



4604

BEAM POWER TUBE

Quick-Heating Filament
Small Size
Sturdy Structure

High Power Sensitivity
90 Watts CW Input (ICAS) up to 60 Mc
60 Watts CW Input (ICAS) at 175 Mc

3-13/16" Max. Length
1-21/32" Max. Diameter
Octal 8-Pin Base

RCA-4604 is a quick-heating beam power tube having high efficiency and high power sensitivity. It is designed as an rf power amplifier in push-to-talk use in mobile and emergency-communications equipment. The 4604 has a maximum plate dissipation of 25 watts under ICAS conditions in cw and fm telephony service. At this service, it can be operated with full input to 60 Mc and with reduced input to 175 Mc.



The 4604 employs a quick-heating, oxide-coated filament which reaches operating temperature less than one second after filament voltage is applied. In addition to its quick-heating characteristic the filament is both sturdy and efficient.

Small in size for its power-output capability, the 4604 has a rugged button-stem construction with short internal leads, a T-12 bulb, triple base-pin connections for grid No.3 and filament tap (both joined to internal shield inside the tube) to permit effective rf grounding, and an octal base with short metal sleeve having its own base-pin terminal. The sleeve shields the input to the tube and isolates it from the output circuit so completely that no other external shielding is required. Separation of input and output circuits is accomplished by bringing the plate lead out of the bulb to a cap opposite the base.

GENERAL DATA

Electrical:

Filament, Coated:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.65	ampere
Heating time	1	second
Transconductance, for plate volts = 200, grid-No.2 volts = 200, and plate ma = 100		
	6000	μmhos
MU-Factor, Grid No.2 to Grid No.1 for plate volts = 200, grid-No.2 volts = 200, and plate ma = 100		
	4	
Direct Interelectrode Capacitances:		
Grid No.1 to plate	0.24 max.	μμf
Grid No.1 to filament & grid No.3 & internal shield, base sleeve and grid No.2	11	μμf
Plate to filament & grid No.3 & internal shield, base sleeve and grid No.2	8.5	μμf

Mechanical:

Operating Position	Vertical, or horizontal with plane of pins 3 and 7 vertical
Maximum Overall Length	3-13/16"
Seated Length	3-1/8" ± 1/8"
Maximum Diameter	1-21/32"
Bulb	T-12
Cap	Small (JEDEC No. C1-1)
Base	Small Wafer Octal 8-Pin with Sleeve (JEDEC Group 1, No. 88-150)
Bulb Temperature (At hottest point)	220 max. °C

RF POWER AMPLIFIER & OSC. — Class C Telephony* and RF POWER AMPLIFIER — Class C FM Telephony

Maximum ICAS* Ratings, Absolute-Maximum Values: ♦
Up to 60 Mc

DC PLATE VOLTAGE	750 max.	volts
DC GRID-No.2 VOLTAGE	250 max.	volts
DC GRID-No.1 VOLTAGE	-150 max.	volts
DC PLATE CURRENT	150 max.	ma
DC GRID-No.1 CURRENT	4 max.	ma
PLATE INPUT	90 max.	watts
GRID-No.2 INPUT	3 max.	watts
PLATE DISSIPATION	25 max.	watts

Typical Operation as Amplifier at 175 Mc:

DC Plate Voltage	400	volts
DC Grid-No.2 Voltage ♦	190	volts
From a series resistor of	18000	ohms
DC Grid-No.1 Voltage ♦	-60	volts
From a grid resistor of	30000	ohms



DC Plate Current.	150	ma
DC Grid-No.2 Current.	11	ma
DC Grid-No.1 Current (Approx.).	2	ma
Driving Power (Approx.)	4.5	watts
Power Output (Approx.)	30	watts

Maximum Circuit Values:

Grid-No.1 Circuit Resistance*	30000 max.	ohms
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CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	<i>Min.</i>	<i>Max.</i>	
Filament Current at 6.3 volts ac.	0.59	0.71	ampere
Direct Interelectrode Capacitances:			
Grid No.1 to plate.	-	0.24	$\mu\mu\text{f}$
Grid No.1 to filament & grid No.3 & internal shield, base sleeve and grid No.2	9.5	12.5	$\mu\mu\text{f}$
Plate to filament & grid No.3 & internal shield, base sleeve and grid No.2	7.3	9.5	$\mu\mu\text{f}$
Plate Current [Ⓞ]	46	94	ma
Grid-No.2 Current [Ⓞ]	-	5.5	ma
Useful Power Output*.	47	-	watts

• Key-down conditions per tube without amplitude modulation. Amplitude modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

★ Intermittent Commercial and Amateur Service.

