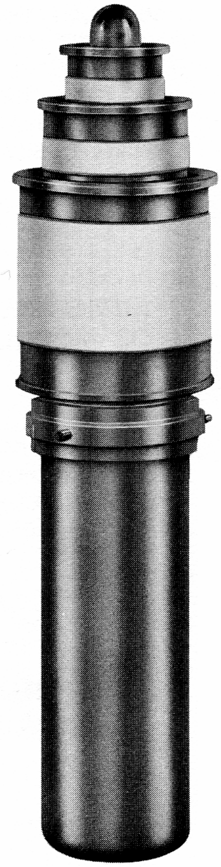
Eimac®

E I M A C
Division of Varian
SAN CARLOS
CALIFORNIA

6696A
WATER COOLED MEDIUM-MU POWER TRIODE



The Eimac 6696A is a water cooled ceramic-metal triode designed for industrial heating service. It is recommended also for use in broadcast and communications amplifiers.

Low-loss ceramic and metal construction permits operation at full ratings at frequencies up to 40 Mc. Useful power output can be obtained at frequencies up to 80 Mc at reduced plate voltage.

The 6696A anode is capable of dissipating 60 kilowatts at a moderate rate of water flow. A forced-air cooled version of this tube, type 6697A, and a vapor cooled version, type 7480, are also available.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.
Filament: Thoriated-Tungsten			
Voltage		13	volts
Current	190		220 amperes
Starting Current			800 amperes
Amplification Factor		20	
Direct Interelectrode Capacitances			
Grid-Plate	47		57 pf
Grid-Filament	65		85 pf
Plate-Filament	2.0		3.2 pf
Frequency for Maximum Ratings			40 Mc

MECHANICAL

Base	Coaxial
Operating Position	Vertical, base up
Cooling	Water and forced air
Maximum Seal Temperature	200°C
Maximum Outlet Water Temperature	70°C
Maximum Height	19.4 inches
Maximum Diameter	4.72 inches
Net Weight	17 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC GRID VOLTAGE	–3200 VOLTS
DC PLATE CURRENT	11 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION

DC Plate Voltage	10	15	kV
DC Grid Voltage	–1200	–1600	volts
Peak RF Grid Voltage	1900	2100	volts
DC Plate Current	10.0	7.0	amps
DC Grid Current	810	300	mA
Resonant Load Impedance	440	970	ohms
Driving Power, approx.	1500	600	watts
Plate Output Power, approx.	72	80	kW

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10.0 KV
DC GRID VOLTAGE	–3200 VOLTS
DC PLATE CURRENT	8.5 AMPS
DC GRID CURRENT	2.0 AMPS
GRID DISSIPATION	1000 WATTS
PLATE DISSIPATION	40 KW

TYPICAL OPERATION

DC Plate Voltage	9.5 kV
DC Grid Voltage	–1600 volts
Peak RF Grid Voltage	2300 volts
DC Plate Current	8.4 amps
DC Grid Current	900 mA
Resonant Load Impedance	510 ohms
Driving Power, approx.	2.0 kW
Plate Output Power, approx.	60 kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION (Two Tubes).

DC Plate Voltage	10	12 kV
DC Grid Voltage	–450	–600 volts
Peak AF Driving Voltage (per tube)	875	1060 volts
Zero-Sig DC Plate Current	3.0	2.0 amps
Max-Sig DC Plate Current	17.4	20.0 amps
Load Resistance, Plate-to-Plate	1170	1230 ohms
Max-Sig Driving Power, approx.	550	600 watts
Max-Sig Plate Output Power, approx.	110	152 kW

RADIO-FREQUENCY AM LINEAR AMPLIFIER

Class-AB (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	9.0 AMPS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION (AM Carrier conditions except where noted).

DC Plate Voltage	12	12 kV
DC Grid Voltage	–550	–550 volts
Peak RF Grid Voltage	510	640 volts
DC Plate Current	4.3	6.8 amps
DC Grid Current	0	0 amps
Resonant Load Impedance	780	500 ohms
Driving Power, approx.*	450	1500 watts
Plate Output Power, approx.	18	28 kW

*At modulation crest.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB, Single-Sideband Suppressed-Carrier Service

MAXIMUM RATINGS

DC PLATE VOLTAGE	16.0 KV
DC PLATE CURRENT	11.0 AMPS
PLATE DISSIPATION	60 KW

TYPICAL OPERATION (Peak-envelope or modulation-crest conditions in cathode-drive circuit).

