



TECHNICAL DATA

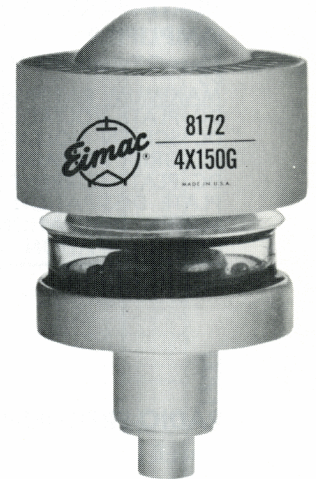
8172
4X150G

**RADIAL-BEAM
POWER TETRODE**

The EIMAC 8172/4X150G is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier, frequency multiplier, or oscillator at frequencies well into the UHF region or as an amplifier in any service requiring a high-gain tube capable of delivering high power-output at low plate-voltage. The combination of a high ratio of transconductance to capacitance and a plate dissipation capability of 250 watts makes the tube an excellent wide-band amplifier for video applications.

The cathode, grid and screen electrodes are mounted on conical and cylindrical supports giving a minimum of circuit discontinuities and lead inductance. The rugged cylindrical terminals, progressively larger in size, allow the tube to be inserted in coaxial line cavities. The screen support and terminal provide maximum isolation between the grid-cathode terminals and the plate circuit.

In amplifier service at 500 megahertz, output power of 140 watts per tube, with a stage power-gain of 14, can be obtained. At 1000 megahertz an output power of 50 watts per tube is obtained with a power-gain of five.



ELECTRICAL GENERAL CHARACTERISTICS

Cathode: Oxide-Coated, Unipotential	Min.	Nom.	Max.	
Heating Time - - - - -	30	60		seconds
Cathode-to-heater Potential - -			150	volts
Heater: Voltage - - - - -		2.5		volts
Current - - - - -	6.2		7.3	amperes
Amplification Factor (Grid-to-Screen) -		5		
Direct Interelectrode Capacitances, Grounded Cathode:	Min.	Max.		
Input - - - - -	25.0	29.0		pf
Output - - - - -	4.0	4.9		pf
Feedback - - - - -		0.05		pf
Direct Interelectrode Capacitances, Grounded Grid and Screen	Min.	Max.		
Input - - - - -	14.5	19		pf
Output - - - - -	4.0	4.9		pf
Feedback - - - - -		0.01		pf
Frequency for Maximum Ratings (CW)				500 MHz
(pulsed)				1500 MHz

MECHANICAL

Base - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Coaxial
Maximum Operating Temperatures:																				
Glass-to-Metal Seals - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	175°C
Ceramic-to-Metal Seals - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	250°C
Anode Core - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	250°C
Operating Position - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Any
Maximum Dimensions:																				
Height - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.75 inches
Diameter - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.635 inches
Cooling - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Forced Air
Net Weight - - - - -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6 ounces
Shipping Weight (Approximate) -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.6 pounds



4X150G

**RADIO-FREQUENCY POWER AMPLIFIER
OR OSCILLATOR**Class-C Telephony or FM Telephony
(Key-down Conditions)**MAXIMUM RATINGS**

DC PLATE VOLTAGE	-	-	-	1250 VOLTS
DC SCREEN VOLTAGE	-	-	-	300 VOLTS
DC GRID VOLTAGE	-	-	-	—250 VOLTS
DC PLATE CURRENT	-	-	-	250 MA
PLATE DISSIPATION	-	-	-	250 WATTS
SCREEN DISSIPATION	-	-	-	12 WATTS
GRID DISSIPATION	-	-	-	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz)

DC Plate Voltage	-	-	600	750	1000	1250	1250 volts
DC Screen Voltage	-	-	250	250	250	250	250 volts
DC Grid Voltage	-	-	—75	—80	—80	—90	—80 volts
DC Plate Current	-	-	200	200	200	200	200 mA
DC Screen Current*	-	-	37	37	30	20	7 mA†
DC Grid Current*	-	-	10	10	10	10	10 mA†
Peak RF Grid Voltage*	-	-	90	95	95	105	— volts
Driving Power*	-	-	0.7	0.7	0.7	0.8	10 watts†
Plate Input Power	-	-	120	150	200	250	250 watts
Plate Output Power	-	-	85	110	150	195	140 watts†

*Approximate values.

†Measured values for a typical cavity amplifier circuit.