♦ The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment-component variation, equipment-control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

♣ Obtained preferably from a separate source, or from the plate-supply voltage with a voltage divider, or through a series resistor. A series grid-No.2 resistor should be used only when the 4604 is used in a circuit which is not keyed. Grid-No.2 voltage must not exceed 400 volts under key-up conditions.

♠ Obtained from fixed supply, by grid-No.1 resistor, or by combination methods.

♣ When grid No.1 is driven positive and the 4604 is operated at maximum ratings, the total dc grid-No.1-circuit resistance should not exceed the specified value of 30000 ohms. If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a fixed supply.

Ⓞ With 6.3 volts ac on filament, dc plate voltage of 300 volts, dc grid-No.2 voltage of 200 volts, and dc grid-No.1 voltage of -26 volts.

* In a single-tube self-excited oscillator circuit, and with 6.3 volts ac on filament, dc plate voltage of 600 volts, dc grid-No.2 voltage of 200 volts, grid-No.1 resistor of 30000 ± 10% ohms, dc plate current of 100 to 112 ma., dc grid-No.1 current of 2 to 2.5 ma., and frequency of 15 Mc.

MECHANICAL CONSIDERATIONS

The *bulb* becomes hot during operation. To insure adequate cooling, therefore, it is essen-

tial that free circulation of air be provided around the 4604.

The *plate* shows no color when the 4604 is operated at full ratings under ICAS conditions. Connections to the plate should be made with a flexible lead to prevent any strain on the seal at the cap.

ELECTRICAL CONSIDERATIONS

The rated plate voltage and grid-No.2 voltage of this tube are high enough to be dangerous. Care should be taken during adjustment of circuits, especially when exposed circuit parts are at high dc potential.

Heavy leads and conductors together with suitable insulation should be used in all parts of the rf plate tank circuit so that losses due to rf voltages and currents may be kept at a minimum. At the higher frequencies, it is essential that short, heavy leads be used for circuit connections in order to minimize lead inductance and losses.

When a new circuit is tried or when adjustments are made, it is advisable to reduce the plate voltage and grid-No.2 voltage. If the 4604 is operated at maximum ratings and grid-No.2 voltage is obtained through a series dropping resistor, the use of a 2500-ohm protective resistor in the high-voltage supply lead is recommended. When a separate grid-No.2 voltage supply is used, a 10000-ohm protective resistor should be connected in the grid-No.2 supply lead.

Grid-No.2 voltage should be obtained from a source of good regulation. The plate voltage should be applied before or simultaneously with the grid-No.2 voltage; otherwise, with voltage on grid-No.2 only, its current may be large enough to cause excessive grid-No.2 dissipation. A dc milliammeter should be used in the grid-No.2 circuit so that its current may be measured and the dc power output determined.

The *grid-No.2 current* is a very sensitive indication of plate-circuit loading and grid-No.2 current rises excessively (often to the point of damaging the tube) when the amplifier is operated without load. Therefore, care should be taken when tuning a 4604 under no-load conditions in order to prevent exceeding the grid-No.2 input rating of the tube.

The *driver stage* for the 4604 in either class C telephony or telegraphy service should have considerably more output capability than the typical driving power shown in the tabulated data in order to permit considerable range of adjustment, and also to provide for losses in the grid-No.1 circuit and the coupling circuits. This recommendation is particularly important near the maximum-rated frequency where there are other losses of driving power, such as circuit losses, radiation losses, and transit-time losses.



Highest operating efficiency in high frequency service, and therefore maximum power output, will be obtained when the 4604 is operated under load conditions such that the maximum rated plate current flows at the plate voltage which will give maximum rated input.

approximately twice that for a single tube. The push-pull arrangement has the advantage of simplifying the balancing of high-frequency circuits.

When two or more tubes are used in the circuit, precautions should be taken to insure that each tube draws the same plate current.

