-air cooling	1000	l/min.
Performance chart	See Fig. 5	
Rieke diagram	See Fig. 6	

Notes:

1. These tabs can be attached to FASTON receptacle No. 250 series.
2. The mounting plate is provided with four M5 bolts (ISO). When coupling, use is made of appropriate nuts.
3. The r-f output terminal can be coupled either to an oven cavity directly or to a rectangular waveguide.
4. It may be coupled to an R22 waveguide.
5. The filter circuit of the tube is housed in a shield box to suppress microwave radiation and to protect from high voltage.
6. The load condition in which instantaneous V.S.W.R. is 4 : 1 through 10 : 1 may be allowed only if the dwell time in that is short.
7. In an abnormal operation, the maximum allowable temperature for anode is 280 °C, provided that the dwell time the maximum temperature does not exceed 2 hours per operation nor 25 hours in total.
8. Filament voltage is measured at the terminals marked "F" and "FA" on the outline drawing. For measurement amoving iron type voltmeter shall be used.

"BE CAREFUL !! IT IS HIGH VOLTAGE".
9. Measurement is made in a typical oven with 2 liter water load as specified in paragraph 7.2.4 of JIS C-9250 (microwave ovens).

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SOME NOTES ON DESIGN AND OPERATING CONDITIONSPower supply circuit for microwave oven.

In actual oven, magnetron should be operated on an L-C stabilized power supply. In home-use microwave ovens, generally, half-wave voltage doubler L-C stabilized power supply circuit is used because of its economical advantages (see Fig.1). In this circuit, high inductance transformer is used; it is essential to design the inductance as low as possible for preventing the appearance of high transient voltage (surge voltage). Also filament transformer should be wound on the primary side of the H.T. transformer.

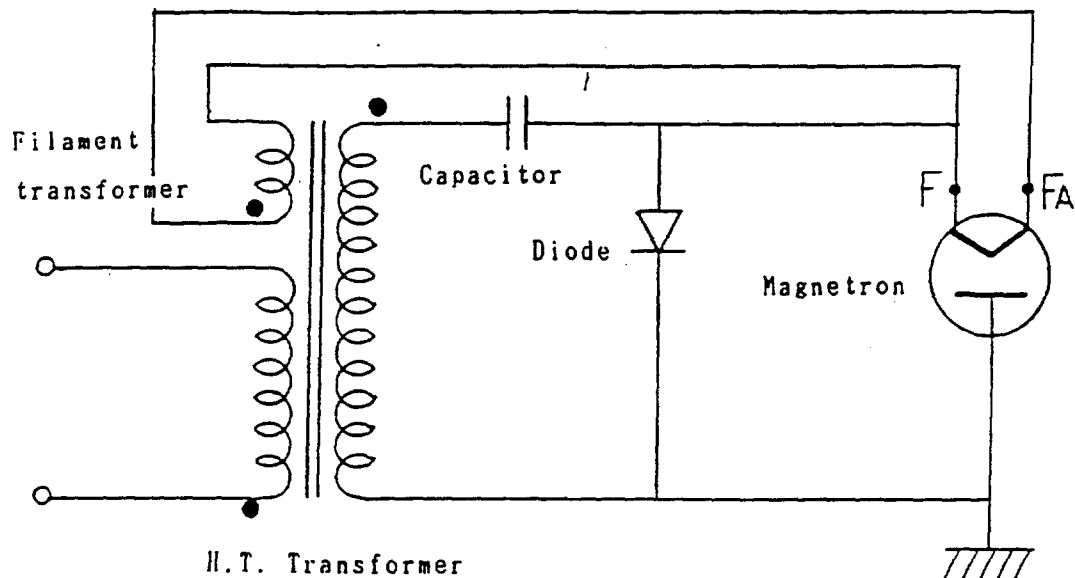


Fig. 1 Half-wave voltage doubler L-C stabilized power supply circuit.

