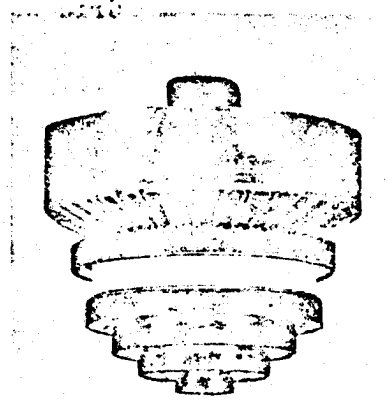
5 F 6 0 R

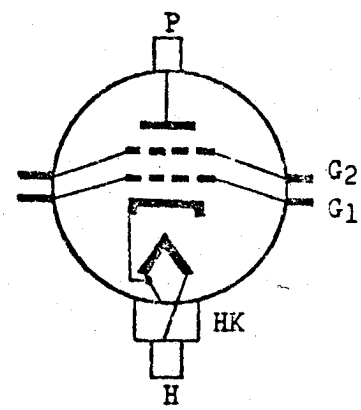
FORCED AIR - COOLED TETRODE



The NEC 5F60R is a forced air-cooled tetrode designed for use in power amplifier, power oscillator and frequency multiplier. Its maximum plate dissipation is 450 W.

It features small loss, rugged ceramic-insulated coaxial construction, resulting in small high-frequency loss and high mutual condactance.

In addition, it operates very stably with a large power gain for UHF band. Its maximum input is 1000 W at 500 MHz or less, and 750 W at frequencies up to 1215 MHz.



H : Heater
HK : Heater Cathode
G_1 : Grid No. 1
G_2 : Grid No. 2
P : Plate

TERMINAL CONNECTION

ELECTRICAL DATA :

General Ratings :

Cathode : Indirectly-Heated Oxide Coated Unipotential

	Min.	Nom.	Max.	
Heater Voltage	-	6.0	-	V
Heater Current (at standard voltage)	-	5.5	-	A

	Min.	Nom.	Max.	
Min. Pre-Heating Time	120	-	-	sec
Mutual Condactance	21	25	29	m℧
Grid No.2 Amplification Factor	11	15	19	
Direct Interelectrode Capacitances :				
Grid No.1 - Cathode	21.2	24.7	28.2	pF
Grid No.1 - Grid No.2	34.8	38.9	43.0	pF
Grid No.2 - Plate	7.0	8.2	9.4	pF
Grid No.1 - Plate	-	0.07	0.12	pF
Grid No.2 - Cathode	-	0.52	0.9	pF
Plate - Cathode	-	0.008	0.02	pF

MECHANICAL DATA :

Dimensions

	Min.	Nom.	Max.	
Overall Length	-	-	61	mm
Max. Diameter	-	-	60.8	mm
Weight (approx.)	-	250	-	g

Mounting Position Any

Cooling :

Radiator : Forced Air-Cooled

Min. Air Flow 0.25 m^3/min

Min. Static Pressure	5 mm water
Terminals : Forced Air-Cooled	
Air Flow (approx.)	0.1 m^3/min
Max. Radiator Temperature	250 °C
Max. Electrode Seal Temperature	250 °C

RF AMPLIFIER, TV LINEAR AMPLIFIER - CLASS AB2

MAXIMUM RATINGS : Frequency, 1215 MHz or less

Frequency	1215	MHz or less
DC Plate Voltage	1500	Vdc
DC Plate Current	500	mAdc
DC Grid No.2 Voltage	600	Vdc
DC Grid No.1 Voltage	-250	Vdc
DC Grid No.1 Current	100	mAdc
Plate Input	750	W
Grid No.2 Input	12	W
Plate Dissipation	450	W

TYPICAL OPERATION : (Values at 200 MHz grounded grid circuit with a 6 MHz bandwith and the standard cathode voltage per tube)

