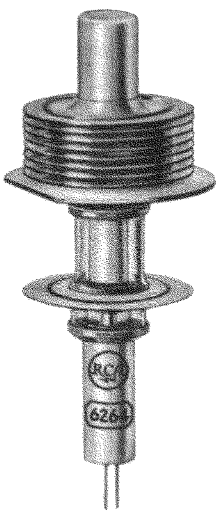
# 6264

## UHF MEDIUM-MU TRIODE

| | | |
|---|---|---|
| **External Plate Radiator** | **"Pencil-Type" Structure** | **High-Altitude Operation** |
| **High Transconductance** | **13-Watt ICAS Plate Dissipation** | **Full Ratings to 500 Mc.** |

TENTATIVE DATA

RCA-6264 is a uhf triode utilizing the "pencil-type" structure with external plate radiator and having an amplification factor of 40. It is intended for use as a frequency multiplier, and as an rf power amplifier and oscillator in mobile equipment and in aircraft transmitters operating at altitudes up to 6000 feet without pressurized chambers. Its structure makes it particularly suitable in cathode-drive applications. In such applications, the grid is employed to provide rf isolation within the tube between the load circuit and the input circuit. The 6264 can be operated with full ratings at frequencies up to 500 megacycles per second and with reduced ratings at frequencies as high as 1700 megacycles per second.



*Actual Size*

When operated under ICAS conditions, the 6264 can deliver useful power outputs of approximately 3.4 watts as a frequency tripler to 510 megacycles per second, 10 watts as an unmodulated class C rf power amplifier at 500 megacycles per second, and 6 watts as an unmodulated class C oscillator at 500 megacycles per second. The oscillator output of 6 watts is obtained with a plate input of only 12 watts.

Featured in the design of the 6264 is an efficient radiator for plate cooling by means of convection or forced air. The radiator consists of 9 disc-type cooling fins, one of which serves as the plate terminal and is wider and thicker than the others. This fin provides high thermal conductivity to the supporting cavity or circuit connections. In addition, this fin has a segment removed to provide a straight edge for locating the plane of the heater leads, and for orienting a pair of tubes so that their straight edges face each other to facilitate compact cavity design.

The 6264 also incorporates a newly designed, sturdy grid flange that permits the design of a clamp connector which will not subject the grid seal to appreciable strain, and a longer glass section between the plate cylinder and grid flange to prevent arc-over at very high altitudes.

The coaxial-electrode structure of the 6264 is of the double-ended metal-glass type in which the plate cylinder with attached radiator and cathode cylinder extend outward from each side of the grid flange. The latter is particularly effective in permitting rf isolation of the load circuit from the input circuit. In addition, the disc-seal type of electrode termination, inherent in the design of "pencil-type" types, permits the utilization of closed-cavity resonators which minimize power loss through radiation. As compared with more conventional terminals, this type of termination gives much lower inductance values and higher resonant frequencies. Although designed for use in circuits of the coaxial-cylinder type, the 6264 is also suitable for use in circuits of the line type and lumped-circuit type.

The "pencil-type" construction not only meets requirements as to minimum transit time, low lead inductance, and low interelectrode capacitance, but also provides other desirable design features such as extreme sturdiness, small size, light weight, low heater wattage, good thermal stability, and convenience of use in equipment design.

## GENERAL DATA

**Electrical:**

| | | |
|---|---|---|
| Heater, for Unipotential Cathode: | | |
| Voltage (AC or DC): | | |
| Under Transmitting Conditions . . | 6.0 ± 10% | volts |
| Under Standby Conditions . . . . | 6.3 max. | volts |
| Current at 6.0 volts . . . . . . . | 0.280 | amp |

Amplification Factor . . . . . . . . 40

Transconductance, for dc plate current of 18.5 milliamperes and dc plate voltage of 200 volts . . . . . . 6800 μmhos

Direct Interelectrode Capacitances:

| | With External Shield▲ | Without External Shield | |
|---|---|---|---|
| Grid to Plate . . . | 1.5 | 1.75 | μμf |
| Grid to Cathode . . | – | 2.95 | μμf |
| Plate to Cathode . | – | 0.07 max. | μμf |

**Mechanical:**

Mounting Position . . . . . . . . . . . . . . . . . . . . Any

Dimensions and Terminal Connections . . . . . . . . . See Dimensional Outline

Radiator . . . . . . . . . . . . . Integral part of tube

Cooling:

In many applications, the 6264 does not require forced-air cooling. The radiator in combination with a connector having adequate heat conduction capability will generally provide adequate cooling under conditions of free circulation of air. The cooling must be sufficient to limit the plate-seal temperature to 175°C. When conditions do not provide adequate circulation of air, provision should be made to direct a blast of cooling air from a small blower through the radiator fins. The quantity of air should be sufficient to limit the plate-seal temperature of 175°C. See curves in Fig.1.