**PLATE-MODULATED RADIO-FREQUENCY
AMPLIFIER**

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	-	-	-	1000 VOLTS
DC SCREEN VOLTAGE	-	-	-	300 VOLTS
DC GRID VOLTAGE	-	-	-	—250 VOLTS
DC PLATE CURRENT	-	-	-	200 MA
PLATE DISSIPATION	-	-	-	165 WATTS
SCREEN DISSIPATION	-	-	-	12 WATTS
GRID DISSIPATION	-	-	-	2 WATTS

TYPICAL OPERATION (Frequencies up to 165 MHz)

DC Plate Voltage	-	-	600	800	1000	volts
DC Screen Voltage	-	-	250	250	250	volts
DC Grid Voltage	-	-	—95	—100	—105	volts
DC Plate Current	-	-	200	200	200	mA
DC Screen Current*	-	-	35	25	20	mA
DC Grid Current*	-	-	8	10	15	mA
Peak RF Grid Input Voltage*	-	-	120	120	125	volts
Driving Power*	-	-	1	1.5	2	watts
Plate Input Power	-	-	40	60	60	watts
Plate Output Power	-	-	120	160	200	watts

*Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	-	-	-	1250 VOLTS
DC SCREEN VOLTAGE	-	-	-	400 VOLTS
DC GRID VOLTAGE	-	-	-	250 VOLTS
DC PLATE CURRENT (Average)	-	-	-	250 MA
PLATE DISSIPATION	-	-	-	250 WATTS
SCREEN DISSIPATION	-	-	-	12 WATTS
GRID DISSIPATION	-	-	-	2 WATTS

TYPICAL OPERATION

(Frequencies up to 216 MHz, 5-MHz bandwidth)

DC Plate Voltage	-	-	750	1000	1250	volts
DC Screen Voltage	-	-	300	300	300	volts
DC Grid Voltage	-	-	—60	—65	—70	volts
During Sync-Pulse Peak:						
DC Plate Current	-	-	335	330	305	mA
DC Screen Current	-	-	50	45	45	mA
DC Grid Current	-	-	15	20	25	mA
Peak RF Grid Voltage	-	-	85	95	100	volts
RF Driving Power (approx.)	-	-	7	8	9	watts
Useful Power Output	-	-	135	200	250	watts
Black Level:						
DC Plate Current	-	-	245	240	230	mA
DC Screen Current	-	-	20	15	10	mA
DC Grid Current	-	-	4	4	4	mA
Peak RF Grid Voltage (approx.)	-	-	65	70	75	volts
RF Driver Power (approx.)	-	-	4.25	4.7	5.5	watts
Plate Power Input	-	-	185	240	290	watts
Useful Power Output	-	-	75	110	140	watts

**PLATE PULSED RADIO FREQUENCY
AMPLIFIER OR OSCILLATOR****MAXIMUM RATINGS**

PULSED PLATE VOLTAGE	-	-	-	7000 VOLTS
PULSED SCREEN VOLTAGE	-	-	-	1500 VOLTS
DC GRID VOLTAGE	-	-	-	—500 VOLTS
PULSE DURATION	-	-	-	5 USEC
PULSED CATHODE CURRENT	-	-	-	7 AMPS
AVERAGE POWER INPUT	-	-	-	250 WATTS
PLATE DISSIPATION	-	-	-	250 WATTS
SCREEN DISSIPATION	-	-	-	12 WATTS
GRID DISSIPATION	-	-	-	2 WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200-MHz

Pulsed Plate Voltage	-	-	-	5	7	kV
Pulsed Plate Current	-	-	-	4.0	6.0	amps
Pulsed Screen Voltage	-	-	-	800	1200	volts
Pulsed Screen Current	-	-	-	0.3	0.4	amps
DC Grid Voltage	-	-	-	—200	—250	volts
Pulsed Grid Current	-	-	-	0.5	0.6	amps
Pulse Duration	-	-	-	4	5	μsec
Pulse Repetition Rate	-	-	-	2500	1000	pps
Peak Power Output	-	-	-	7	17	kW

TYPICAL OPERATION (Frequencies up to 165 MHz
peak-envelope conditions except where noted)

DC Plate Voltage	-	-	-	1000	1250	volts
DC Screen Voltage	-	-	-	350	350	volts
DC Grid Voltage*	-	-	-	—55	—55	volts
Zero-Signal DC Plate Current	-	-	-	100	100	mA
Peak RF Grid Voltage**	-	-	-	50	50	volts
DC Plate Current	-	-	-	250	250	mA
DC Screen Current**	-	-	-	10	9	mA
Plate Input Power	-	-	-	250	310	watts
Plate Output Power	-	-	-	120	170	watts
Two-Tone Average						
DC Plate Current	-	-	-	190	190	mA
Two-Tone Average						
DC Screen Current**	-	-	-	2	—1	mA

*Approximate values.

**Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIERClass-AB₁ (Single-Sideband Suppressed-Carrier Operation)**MAXIMUM RATINGS**

DC PLATE VOLTAGE	-	-	-	2000 VOLTS
DC SCREEN VOLTAGE	-	-	-	400 VOLTS
DC PLATE CURRENT	-	-	-	250 MA
PLATE DISSIPATION	-	-	-	250 WATTS
SCREEN DISSIPATION	-	-	-	12 WATTS
GRID DISSIPATION	-	-	-	2 WATTS

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.