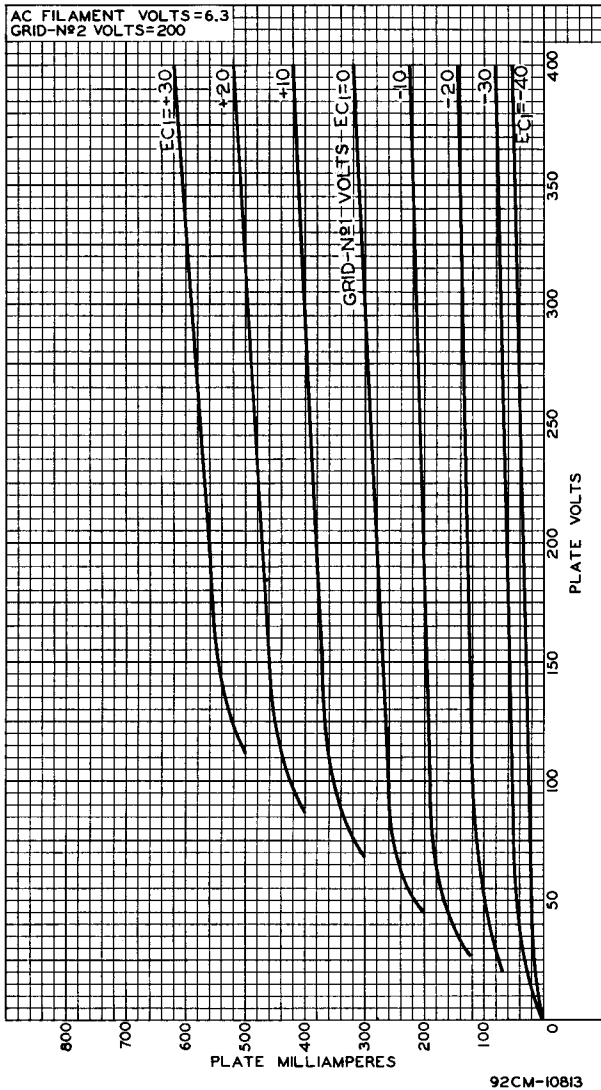


Fig. 1 - Typical Plate Characteristics of Type 4604.

Push-pull or parallel circuit arrangements can be used when more radio-frequency power is required than can be obtained from a single 4604. Two 4604's in parallel or push-pull will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage necessary to drive a single tube. With either connection, the driving power required is

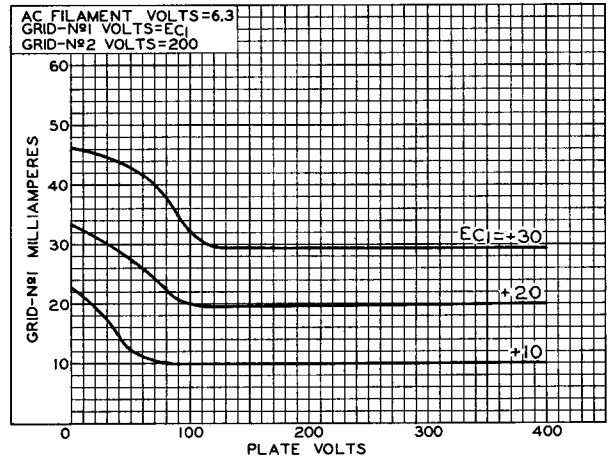


Fig. 2 - Typical Characteristics of Type 4604.

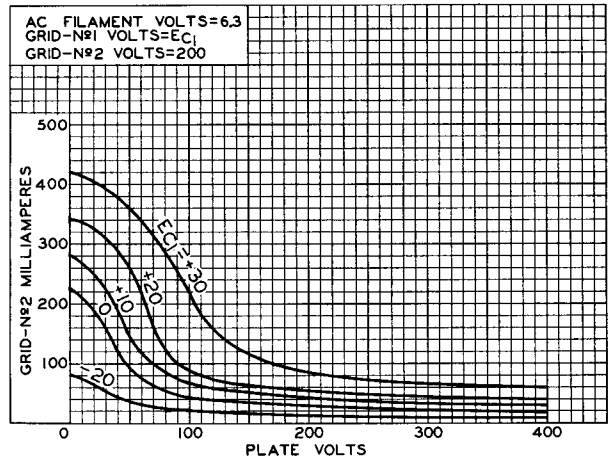


Fig. 3 - Typical Characteristics of Type 4604.