Incoming Air Temperature . . . . . . . 40 max. °C

Plate-Seal Temperature (Measured on Plate Seal) . . . . . . . . . . . . 175 max. °C

Weight (Approx.) . . . . . . . . . . . 24 grams(0.85 oz)

## RF POWER AMPLIFIER AND OSCILLATOR-- Class C Telegraphy

*Key-down conditions per tube without amplitude modulation**

| | *CCS#* | *ICAS##* | |
|---|---|---|---|
| **Maximum Ratings,** *Absolute Values:* | | | |
| *For Pressures Down to 46 mm of Hg*** | | | |
| DC PLATE VOLTAGE . . . . . | 330 max. | 400 max. | volts |
| DC GRID VOLTAGE . . . . . . | –100 max. | –100 max. | volts |
| DC PLATE CURRENT . . . . . | 40 max. | 50 max. | ma |
| DC GRID CURRENT . . . . . . | 25 max. | 25 max. | ma |
| DC CATHODE CURRENT . . . . | 55 max. | 70 max. | ma |
| PLATE INPUT . . . . . . . . | 13 max. | 22 max. | watts |
| PLATE DISSIPATION . . . . . | 8 max. | 13 max. | watts |
| PEAK HEATER-CATHODE VOLTAGE: | | | |
| Heater negative with respect to cathode . | 90 max. | 90 max. | volts |
| Heater positive with respect to cathode . | 90 max. | 90 max. | volts |

**Typical Operation as Oscillator in Cathode-Drive Circuit at 500 Mc:**

| | | | |
|---|---|---|---|
| DC Plate Voltage . . . . . | 300 | 350 | volts |
| DC Grid Voltage† . . . . . | –25 | –30 | volts |
| DC Plate Current . . . . . | 35 | 35 | ma |
| DC Grid Current (Approx.) . | 11 | 13 | ma |
| Useful Power Output (Approx.) | 5● | 6● | watts |

**Typical Operation as RF Power Amplifier in Cathode-Drive Circuit at 500 Mc:**

| | | | |
|---|---|---|---|
| DC Plate Voltage . . . . . | 300 | 350 | volts |
| DC Grid Voltage† . . . . . | –42 | –45 | volts |
| DC Plate Current . . . . . | 35 | 40 | ma |
| DC Grid Current (Approx.) . | 13 | 15 | ma |
| Driver Power Output (Approx.) | 2.4 | 3 | watts |
| Useful Power Output (Approx.) | 7.5● | 10● | watts |

**Maximum Circuit Values:**

| | | | |
|---|---|---|---|
| Grid-Circuit Resistance . . | 0.1 max. | 0.1 max. | megohm |

## FREQUENCY MULTIPLIER

| | *CCS#* | *ICAS##* | |
|---|---|---|---|
| **Maximum Ratings,** *Absolute Values:* | | | |
| *For Pressures Down to 46 mm of Hg*** | | | |
| DC PLATE VOLTAGE . . . . . | 300 max. | 350 max. | volts |
| DC GRID VOLTAGE . . . . . . | –125 max. | –140 max. | volts |
| DC PLATE CURRENT . . . . . | 33 max. | 45 max. | ma |
| DC GRID CURRENT . . . . . . | 15 max. | 15 max. | ma |
| DC CATHODE CURRENT . . . . | 45 max. | 55 max. | ma |
| PLATE INPUT . . . . . . . . | 9.9 max. | 15.8 max. | watts |
| PLATE DISSIPATION . . . . . | 6 max. | 9.5 max. | watts |
| PEAK HEATER-CATHODE VOLTAGE: | | | |
| Heater negative with respect to cathode . | 90 max. | 90 max. | volts |
| Heater positive with respect to cathode . | 90 max. | 90 max. | volts |