DC Plate Voltage	12	12 kV
DC Cathode Voltage	600	600 volts
Peak RF Driving Voltage	830	1020 volts
DC Plate Current	5.2	9.8 amps
DC Grid Current, approx.	60	200 mA
Resonant Load Impedance	880	700 ohms
Driving Power, approx.	3.5	8.2 kW
Plate Power Output, approx.	43	83 kW

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance for circuit losses has been made.

APPLICATION

MECHANICAL

Mounting—

The 6696A should be mounted vertically anode down in the waterjacket (Machlett type F-17393 or equivalent). Filament and grid connections are made through clamp rings or spring-finger contacts to the O.D. of the sturdy copper terminals of the tube. Satisfactory anode contact can be made to the water jacket.

Anode Cooling—

Minimum cooling requirements are given in the accompanying table, where the pressure drop is measured at the jacket fittings. The water supply line must be connected to the inlet fitting of the water jacket.

MINIMUM ANODE COOLING REQUIREMENTS		
Plate Dissipation kW	Water Flow Rate gpm	Pressure Drop psi
20	5.7	1.3
30	8.0	2.1
40	11.2	3.3
50	14.5	5.0
60	18.0	7.2

Base Cooling—

Forced-air cooling of the ceramic base and seals may be required, depending on ambient conditions and operating frequency. Air flow rate and direction should be determined to limit envelope temperatures to 200°C maximum and to maintain uniform temperature distribution around the seals. Spot temperatures are conveniently measured with Tempilaq (spray type) or equivalent. Often a flow of about 100 cfm, directed axially downward towards the tube, is sufficient.

ELECTRICAL

Filament Operation—

The rated filament voltage, as measured at the tube terminals, should be maintained within ±5% to assure long life and good performance within the rated power capability of the tube. To accommodate special requirements, the filament voltage may be centered near either of these extremes, e.g. at plus 5 percent for exceptionally high emission at a sacrifice of life, or at minus 5 percent for exceptionally long life where perhaps only half the full emission capability is required.

Grid Dissipation—

Grid dissipation should be limited to 1,000 watts maximum. Grid dissipation may be calculated approximately as the product of peak positive grid voltage and dc grid current.

In many r-f amplifier applications where it is impractical to measure the positive grid voltage, the dc grid current rating serves as a satisfactory guide. The maximum dc grid current rating under normal full load conditions is 2 amperes. In most cases, however, high power output and good efficiency can be realized with grid current less than one ampere. By limiting the grid current in this manner there is obviously more latitude for grid current excursions resulting from changes in loading.

High Frequency Operation—

The maximum ratings listed apply at frequencies up to 40 Mc. Useful output can be obtained at higher frequencies if the plate voltage and plate input power are reduced accordingly. For operation up to 60 Mc these parameters should be reduced to 75% of the listed dc plate voltage rating; for operation up to 80 Mc they should be reduced to 50%.

Aging—

The manner of operating most high power tubes differs in at least some respects from conditions under which the tubes are tested, therefore, some aging is almost always required to condition a new tube to its new environment. In basic terms, the different operating conditions are manifest as different distributions of heat and voltage gradients. Satisfactory aging is most easily achieved by gradual application of voltages, e.g. first filament voltage, then partial plate voltage, and drive, working up to the final values. If continuous or stepped plate voltage control is not used, sufficient load should be connected before snapping on full voltage to limit transients to about 120% of the dc voltage.