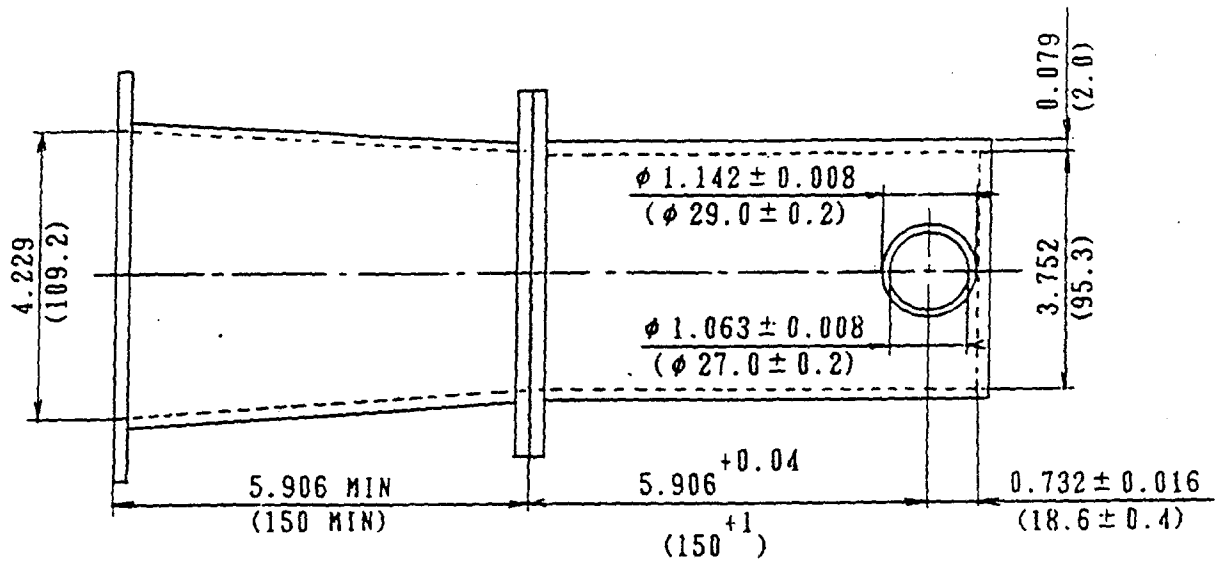
Cold start operation

Preheating of filament for a few seconds is desirable for reliable operation. If the magnetron is operated under the cold start conditions (without preheating), a surge absorber shall be installed so as to protect the diode from a transient voltage (surge voltage) which is sometimes produced in the transformer. To minimize the possible transient voltage, the connection for the filament terminals F and FA to the transformer taps shall be set up in such a way that the mean anode current of the magnetron decreases and anode voltage increases.

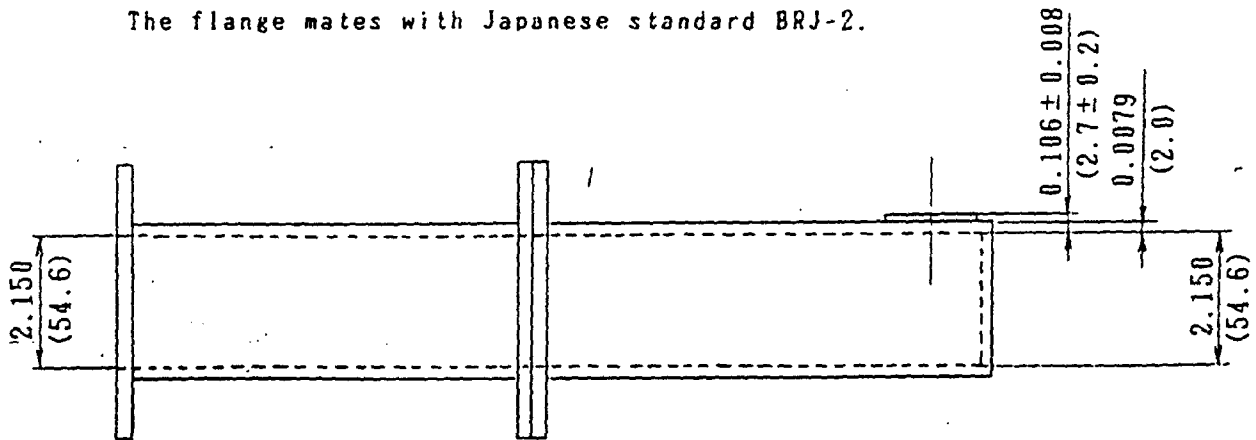
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Fig. 2 R.F. coupler

Unit in inch (mm)



The flange mates with Japanese standard BRJ-2.



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Fig. 3 ANODE DISSIPATION vs. ANODE TEMPERATURE