**Typical Operation as Tripler to 510 Mc in Cathode-Drive Circuit:**

| | | | |
|---|---|---|---|
| DC Plate Voltage . . . . . | 300 | 350 | volts |
| DC Grid Voltage† . . . . . | –110 | –122 | volts |
| DC Plate Current . . . . . | 26 | 36.5 | ma |
| DC Grid Current (Approx.) . | 4.1 | 5.8 | ma |
| Driver Power Output (Approx.) | 2.75 | 4.5 | watts |
| Useful Power Output (Approx.) | 2.1● | 3.4● | watts |

**Maximum Circuit Values:**

| | | | |
|---|---|---|---|
| Grid-Circuit Resistance . . | 0.1 max. | 0.1 max. | megohm |

## CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

| | *Note* | *Min.* | *Max.* | |
|---|---|---|---|---|
| Heater Current . . . . . . | 1 | 0.260 | 0.300 | ma |
| Grid-to-Plate Capacitance . | – | 1.50 | 2.0 | μμf |
| Grid-to-Cathode Capacitance | – | 2.50 | 3.40 | μμf |
| Plate-to-Cathode Capacitance | – | – | 0.07 | μμf |
| Plate Current . . . . . . . | 1,2 | 13 | 24 | ma |
| Transconductance . . . . . | 1,2 | 5400 | 8200 | μmhos |
| Useful Power Output . . . . | 3,4 | 6.5 | – | watts |

Note 1: With 6.0 volts ac or dc on heater.

Note 2: With dc plate voltage of 200 volts, cathode resistor of 100 ± 1% ohms, and cathode bypass capacitor of 1000 uf.

Note 3: With 5.4 volts ac or dc on heater.

Note 4: With plate voltage of 350 volts, grid resistor adjusted to give a dc plate current of 50 milliamperes in a cavity-type oscillator operating at 500 megacycles per second and having an efficiency of about 75 per cent.

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▲ A flat plate shield 1-1/4" diameter located parallel to the plane of the grid flange and midway between the grid flange and the radiator plate terminal. The shield is tied to the cathode.

* Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 percent of the carrier conditions.

** Corresponds to altitude of about 60000 feet.

# Continuous Commercial Service.

## Intermittent Commercial and Amateur Service.

● This value of useful power is measured at load of output circuit having an efficiency of about 75 per cent.

† From a grid resistor, or from a suitable combination of grid resistor and fixed supply or grid resistor and cathode resistor.

## OPERATING CONSIDERATIONS

The *maximum ratings* shown in the tabulated data are limiting values above which the serviceability of the 6264 may be impaired from the viewpoint of life and satisfactory performance.

Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The *maximum seal temperature* of 175°C is a tube rating and is to be observed in the same manner as other ratings. The temperature of the plate seal should be measured on the plate seal. The temperature may be measured with temperature-sensitive paint, such as Tempilaq. The latter is made by the Tempil Corporation, 11 W. 25th Street, New York 10, N. Y., in the form of a liquid and stick.

The *mounting* for the 6264 in coaxial-line, parallel-line, or lumped circuits may support the tube securely by any one of the three terminals as described in RCA Application Note No. AN-156, "Electrode-Terminal Connections for Pencil-Type UHF Triodes". Connections to the other two terminals must be made by contacts with flexible leads.

The mounting for the 6264 in cavity-type circuits should preferably support the tube by the large fin of the radiator to allow for maximum heat conductivity. This fin, which serves as the plate terminal, should make firm contact to the cavity surface.

The *heater* leads of the 6264 fit the Cinch socket No.54A16325 or equivalent. They should not be soldered to circuit elements. The heat of the soldering operation may crack the glass seals of the heater leads and damage the tube.

The *cathode* should preferably be connected to one side of the heater. When, in some circuit designs, the heater is not connected directly to the cathode, precautions must be taken to hold the peak heater-cathode voltage to the maximum values shown in the tabulated data.

In *class C rf telegraphy service*, the 6264 may be supplied with bias by any convenient method. When the tube is used in the final amplifier or a preceding stage of a transmitter designed for break-in operation and oscillator keying, a small amount of fixed bias must be used to limit the plate current and, therefore, the plate dissipation to a safe value. If the 6264 is operated at a plate voltage of 300 volts, a fixed bias of at least -5 volts should be used.

In *cathode-drive circuits*, the grid driving voltage and the developed rf plate voltage act in series to supply the load circuit. Furthermore, the power required to drive the grid is greatly increased over that needed for grid-drive circuits. However, this increase in power is not lost, because it is transferred to the plate circuit and appears there as tube output.