APPLICATION

MECHANICAL

Mounting—The 4X150G may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling — The 4X150G requires sufficient forced air to keep the glass-to-metal seals below 175°C and the ceramic-metal seals and anode core below 250°C. The air flow must be started when power is applied to the heater and must continue without interruption until all electrode voltages have been removed from the tube.

Effective cooling of the anode is accomplished by directing six cubic feet per minute of air

through the anode cooler. This flow is obtained at a pressure drop across the cooler of approximately 0.25 inch of water column. The grid, cathode and heater terminals are cooled by high velocity air directed at the terminals and the connecting collets which aid in the removal of heat from the terminals by conduction. The volume required will depend upon the socket arrangement and should be adequate to keep the metal-to-glass seals below 175°C and the center heater terminal below 250°C.

The air requirements stated above are based on operation at sea level an ambient temperature of 20°C. Operation at high altitudes or at high ambient temperatures requires a greater volume of air flow.

Temperature of the external parts of a tube may be measured with the aid of a temperature-sensitive lacquer.

ELECTRICAL

Heater — The rated heater voltage for the 4X150G is 2.5 volts, and should be maintained at this value plus or minus five percent. At frequencies above 300 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C CW amplifier, the heater voltage should be reduced according to the following table.

Frequency	Heater Voltage
301 to 400 MHz	2.4 volts
401 to 500 MHz	2.3 volts

At low duty, in pulse service, no reduction in heater voltage is normally required up to 1500 MHz.

Cathode — The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation—Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents

below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation — The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected

between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4X150G.

Plate Operation — The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage

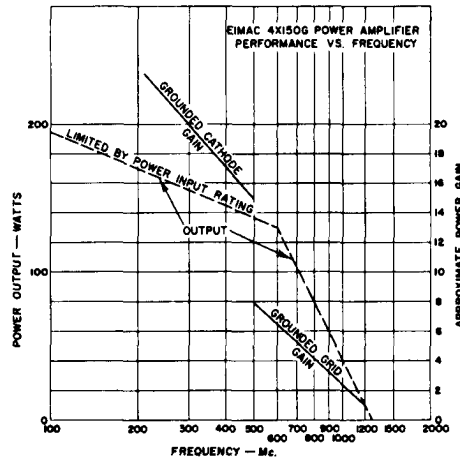
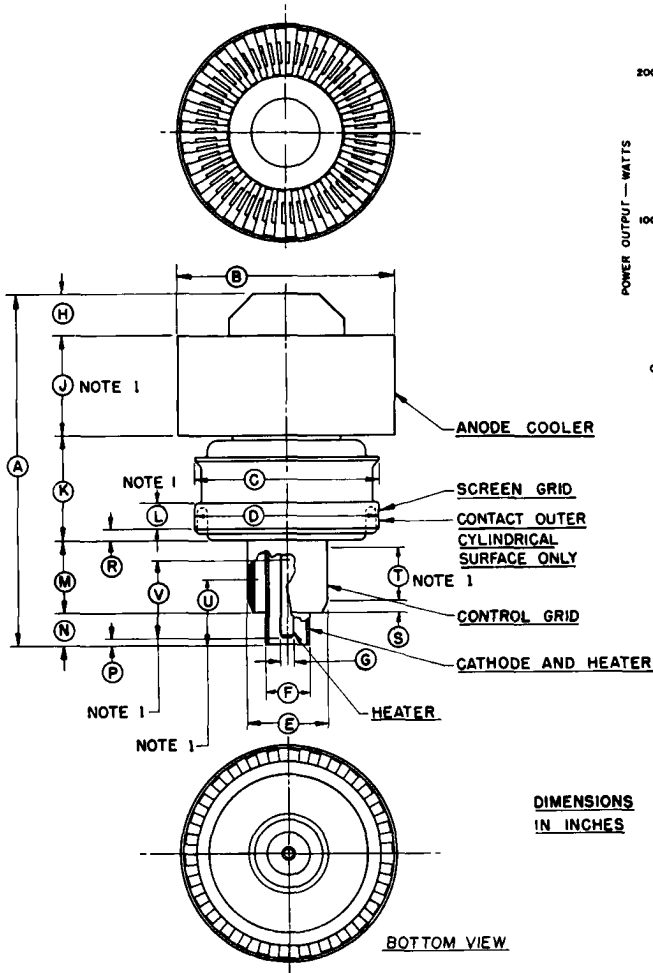
to the tube.

UHF Operation — The 4X150G is suitable use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.



DIMENSION			
REF	NOMINAL	MINIMUM	MAXIMUM
A			2 3/4
B		1.615	1.635
C			1.406
D		1.417	1.433
E		.587	.597
F		.317	.327
G		.088	.098
H			5/16
J		23/32	25/32
K		3/4	13/16
L		3/16	
M		.500	.578
N		15/64	17/64
P		1/32	1/16
R	3/32		
S	1/8		
T		11/32	
U		13/32	
V		15/32	

NOTE 1. LENGTH AVAILABLE FOR CONTACT.



4X150G