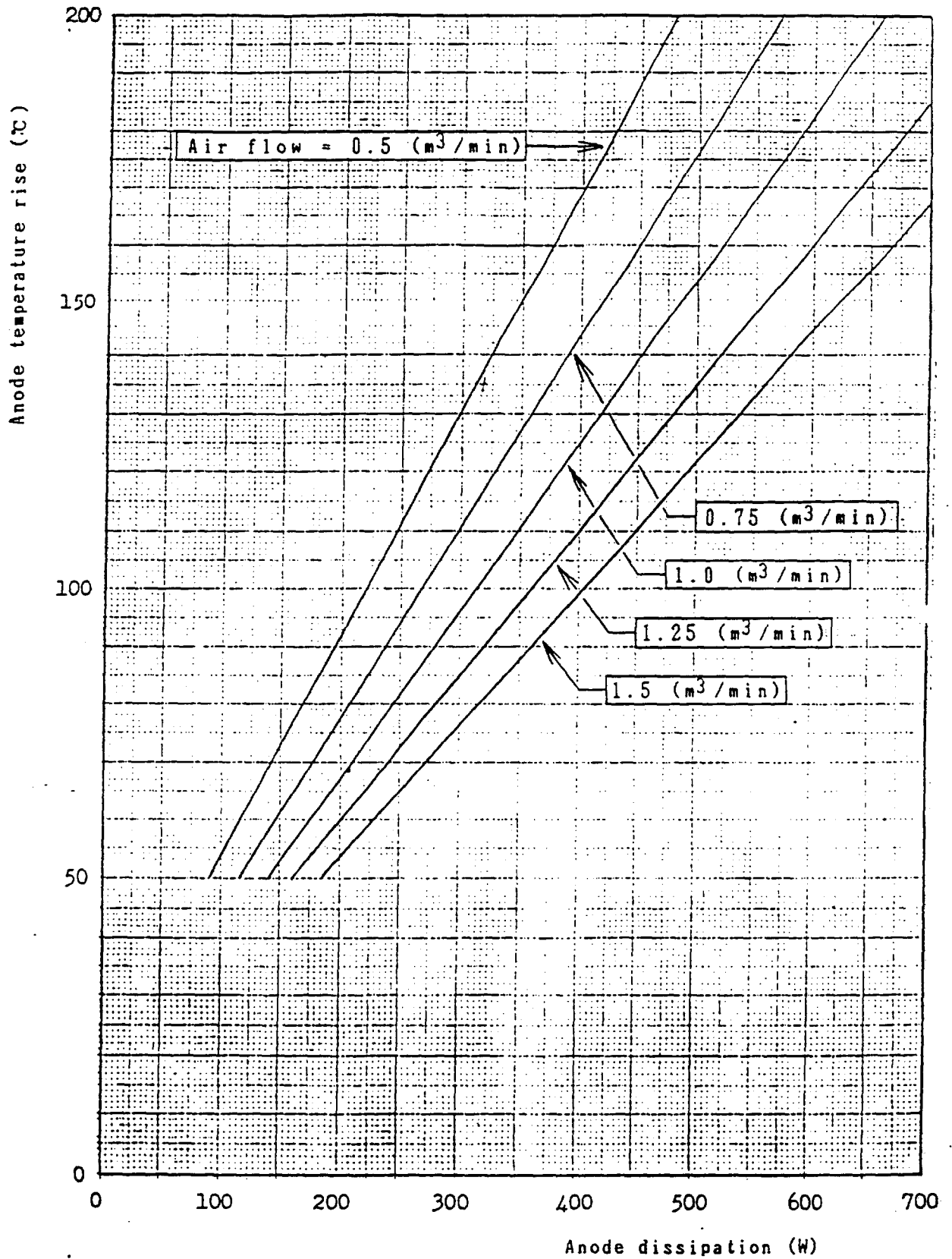
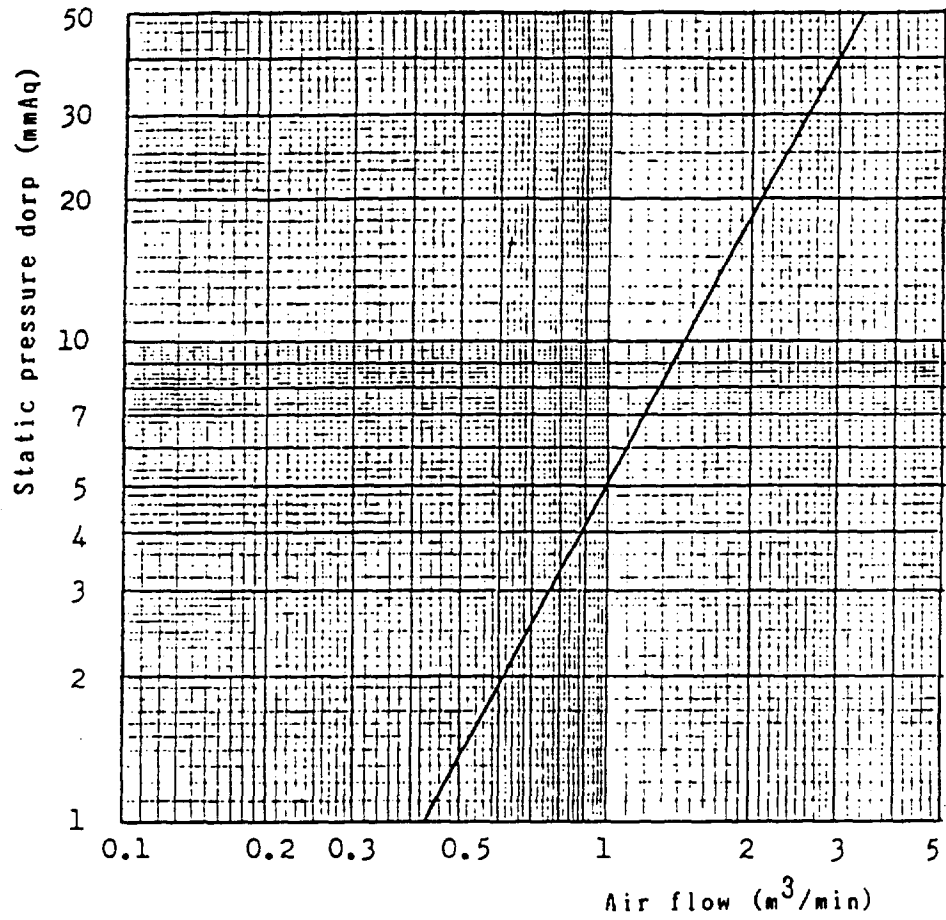