Another distinction between cathode-drive and grid-drive circuits is that in a grid-drive circuit where a surplus of grid driving power is always available, the power output is only moderately affected by variations in tube charac-

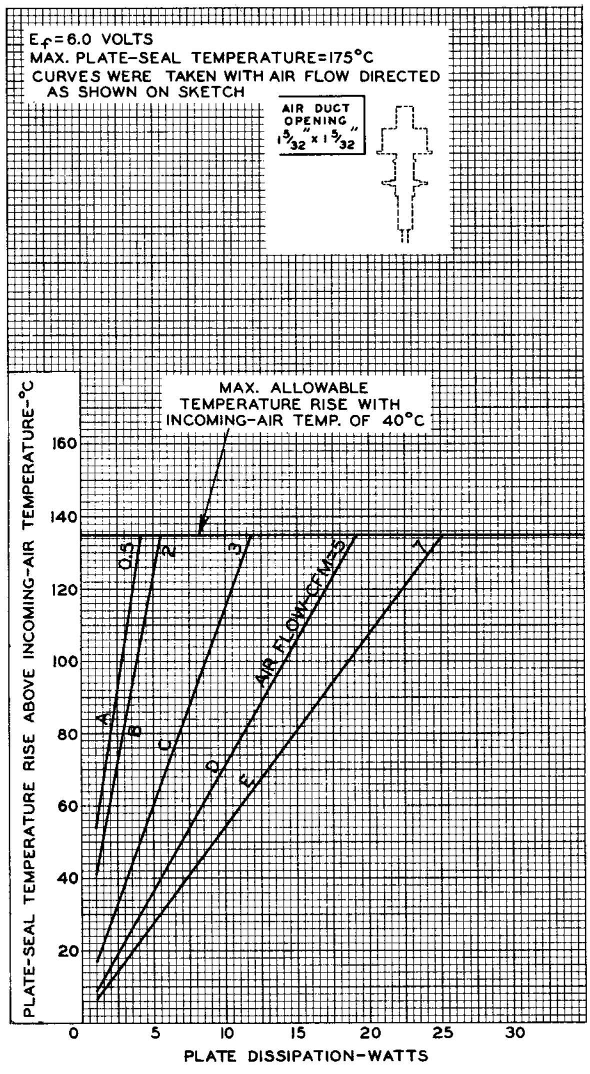



*Fig. 1 - Cooling Requirements of Type 6264.*

teristics and operating conditions with the result that the power output is fairly independent of such variations. In a cathode-drive circuit, however, because part of the grid-driving power is transferred to the output circuit, the power output continues to increase with increased driving power to the point that the tube may be seriously overloaded. This difference in the operating nature of the two circuits is especially important when several tubes are operated in cascade.

In the grid-drive circuit, the output from the final stage is affected to only a minor degree by variations in tube characteristics and operating conditions, whereas in a cathode-drive circuit, the effects of either high or low efficiency are cumulative and can produce wide differences in power output. It is important, therefore, in the design of cathode-drive circuits that due allowances are made for the normal variations which can be expected from individual tubes.

