

# Amperex

## 4PR1000A

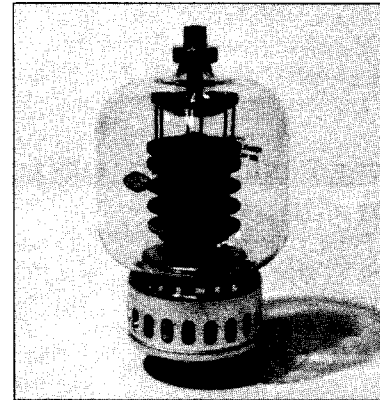
RADIAL-BEAM  
PULSE TETRODE

MODULATOR  
OSCILLATOR  
AMPLIFIER

The 4PR1000A is a pulse tetrode intended for use in pulse modulator, pulsed-amplifier and pulsed-oscillator service. This compact, high vacuum radial-beam tetrode, incorporating a graphite anode and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the anode and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the SK-510 Air System Socket and the SK-506 Air chimney.

The 4PR1000A is specially designed for medical MRI applications where high noise immunity and high stability are required.



### GENERAL CHARACTERISTICS

#### ELECTRICAL

Filament : Thoriated Tungsten	<u>Min.</u>	<u>Nom.</u>	<u>Max.</u>	
Voltage	—	—	7.5	Volts
Current	20.0	—	22.7	Amps
Amplification Factor (Grid to screen)	—	6.9	—	
Direct Interelectrode Capacitances (Grounded Cathode)				
Grid Plate			0.35	pf
Input	23.8		32.4	pf
Output	6.8		9.4	pf
Transconductance ( $I_b = 300$ ma)	10			ma/v
Highest Frequency for Maximum Ratings	110			MHz

#### MECHANICAL

Base	5 Pin metal shell
Basing	See drawing
Recommended Socket	SK-510 Air-System Socket
Operating Position	Vertical base down or up
Maximum Operating Temperatures :	
Base Seals	150°C
Plate Seal	200°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	HR-8
Maximum Over-all Dimensions :	
Length	(9.63 inches) 235 mm
Diameter	(5.25 inches) 133 mm
Net Weight (tube only)	(1.5 lbs.) 0,74 kg
Shipping Weight in Shielded Fixture	(12 lbs) 3,70 kg

 **Richardson Electronics, Ltd.**

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## PULSE MODULATOR SERVICE

### MAXIMUM RATINGS

DC Plate Voltage	30 max.	kV
DC Screen Voltage	2.5 max.	kV
DC Grid Voltage	- 1.0 max.	kV
Peak Plate Current	8.0 max.	amperes
Plate Dissipation (Ave.)	1000 max.	watts
Screen Dissipation (Ave.)	75 max.	watts
Grid Dissipation (Ave.)	25 max.	watts

### TYPICAL OPERATION

DC Plate Voltage	20	25	30	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	- 335	- 360	- 380	V
Pulse Plate Voltage	17.7	22.7	27.7	kV
Peak Plate Current	8.0	8.0	8.0	Amp
Pulse Screen Current	1.25	1.25	1.25	Amp
Pulse Grid Current	0.2	0.2	0.2	Amp
Pulse Pos. Grid Voltage	200	200	200	V
Pulse Drive Power	107	112	116	W
Pulse Plate Input Power	160	200	240	kW
Pulse Plate Output Power	140	180	220	kW
Duty	4.0	4.0	4.0	%

## RADIO FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR \*

### MAXIMUM RATINGS

Peak DC Plate Voltage	20 max.	kV
DC Screen Voltage	2.5 max.	kV
DC Grid Voltage	- 1.0 max.	kV
Peak Cathode Current (Note 1)	12.0 max.	Amp
Plate Dissipation (Ave.)	1000 max.	W
Screen Dissipation (Ave.)	75 max.	W
Grid Dissipation (Ave.)	25 max.	W