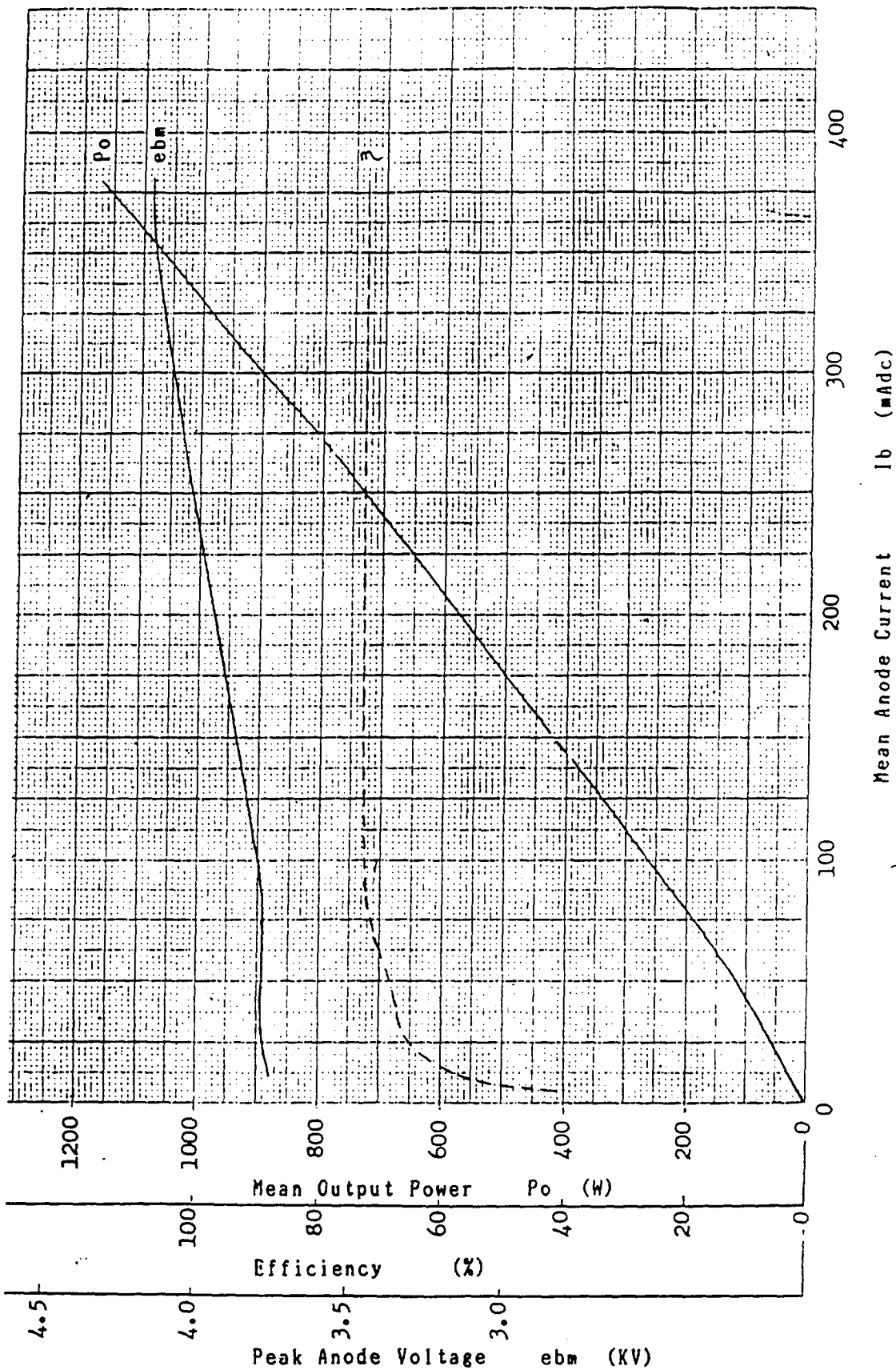