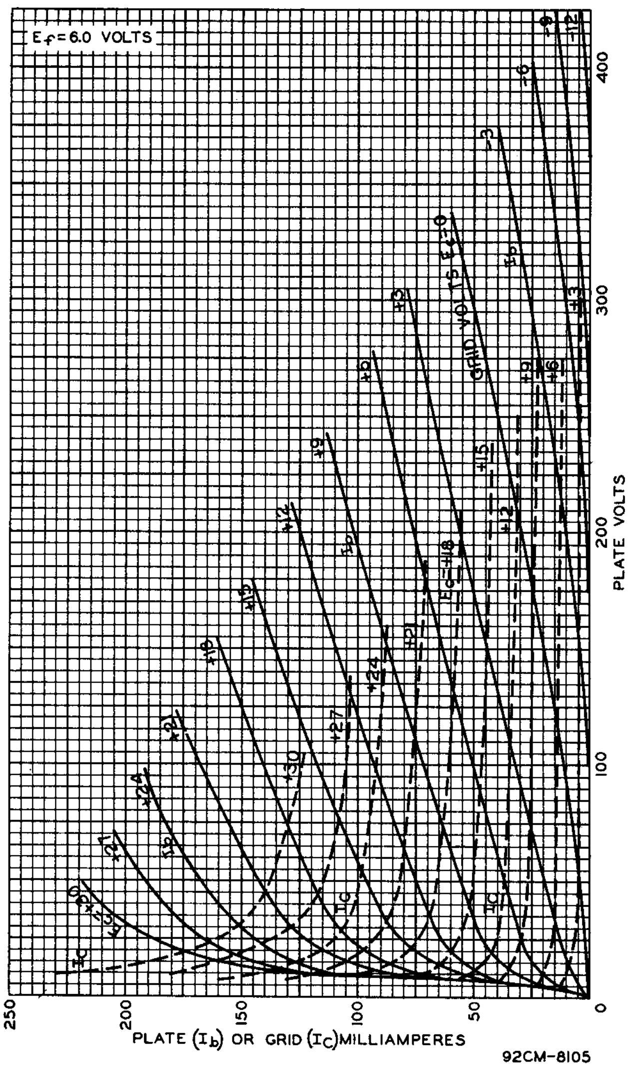



*Fig. 2 - Average Plate Characteristics of Type 6264.*

For example, it is not good design practice to base the expected performance of cascaded cathode-drive stages on a few high-performance tubes. If this practice were to be followed, a substantial percentage of tubes would either not give the anticipated performance or would be disastrously overloaded.

In tuning a cathode-drive rf amplifier, it must be remembered that variations in the load on the output stage will produce corresponding variations in the load on the driving stage. This effect will be noticed by the simultaneous increase in plate currents of both the output and driving stages.

*Parallel circuit arrangements* may be used when more radio-frequency power is required than

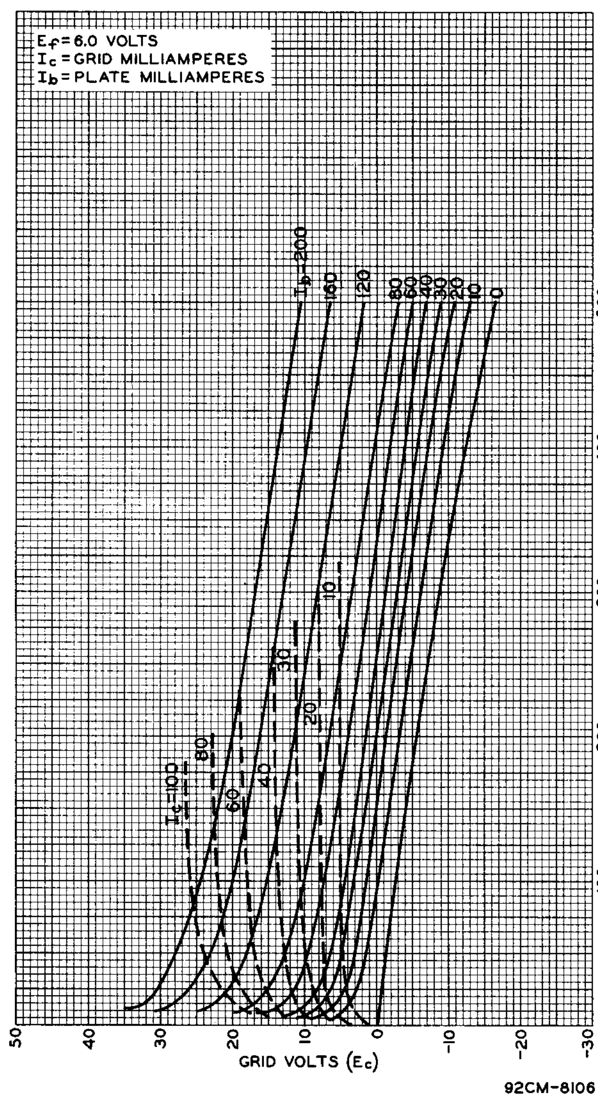



*Fig. 3 - Average Constant-Current Characteristics of Type 6264.*

can be obtained from a single tube. Two tubes in parallel will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage over that required to drive a single tube, but the driving power required is approximately twice that for a single tube. When two or more tubes are used in the circuit, precautions should be taken to balance the plate currents.