### TYPICAL OPERATION

Pulse Plate Voltage	10	15	20	kV
Pulse Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	-480	-510	-535	V
Pulse Plate Current (Note 1)	1.95	1.95	1.95	A
Pulse Screen Current	0.32	0.32	0.32	A
Pulse Grid Current	0.02	0.02	0.02	A
Peak RF Grid Voltage	735	760	785	V
Pulse Drive Power	14.7	15.2	15.7	W
Pulse Plate Input Power	19.5	29.3	39.0	kW
Pulse Plate Output Power	17.0	23.0	31.5	kW
Duty	15.0	15.0	12.0	%

\* When used as a RF Plate and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

## RADIO FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

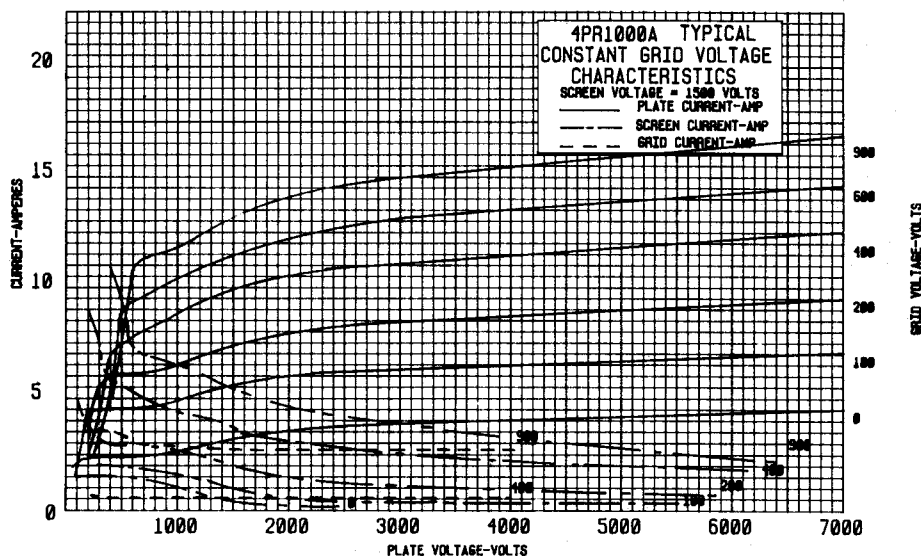
### MAXIMUM RATINGS

DC Plate Voltage	15 max.	kV
DC Screen Voltage	2.5 max.	kV
DC Grid Voltage	- 1.0 max.	kV
Peak Cathode Current (Note 1)	12.0 max.	A
Plate Dissipation (Ave.)	1000 max.	W
Screen Dissipation (Ave.)	75 max.	W
Grid Dissipation (Ave.)	25 max.	W

### TYPICAL OPERATION

DC Plate Voltage	10	12.5	15	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	- 480	- 495	- 510	V
Pulse Plate Current (Note 1)	1.95	1.95	1.95	A
Pulse Screen Current	0.32	0.32	0.32	A
Pulse Grid Current	0.02	0.02	0.02	A
Peak RF Grid Voltage	735	745	760	V
Pulse Drive Power	14.7	15.0	15.2	W
Pulse Plate Input Power	19.5	24.4	29.3	kW
Pulse Plate Output Power	17.0	18.6	23.0	kW
Duty	15.0	15.0	15.0	%

Note 1: The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on an available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation sections refers to the dc plate current component during the pulse.



MECHANICAL

**Mounting** — The 4PR1000A must be operated vertically, base up or base down. When the SK-510 Air-System Socket is used in conjunction with the SK-506 Air Chimney, the socket must be mounted to the under surface of the chassis to maintain proper air space between the plate seal and the chimney opening, otherwise plate seal cooling will be seriously impaired.

In the event the SK-510 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers.