Fig. 4 AIR FLOW vs. STATIC PRESSURE DROP



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Performance Chart



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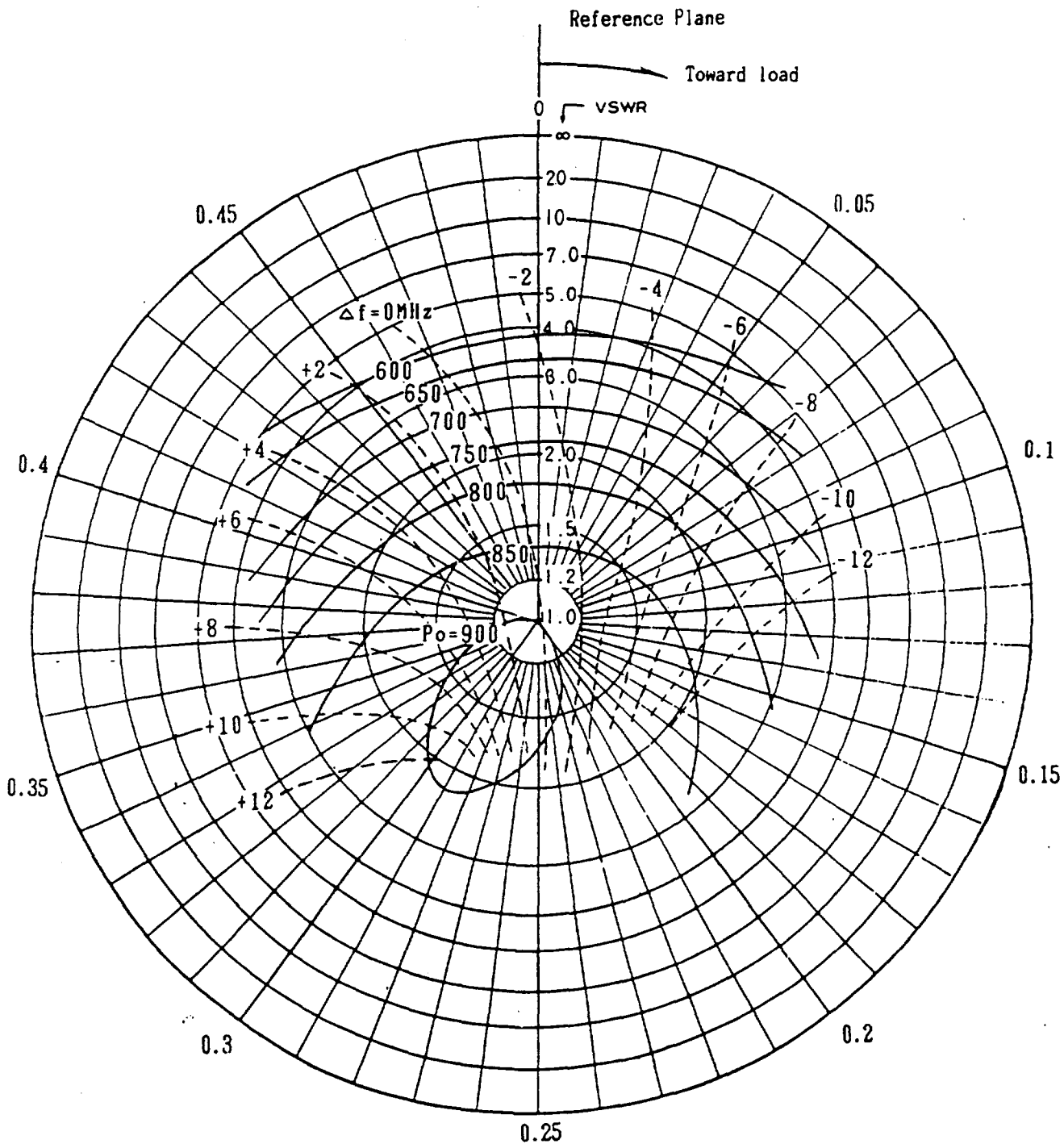
Fig. 6 Rieke Diagram

Anode supply : Unfiltered single-phase full-wave rectification
 Filament voltage : 3.3 V
 Mean anode current : 300 mA
 Reference plane : Antenna

Po : Mean output power.
 Δf : Deviation from nominal frequency.
 d : Distance of voltage standing wave minimum from reference plane toward load.