DC Plate Voltage	1300	1400	Vdc
DC Grid No.2 Voltage	400	400	Vdc

DC Grid No.1 Voltage	-17	-18	Vdc
DC Plate Current			
Max. Signal Current	350	420	mAdc
Zero-Signal Current	100	95	mAdc
DC Grid No.2 Current			
Max. Signal Current	30	35	mAdc
Zero-Signal Current	0	0	mAdc
DC Grid No.1 Current (max. signal current)	25	30	mAdc
Max. Signal Driving Power (approx.)	15	20	W
Max. Signal Plate Output (approx.)	120	170	W

RF POWER AMPLIFIER AND OSCILLATOR --

CLASS C TELEGRAPHY AND FM TELEPHONY

MAXIMUM RATINGS:

Frequency	500 MHz or less	1215 MHz or less	
DC Plate Voltage	2000	1500	Vdc
DC Plate Current	500	500	mAdc
DC Grid No.2 Voltage	600	600	Vdc
DC Grid No.1 Voltage	-250	-250	Vdc
DC Grid No.1 Current	100	100	mAdc
Plate Input	1000	750	W
Grid No.2 Input	12	12	W
Plate Dissipation	450	450	W

TYPICAL OPERATION (circuit, grounded cathode)

Frequency	500	500	500	MHz
DC Plate Voltage	1200	1500	2000	Vdc
DC Grid No.2 Voltage	400	400	400	Vdc
DC Grid No.1 Voltage	-48	-50	-50	Vdc
DC Plate Current	350	500	500	mAdc
DC Grid No.2 Current	0.5	5	4	mAdc
DC Grid No.1 Current	35	60	50	mAdc
Plate Input	420	750	1000	W
Driving Power (approx.)	11.5	21	21	W
Effective Output	230	410	550	W

CHARACTERISTIC VALUES FOR EQUIPMENT DESIGN

Characteristics	Conditions	Allowable Values			
		Symbol	Nom.	Min.	Max.	Unit
Heater Current		I_f:	5.5	5.0	6.0	A
Grid No.1 Voltage (1)	Eb=1400Vdc Ib=250mAdc E_{c2}=400Vdc E_f=6V	E_{c1}:	-12	-17	-7	Vdc
Grid No.1 Voltage (2)	Eb=1400Vdc Ib=5mAdc E_{c2}=400Vdc E_f=6V	E_{c1}:	-	-45	-	Vdc
Grid No.2 Amplification Factor	Eb=Open I_{c2}=30mAdc E_{c2}=400Vdc ΔE_{c2}=-30Vdc	μ_{g1g2}:	15	11	19	-
Mutual Condactance	Eb=1400Vdc E_{c2}=400Vdc Ib=250mAdc ΔE_{c1}=-5Vdc	g_m:	25	21	29	m℧

Characteristics	Conditions	Allowable Values			
		Symbol	Nom.	Min.	Max.	Unit
Peak Emission	E_f=6V is=30A	es:	-	-	450	V
Plate Power Output	Eb=2000Vdc Ef=5.5V Ec1/Ib=5000mAdc f=480MHz	Po:	-	480	-	W
Direct Interelectrode Capacitances						
Grid No.1 - Cathode		C_{g1k}:	24.7	21.2	28.2	pF
Grid No.1 - Grid No.2		C_{g1g2}:	38.9	34.8	43.0	pF
Grid No.2 - Plate		C_{g2p}:	8.2	7.0	9.4	pF
Grid No.1 - Plate		C_{g1p}:	0.07	-	0.12	pF
Grid No.2 - Cathode		C_{g2k}:	0.52	-	0.9	pF
Plate - Cathode		C_{pk} :	0.008	-	0.02	pF

EQUIPMENT DESIGN CONSIDERATIONS

1. Maximum Ratings

The tabulated maximum electrical and mechanical ratings are limited values above which the performance of the tube may be impaired. Be sure not to exceed the given values under continuous of transient conditions. Equipment design should limit voltage and environmental variations so that ratings will never be exceeded.

2. Cooling System

The relation of the plate dissipation and the plate seal temperature rise is shown in Fig. 1 -- cooling air flow given in parameters.