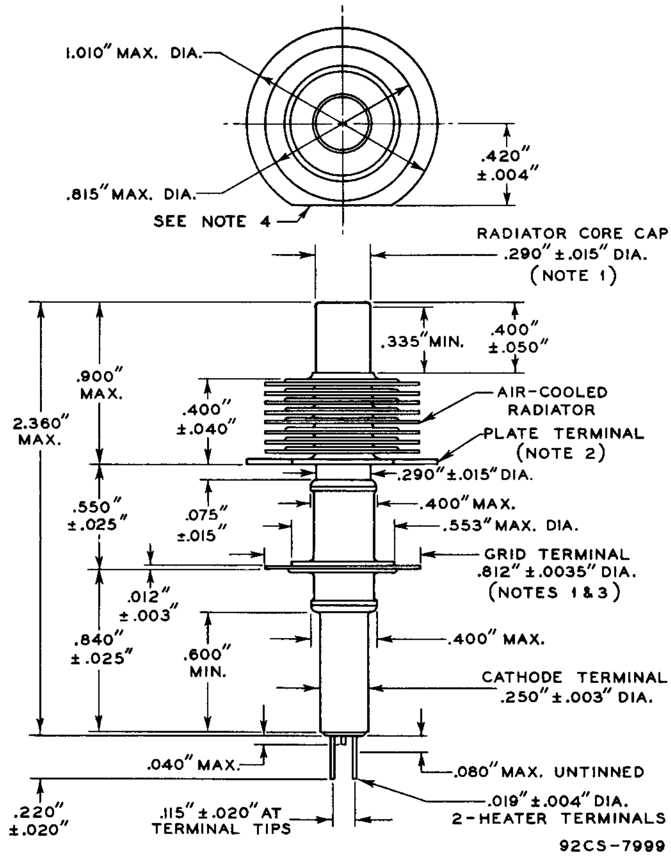
## REFERENCES

G. M. Rose, D. W. Power, and W. A. Harris, *"Pencil-Type UHF Triodes"*, RCA Review, Vol.10, No.3, pp.321-338 (September, 1949).

E. E. Spitzer, *"Grounded-Grid Power Amplifiers"*, Electronics, Vol.19, No.4 pp.138-141 (April, 1946).

RCA Application Note *"Electrode-Terminal Connections for Pencil-Type UHF Triodes"*, No.AN-156 September, 1953.

## DIMENSIONAL OUTLINE



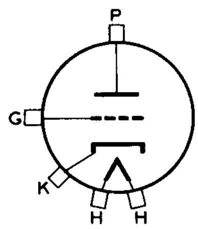

**NOTE 1:** MAX. ECCENTRICITY OF ℄ (AXIS) OF RADIATOR-CORE CAP OR GRID-TERMINAL FLANGE WITH RESPECT TO THE ℄ (AXIS) OF THE CATHODE TERMINAL IS 0.015".

**NOTE 2:** TILT OF PLATE-TERMINAL FIN OF RADIATOR WITH RESPECT TO ROTATIONAL AXIS OF CATHODE CYLINDER IS DETERMINED BY CHUCKING THE CATHODE TERMINAL, ROTATING THE TUBE, AND GAUGING THE TOTAL TRAVEL DISTANCE OF THE PLATE-TERMINAL FIN PARALLEL TO THE AXIS AT A POINT APPROXIMATELY 0.020" INWARD FROM THE STRAIGHT EDGE OF THE PLATE-TERMINAL FIN FOR ONE COMPLETE ROTATION. THE TOTAL TRAVEL DISTANCE WILL NOT EXCEED 0.035".

**NOTE 3:** TILT OF GRID-TERMINAL FLANGE WITH RESPECT TO ROTATIONAL AXIS OF CATHODE TERMINAL IS DETERMINED BY CHUCKING THE CATHODE TERMINAL, ROTATING THE TUBE, AND GAUGING THE TOTAL TRAVEL DISTANCE OF THE GRID-TERMINAL FLANGE PARALLEL TO THE AXIS AT A POINT APPROXIMATELY 0.020" INWARD FROM ITS EDGE FOR ONE COMPLETE ROTATION. THE TOTAL TRAVEL DISTANCE WILL NOT EXCEED 0.025".

**NOTE 4:** THE STRAIGHT EDGE ON THE PERIMETER OF THE LARGE FIN (PLATE TERMINAL) IS PARALLEL TO A PLANE THROUGH THE CENTERS OF THE HEATER LEADS AT THEIR SEALS WITHIN 15°.

## TERMINAL CONNECTIONS




H: HEATER
K: CATHODE CYLINDER
(Adjacent to heater-lead terminals)
G: GRID FLANGE
(Between glass sections)
P: PLATE CYLINDER
(With integral radiator)