Matched load condition

Peak anode voltage : 4.1 KV
 Mean output power : 900 W
 Frequency : 2455 MHz

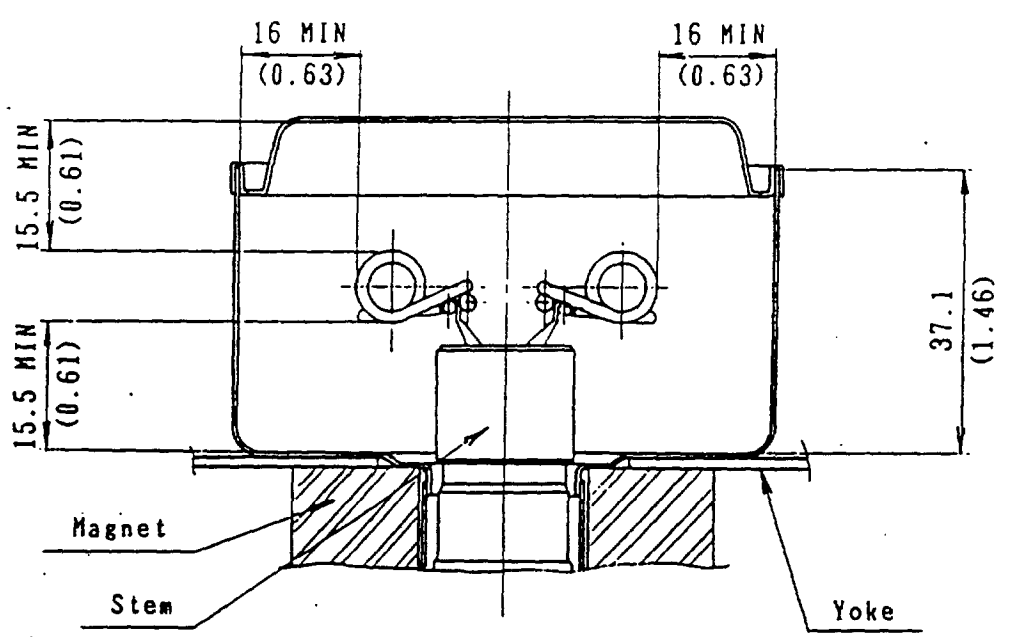
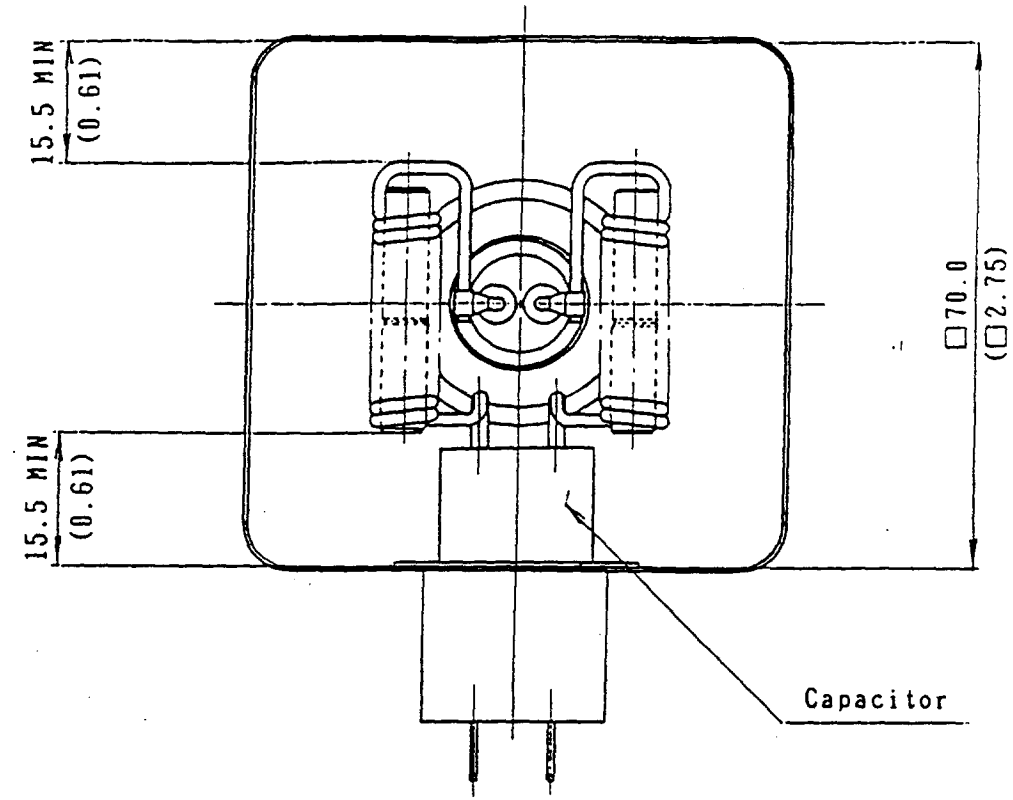


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Dimensions of filter case for B.S.