The terminals other than the plate are cooled by the air flow in the cavity oscillator at a rate of about minimum 0.1 m^3/min.

As the temperature of the heater terminals is apt to increase, they must be cooled by conducting through the terminal contacts in addition to the air-cooling system.

3. Heater Voltage

As the frequency becomes higher, the temperature of the cathode rises because of counter-heat resulting from the interelectrode electron transit. In order to keep the cathode at the normal temperature, the heater voltage must be dropped. The relation of the operational frequency and the heater voltage is shown in Table 1.

Table 1

Frequency (MHz)	Heater Voltage (V)
400 or less	6.0 - 5.5
400 - 800	5.5 - 5.2
800 - 1200	5.2 - 4.9

4. High Voltage Application and Stop

When applying a voltage to grid No.2 and the plate after pre-heating, it must be applied at a time or to the plate first.

To stop operation, the plate voltage and grid No.2 voltage must be discontinued at a time or grid No.2 voltage must be discontinued at first.

If the voltage is applied to grid No.2 only, grid No.2 input will exceed the rated value and the tube will be damaged.

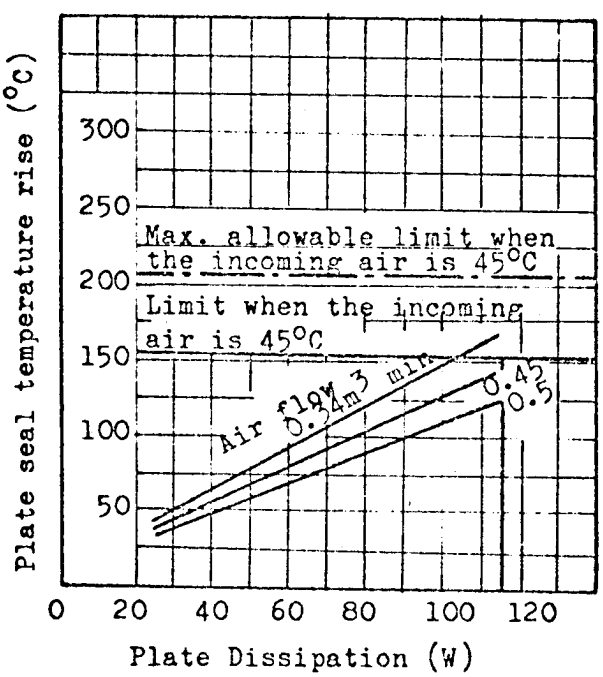


Fig. 1

APPLICATION INSTRUCTIONS

1. Inspection

As soon as you receive the NEC 5F60R tube(s), inspect whether there is a crack to the ceramic part or a defect -- such as abnormal deformation or damage -- to the metal part or not.

Then, the heater must be tested for its continuity by an ohmmeter.

If there is any damage or defect, please describe the conditions of the damage and mail to the Electron Tube Division, NEC, within two weeks after you received the tube. The serial number of the tube in question must be also stated.