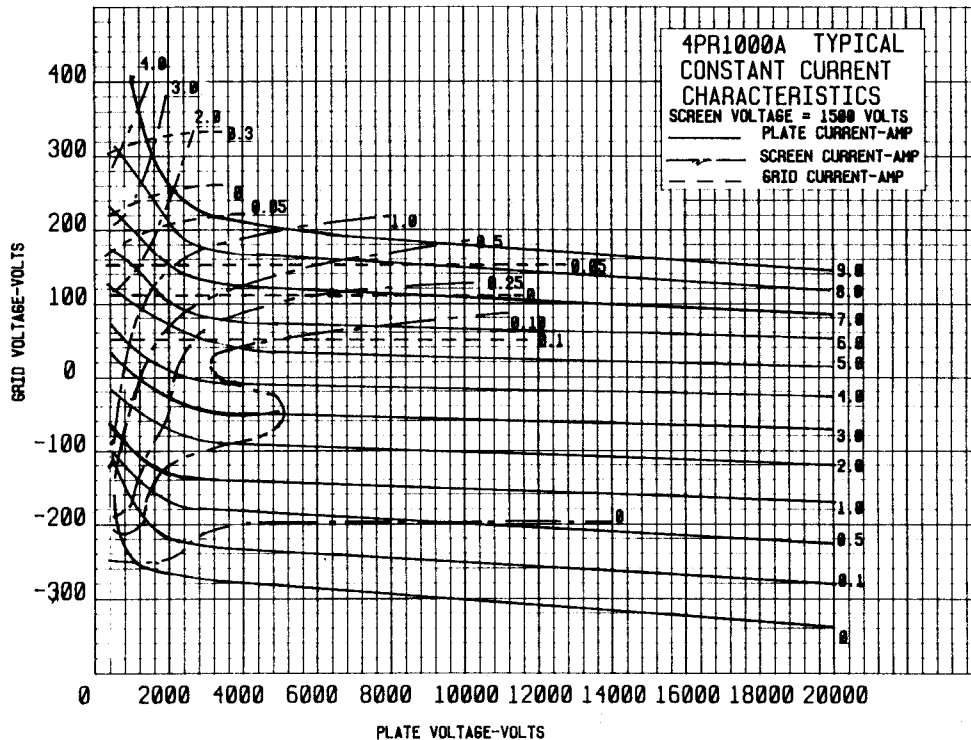
**Cooling** — Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 150°C and 200°C, respectively. In all classes of operation, it is recommended that a heat-radiating connector, the HR-8 or equivalent, be installed on the anode terminal and that a socket and chimney be employed which provides for proper seal cooling. When the 4PR1000A is operated at d-c or low frequencies in a SK-510 Air-System Socket, complete with SK-506 Air Chimney and HR-8 Heat Radiator, the minimum airflow requirements to maintain seal temperatures at 150°C in 50°C inlet air are tabulated below:

Ave. Plate Dissipation (watts)	Sea Level		10,000 Feet <sup>+</sup>	
	Air Flow (CFM)*	Plenum Pressure Drop. (Inches of Water) **	Air Flow (CFM)*	Plenum Pressure Drop. (Inches of Water) **
600	17.0	0.30	24.0	0.45
800	20.0	0.40	28.0	0.56
1000	25.0	0.55	36.0	0.80

- \* 1 CFM = 0.47195 Liters/sec
- \*\* 1 inch of H<sub>2</sub>O = 0.002458 ATM
- + Approx 3,000 meters

When the 4PR1000A is used as a pulsed-amplifier or oscillator at frequencies above 30 MHz, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by rf charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature sensitive paint.



## PULSE MODULATOR SERVICE

### MAXIMUM RATINGS

DC Plate Voltage	30 max.	kV
DC Screen Voltage	2.5 max.	kV
DC Grid Voltage	- 1.0 max.	kV
Peak Plate Current	8.0 max.	amperes
Plate Dissipation (Ave.)	1000 max.	watts
Screen Dissipation (Ave.)	75 max.	watts
Grid Dissipation (Ave.)	25 max.	watts

### TYPICAL OPERATION

DC Plate Voltage	20	25	30	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	- 335	- 360	- 380	V
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Pulse Pos. Grid Voltage	200	200	200	V
Pulse Drive Power	107	112	116	W
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Duty	4.0	4.0	4.0	%