Clearance = 15.5 minimum
 Creepage = 17.5 minimum

Unit in mm (inch)



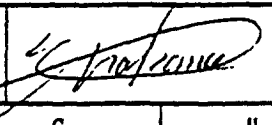
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TUBE TEST SPECIFICATION

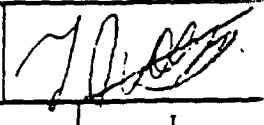
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2M167B Test Specifications

Item (Note 1)	Sym- bol	Test Conditions (Remark 1)					Limit				Test Method
		Ef V	tK sec	Ib mAdc	Load VSWR	t sec	Nom- nal	Min.	Max.	Unit	
*Filament current	If	3.3	120	0	-	-	10	8	12	A	T-1
Peak anode voltage (Note 5)	ebm	3.3	3	300	≤ 1.1	< 30	4.1	3.9	4.3	KV	T-2
Mean output power (Note 5)	Pol	3.3	3	300	≤ 1.1	< 30	900	860	940	W	T-3
Frequency	f	3.3	3	300	≤ 1.1	-	2455	2445	2465	MHz	T-4
*Stability-modng	ST	3.3	3	300	2,3,4	60	-	-	-	-	T-5
*Pulling figure	fpl	3.3	3	300	1.5 (all phase)			-	15	MHz	T-6
Emission stability	Efm	adj	3	300	≤ 1.1	≤ 5	-	-	2.5	V	T-7
Breakdown voltage	BVaf	0	E=7.1 KVac or 10 KVpeak			-	-	-	-	-	T-8
Cold start voltage transient	Vs	(Note 2)		-	-	-	-	-	8	KV	T-9
*Spurious radiation	--	(Note 3)		-	-	-	-	-	-	-	T-10
*Microwave radiation (Note 4)	--	3.3	3	300	2,3,4 (all phase)			-	1	mW/cm ²	T-11
*Outline dimensions	Remark 2										

Remark 1. Test Conditions

- a) Anode supply : Unfiltered single-phase full-wave rectification.
- b) The specified RF coupler (see Fig. 2) or an equivalent is used.
- c) Forced air cooling (air flow : about 1000 l/min.)

Remark 2.

All the outline dimensions shall comply with the outline drawing.

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N O T E SNote 1. Classification of Factory Tests

The test items are classified into following three levels.

a) Production test: (non marked items)

This test is intended to check if the production process is carried out in accordance with the specified process. The test shall be conducted on such items in which possibility of some deviation is predicted by a process change.

b) Design test: (asterisked items)

This test is intended to check if the tube is manufactured in accordance with the standard design. The test shall be conducted on such item as is not influenced if the standard design is properly maintained by ordinary production process.

c) Type approval test

This test is intended for determining if the standard design complies with the given specifications. The test may be omitted if there is no substantial change in the design.

Note 2. Cold Start Voltage Transient (Surge voltage)

Surge voltage specified herein is defined by the transient voltage which takes place during the period 0.5 through 2.0 seconds after the oven is switched on. This test is carried out on the customer's oven without surge absorber.

(OVEN MODEL : _____)

Note 3. Spurious Radiation

This test is carried out on the customer's oven.
MODEL : _____

The magnetron to be delivered to the customer shall be such that the oven meets the Federal Communication Commission's requirements, stated in Part 18 of the Rules of Regulations.

Note 4. Microwave Radiation

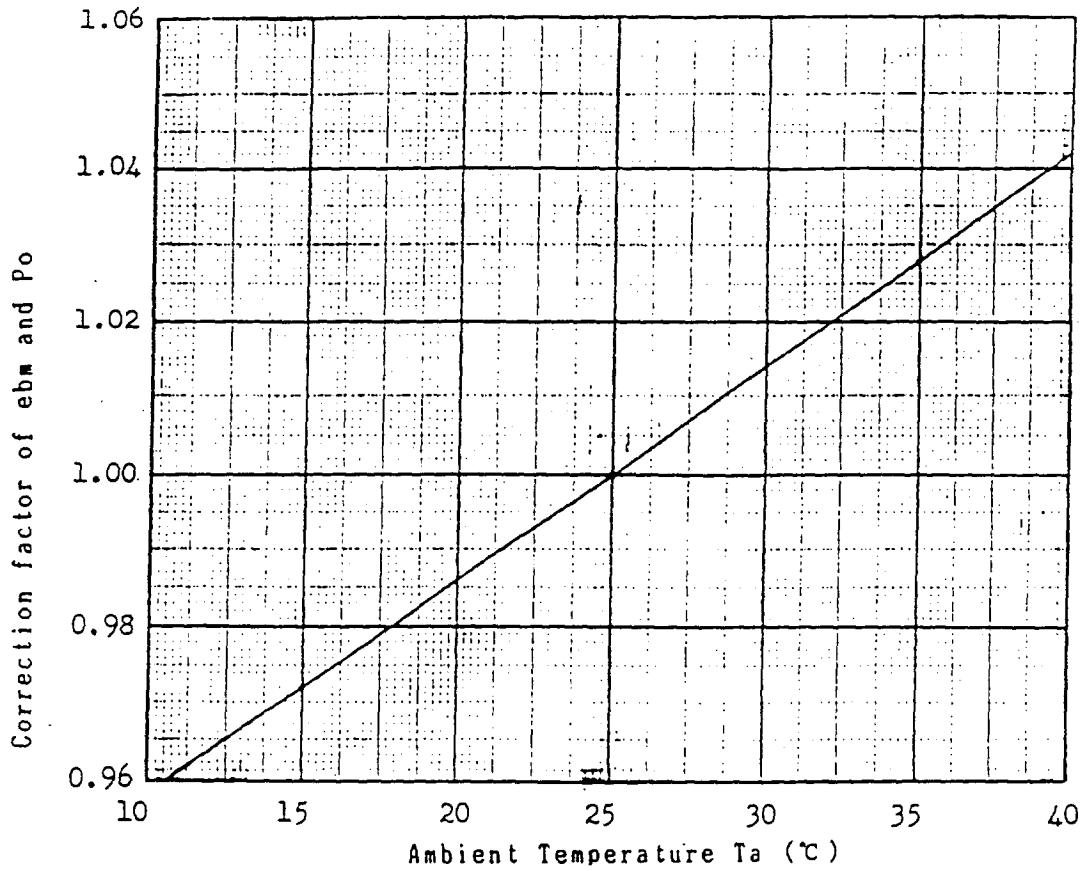
In the frequency range of 2450 ± 50 MHz, the power density of microwave radiation shall not exceed 1.0 mW/cm^2 at a distance of 5 cm from the tube in any direction.