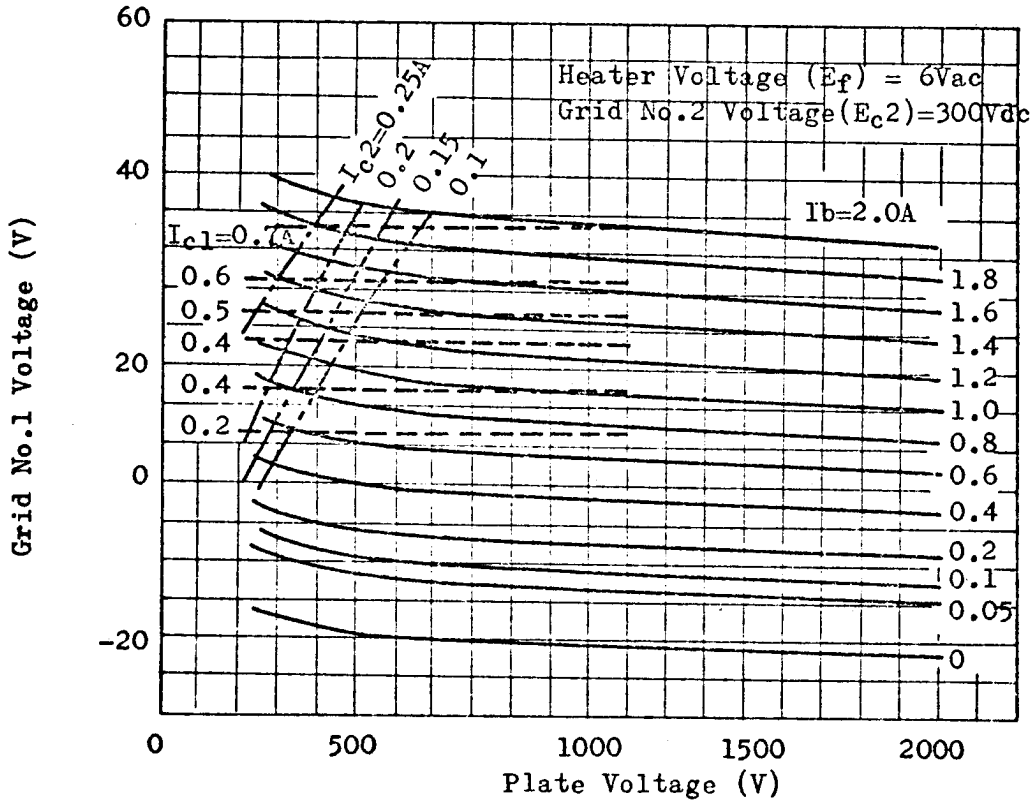
2. Operation

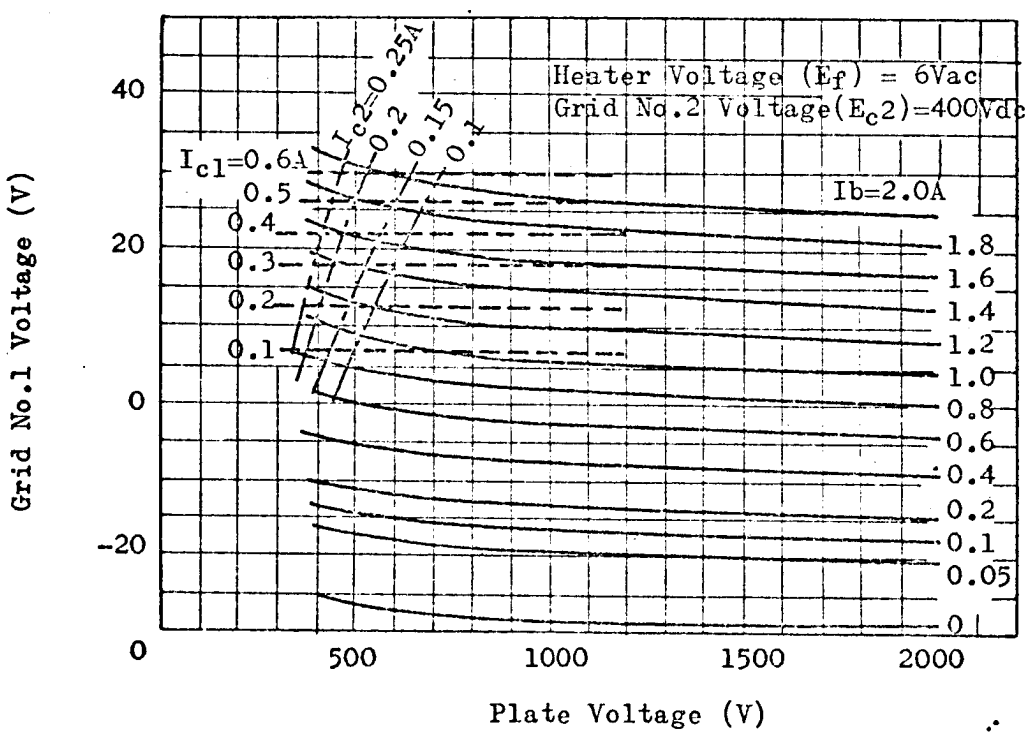
Mount the tube in the socket after making sure that the cooling air is being supplied as prescribed and pre-heat it.