## RADIO FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR \*

### MAXIMUM RATINGS

Peak DC Plate Voltage	20 max.	kV
DC Screen Voltage	2.5 max.	kV
DC Grid Voltage	- 1.0 max.	kV
Peak Cathode Current (Note 1)	12.0 max.	Amp
Plate Dissipation (Ave.)	1000 max.	W
Screen Dissipation (Ave.)	75 max.	W
Grid Dissipation (Ave.)	25 max.	W

### TYPICAL OPERATION

Pulse Plate Voltage	10	15	20	kV
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DC Grid Voltage	-480	-510	-535	V
Pulse Plate Current (Note 1)	1.95	1.95	1.95	A
Pulse Screen Current	0.32	0.32	0.32	A
Pulse Grid Current	0.02	0.02	0.02	A
Peak RF Grid Voltage	735	760	785	V
Pulse Drive Power	14.7	15.2	15.7	W
Pulse Plate Input Power	19.5	29.3	39.0	kW
Pulse Plate Output Power	17.0	23.0	31.5	kW
Duty	15.0	15.0	12.0	%

\* When used as a RF Plate and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

## RADIO FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

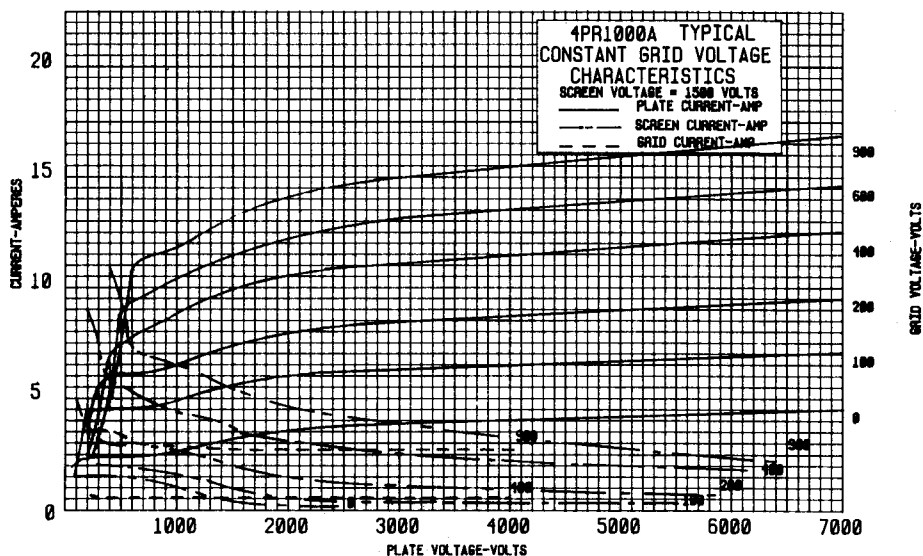
### MAXIMUM RATINGS

DC Plate Voltage	15 max.	kV
DC Screen Voltage	2.5 max.	kV
DC Grid Voltage	- 1.0 max.	kV
Peak Cathode Current (Note 1)	12.0 max.	A
Plate Dissipation (Ave.)	1000 max.	W
Screen Dissipation (Ave.)	75 max.	W
Grid Dissipation (Ave.)	25 max.	W