Note 5. The ebm should be measured at 25°C and within 30 seconds after supply of the filament and anode voltage. See the conversion Table S-1.

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Conversion Table S-1

Correction Factor of Peak Anode Voltage (ebm) and Mean output Power (Po) Versus Ambient Temperature.



ebm (or Po)
measured
at Ta °C

x

Correction
factor
at Ta °C

=

ebm (or Po)
at 25 °C

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TUBE TEST METHOD SPECIFICATION

Continuous Wave Magnetron

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T-1. Filament Current (I_f)

Preheat the filament for the stated time (t_k) before measuring the filament current and then read the value with a moving type ammeter.

T-2. Peak Anode Voltage (e_{bm})

After the stated preheating time of the filament (t_k), the anode voltage is applied and adjusted so that it provides the stated anode current. If the measuring time (t) is specified, following conditions must be satisfied:

The measurement shall be carried out after the magnets reached to the ambient temperature (T_a). And the peak anode voltage shall be measured within the stated time, after applying filament voltage and anode voltage. When the ambient temperature range is stated, the tube shall be measured within the stated range and shall be judged by the specifications. When the ambient temperature is stated at 25 °C by using the conversion table and shall be judged by specifications at 25 °C. The readings of the meters are allowed to be provided that the room temperature is also recorded at the same time.

T-3. Mean output power (P_{o1})

The tube is operated under the stated conditions. Measure the mean output power with direct measuring method, indirect measuring method or identical measuring equipment, by connecting the tube (including the RF coupler) to the load which satisfies the stated conditions. The P_{o1} reading shall be carried out simultaneously with the reading of peak anode voltage in T-2.

T-4. Frequency (f)

The tube is operated under the stated conditions. After the frequency is stabilized, measurement is made by a frequency meter which is calibrated at the accuracy of 0.5 percent or better.

T-5. Stability Moding

The tube is operated under the stated conditions. With the V.S.W.R. maintained at the stated level, the phase angle of load standing wave is adjusted to give maximum output power of the tube. The moding is evidenced by observing the marked change in anode current, oscillating frequency or output power.

T-6. Pulling Figure (f_{pl})

The tube is operated under the stated conditions. The pulling figure is measured as the difference between the maximum and minimum frequencies when varying the phase of the load standing wave, thoroughly keeping the V.S.W.R. constant. If it is difficult to keep the V.S.W.R. constant, adjust the minimum V.S.W.R. through all phase angles above the stated value.

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T-7. Emission Stability (Efm)

The tube is operated under the stated conditions. Decrease the filament voltage, then measure the filament voltage at which the moding starts (Efm). This procedure to decrease the filament voltage shall be made within 5 seconds.

T-8. Breakdown Voltage (BVaf)

The tube is placed in an ordinary air atmosphere when the relative humidity is held at 85 percent or below. With the stated voltage between the anode and filament, the insulation or breakdown voltage between electrodes are measured. When applying this voltage, increase the voltage gradually from zero to the stated value. The tube is acceptable when the indication of breakdown takes place up to three times of above procedure.

T-9. Cold Start Voltage Transient (Surge voltage)

The tube is operated in actual oven without surge absorber. Anode and filament voltage should be supplied simultaneously. Surge voltage is measured on storage oscilloscope during the period 0.5 to 2 seconds after the oven is switched on.

Measuring equipment

oven used : Customer's typical oven.
voltage divider : Resistance type potential divider
(2000 M Ω , 1/1000) or an
equivalent device.

T-10. Spurious radiation

In accordance with the FCC standard.

T-11. Microwave Radiation

The tube is operated under the stated conditions. The power density of radiation is measured with Electro-magnetic leakage monitor (Narda Model 8100). Measurements shall be made at a distance of 5 cm from the tube in any direction.

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