The normal pre-heating time is two minutes but for the first operation it must be pre-heated for about 5 minutes. After pre-heating the tube, apply the voltage to the electrodes and adjust the circuit. As grid No.2 current is very sensitive against the anode circuit load, the non-loaded or lightly-loaded circuit must be carefully adjusted.

If grid No.2 current is excessive, the tube will be damaged.

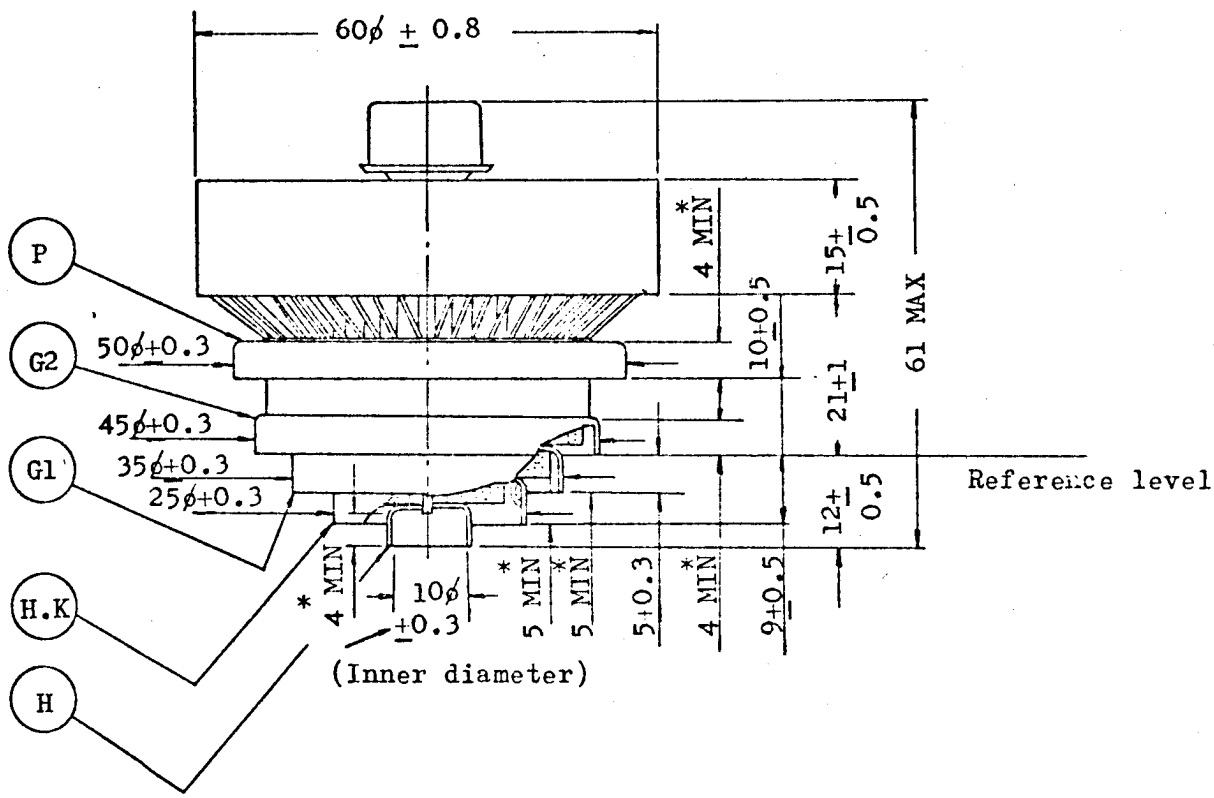
CONSTANT CURRENT CHARACTERISTICS





OUTLINE DRAWING

(Unit: mm)



Note: * mark denotes the length of the effective contact surfaces.