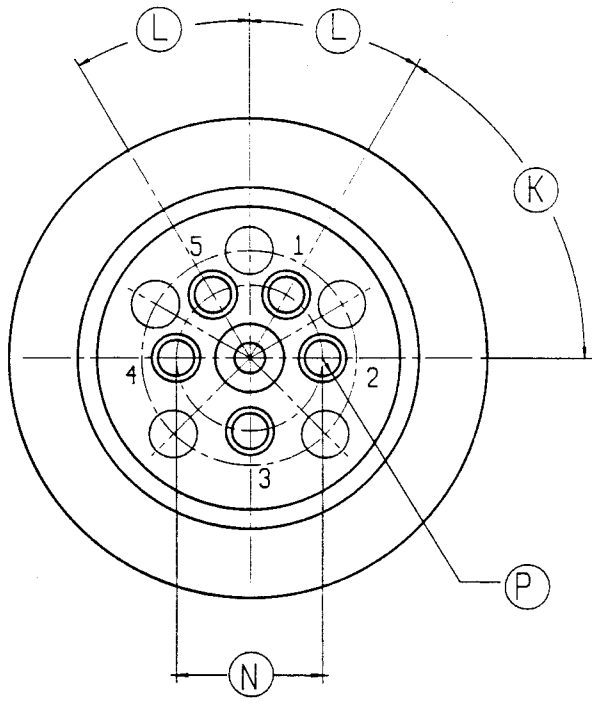
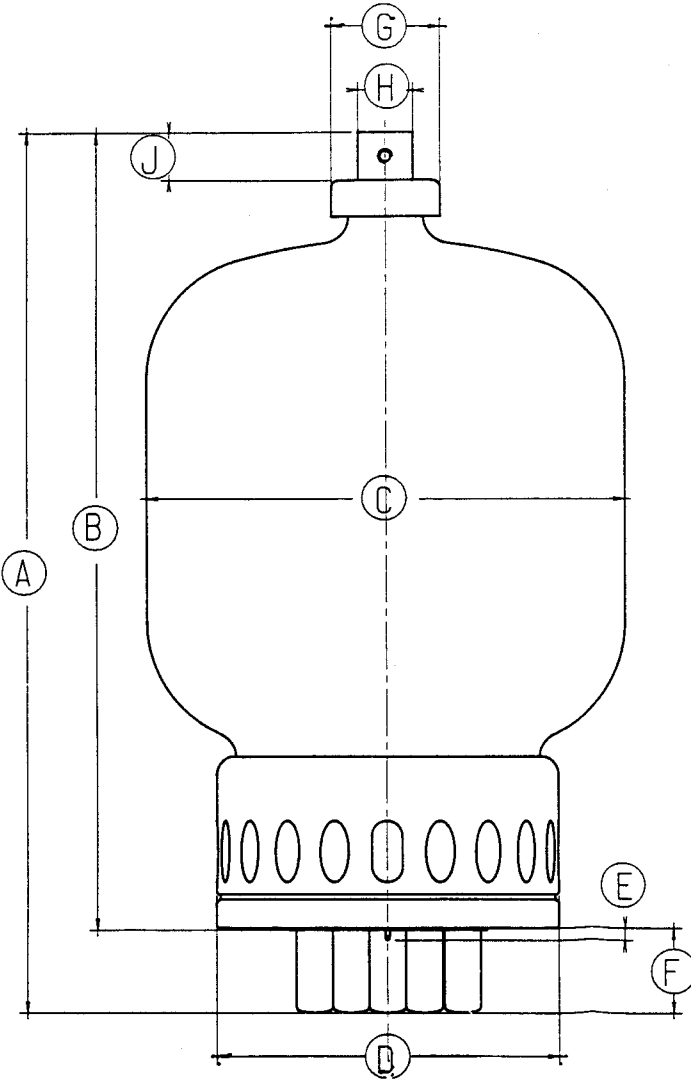
### TYPICAL OPERATION

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# 4PR1000A



BOTTOM VIEW

DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	8.875	9.625	9.250	225.4	244.5	234.9
B	8.000	8.750	8.375	203.2	222.2	212.7
C	—	5.250	—	—	133.3	—
D	—	3.625	—	—	92.1	—
E	—	.313	—	—	7.9	—
F	.825	.925	.875	20.9	23.5	22.2
G	1.110	1.140	1.250	28.2	29	28.6
H	.559	.573	—	14.2	14.55	—
J	.484	—	—	12.3	—	—
K	—	—	60°	—	—	60°
L	—	—	30°	—	—	30°
N	1.495	1.505	1.500	38	38.2	38.1
P	.371	.377	.374	9.42	9.57	9.49