When two 4604's are used in push-pull or parallel circuit arrangements with their filaments connected in series across a 12.6-volt supply, a different bias voltage is required for each tube. Furthermore, the relative polarity of the filament terminals must be maintained when switching between negative-ground and positive-ground supplies.

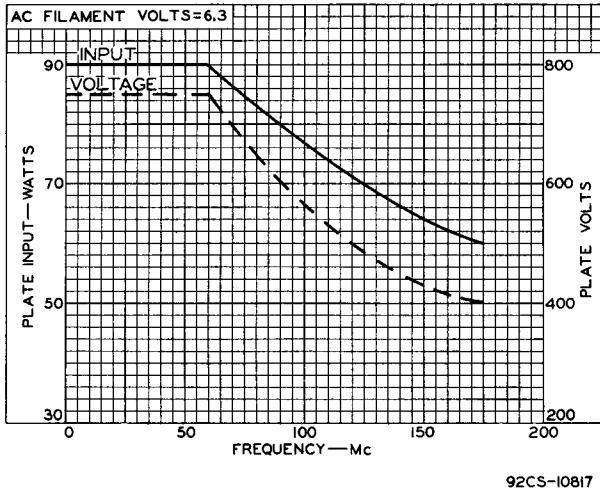
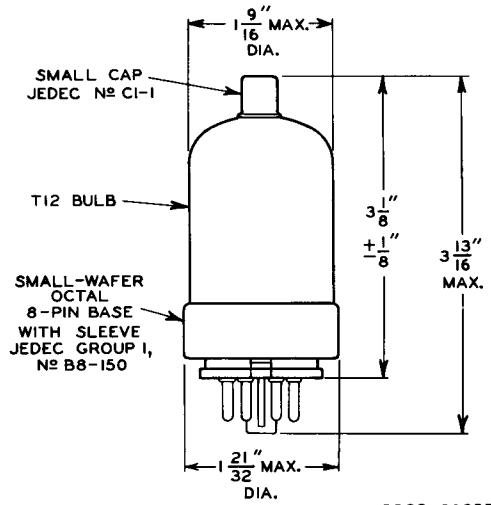
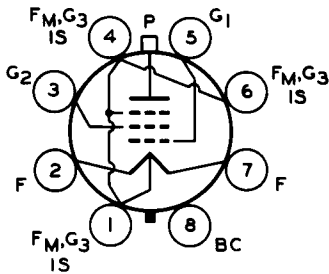


Fig. 4 - Maximum Ratings vs. Operating Frequency for Type 4604 in ICAS Class C Telegraphy or Telephony Service.

DIMENSIONAL OUTLINE



**BASING DIAGRAM
Bottom View**

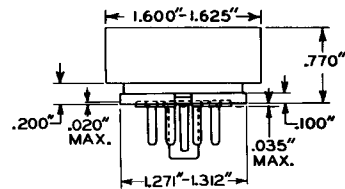


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|--|----------------------------------|
| PIN 1: FILAMENT TAP,
GRID No. 3,
INTERNAL SHIELD | PIN 5: GRID No. 1 |
| PIN 2: FILAMENT | PIN 6: SAME AS PIN No. 1 |
| PIN 3: GRID No. 2 | PIN 7: FILAMENT |
| PIN 4: SAME AS PIN No. 1 | PIN 8: BASE SLEEVE
CAP: PLATE |

BASE DRAWING

SMALL-WAFER OCTAL WITH SLEEVE
JEDEC GROUP I, No. B8-150



BASE-PIN POSITIONS ARE HELD TO TOLERANCES SUCH THAT ENTIRE LENGTH OF PINS WILL ENTER FLAT-PLATE GAUGE (JEDEC No. GB8-1) HAVING THICKNESS OF 1/4" AND EIGHT HOLES WITH DIAMETERS OF 0.1030" ± 0.0005" SO LOCATED ON A 0.6870" ± 0.0005" DIAMETER CIRCLE THAT THE DISTANCE ALONG THE CHORD BETWEEN ANY TWO ADJACENT HOLE CENTERS IS 0.2629" ± 0.0005".

PIN FIT IN GAUGE IS SUCH THAT GAUGE TOGETHER WITH SUPPLEMENTARY WEIGHT TOTALING 2 POUNDS WILL NOT BE LIFTED WHEN PINS ARE WITHDRAWN.

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