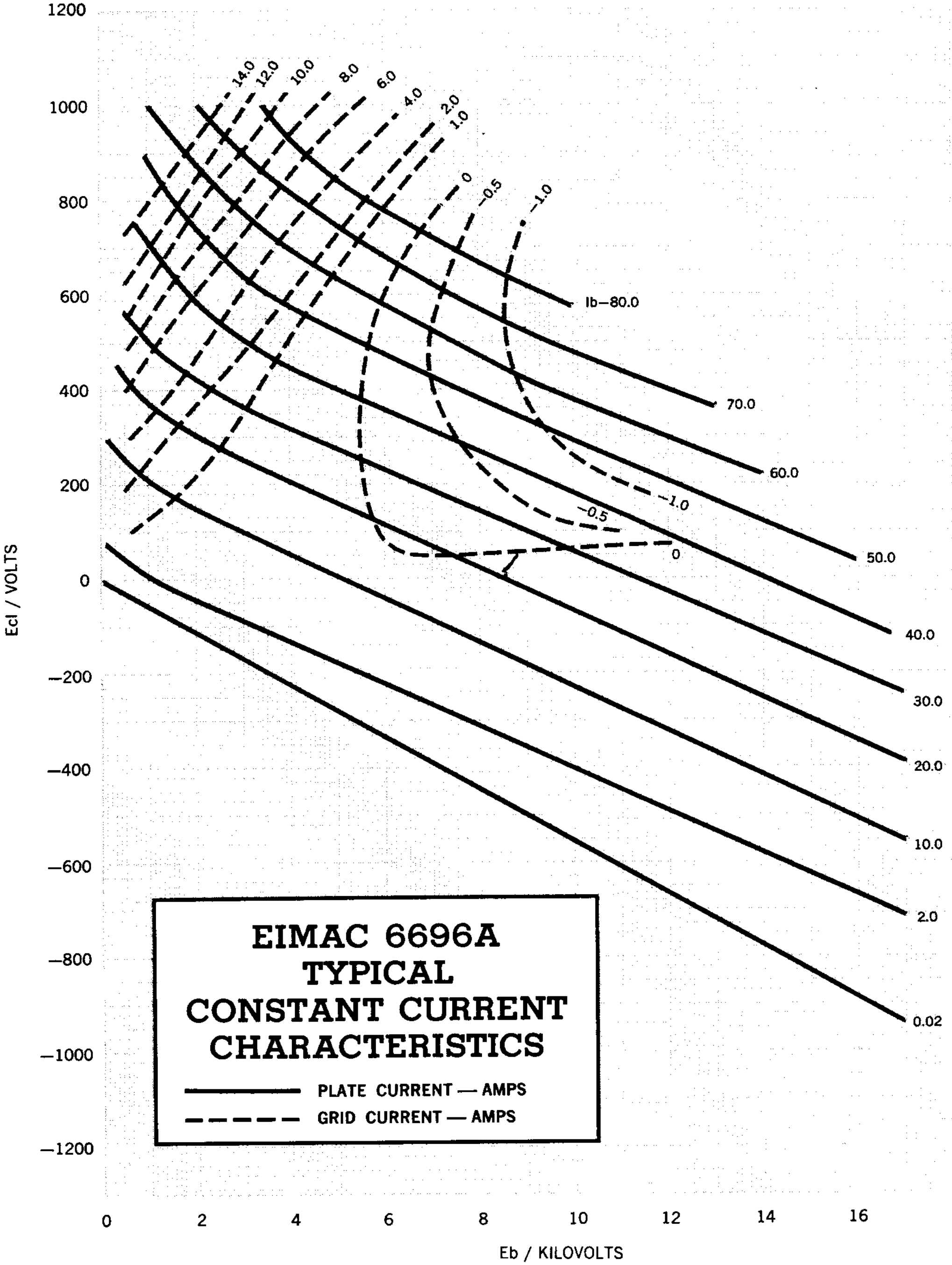
Tube Protection—

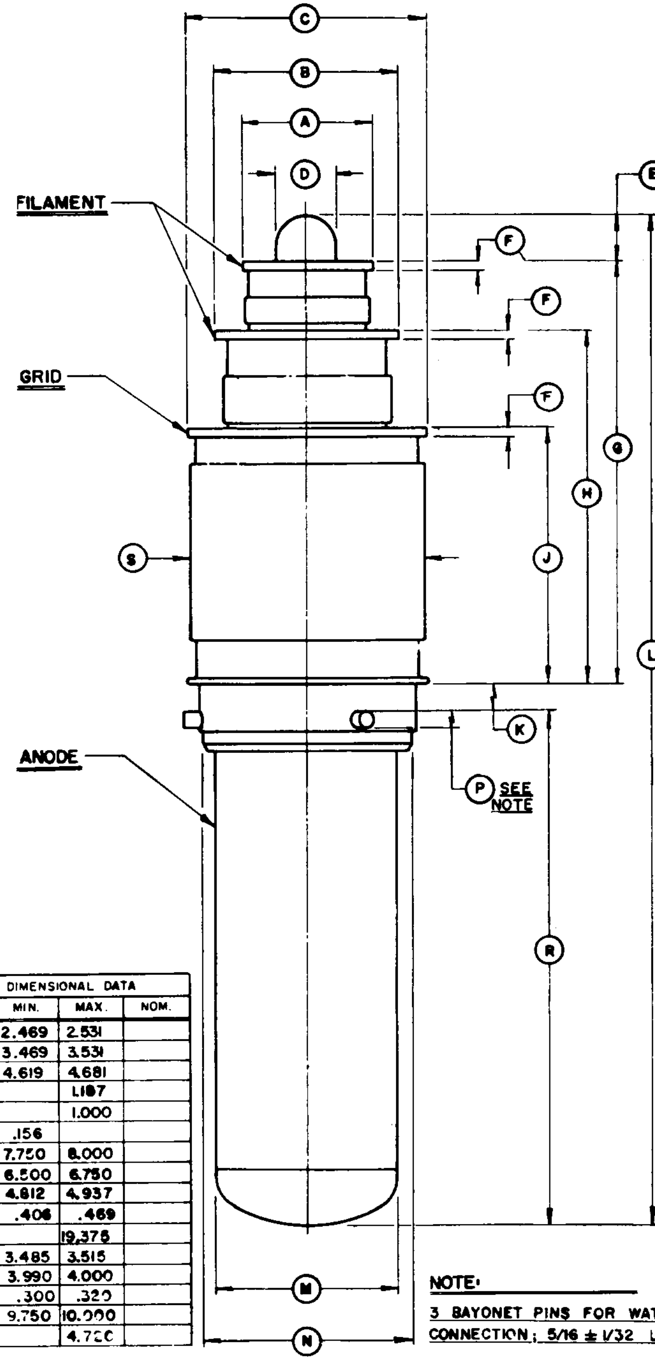
Since the possibility of fault overloads due to occasional tube or circuit instabilities is ever present, good engineering practice holds that suitable protective circuitry and devices be included in the equipment. In addition to the standard overcurrent relays, some series resistance should be placed in the output of the power supply to limit surge currents. In cases where no filter is used, the resistors may be placed in each rectifier lead to reduce the power loss during normal operation. In certain applications, furthermore, it is helpful to attach sphere gaps or rings to the tube terminals to divert any excessive transient voltages from the envelope and seals.

The use of an electronic fault diverter, or "crowbar" is probably the best way to insure high performance reliability and freedom from gassing or catastrophic failures. The crowbar system consists of circuitry to sense incipient fault currents and trigger the crowbar device, which is connected to short the power supply energy to ground, preferably within about 10 microseconds. The crowbar device, which is usually an ignitron, hydrogen thyratron, or spark gap, diverts most of the fault energy from the protected tube until the relay and circuit breakers open.

Special Applications—

If it is desired to operate this tube under conditions widely different from those given herein, write to Power Grid Tube Marketing, Eimac, Division of Varian, 301 Industrial Way, San Carlos, California.





DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	2.469	2.531	
B	3.469	3.531	
C	4.619	4.681	
D		1.187	
E		1.000	
F	.156		
G	7.750	8.000	
H	6.500	6.750	
J	4.812	4.937	
K	.406	.469	
L		19.375	
M	3.485	3.515	
N	3.990	4.000	
P	.300	.320	
R	9.750	10.000	
S		4.720	

NOTE:
3 BAYONET PINS FOR WATER JACKET CONNECTION; 5/16 ± 1/32 LONG.