CERAMIC HYDROGEN THYRATRON

Description

The F-104 is a 60 megawatt peak tetrode type ceramic envelope hydrogen thyratron. Great care has been exercised in the design of this tube in order to insure an equal distribution of capacity across the gaps. This makes the use of compensating capacitors unnecessary. Provision for liquid cooling of the anode is provided for.

A special feature of the F-104 is the auxiliary electrode which is incorporated to provide a means for reducing anode time variation to a negligible amount over all power levels.

Electrical Data, General:	Nom.	Min.	Max.	
Heater Voltage	6.3	5.8	6.8	Volts AC
Heater Current (at 6.3 volts)		25	35	Amperes
Heater (Note 1)				
Reservoir Voltage (Note 2)		3.5	5.5	Volts
Reservoir Current at 4.5 volts		8	14	Amperes
Minimum Heating Time		5		Minutes

Mechanical Data, General:

Mounting Position	Vertical	Base Down
Base (Per Outline)		
Cooling (Note 3)		
Net Weight		15 Pounds
Dimensions (See Outline Drawing)		

Ratings

Max. Peak Anode Voltage, Forward	50.0	Kilovolts
Max. Peak Anode Voltage, Inverse (Note 4)	50.0	Kilovolts
Min. Anode Supply Voltage (Note 5)	2.5	Kilovolts
Max. Peak Anode Current	2400	Amperes
Max. Average Anode Current	4.0	Amperes
Max. RMS Anode Current (Note 6)	90	Amperes AC
Max. epy x ib x prr	55×10^9	
Max. Anode Current Rate of Rise	15,000	Amps./u sec
Trigger Voltage (Note 7)		

Max. Anode Delay Time (Notes 8 & 9)	0.4	Microseconds
Max. Anode Delay Time Drift (Notes 8 & 9)	0.1	Microsecond
Max. Time Jitter	.002	Microsecond
Ambient Temperature	-55° to 150°	C

Note 1:

Cathode connected to center of cathode heater.

Note 2:

Reservoir voltage is marked on the base of each tube. This is the correct voltage for one typical operating condition but is not the optimum value for all types of operation. This value may be used initially in new applications and the optimum value may then be obtained by exploring the range of voltage on either side of that marked on the tube. Excess reservoir voltage will result in a failure of the thyratron to deionize between pulses (continuous conduction). Insufficient reservoir voltage will result in excess anode dissipation as indicated by heating of the anode. The anode dissipation must not be permitted to exceed 1500 watts as measured in the cooling water. A useful formula for this determination follows:

$$P = 264\ Qw\ (T2 - T1)$$

P	=	Power in Watts
Qw	=	Flow in gallons/minute
T2 - T1	=	Outlet and inlet water temperatures in degrees Kelvin, respectively

The optimum reservoir voltage is the midpoint between these two extremes. In certain applications it may be necessary to provide a regulated source to assure operation within the permissible range of reservoir voltages.

Note 3:

Cooling of the anode is not required for operation at heat factors under 30×10^9. Above this value, forced cooling is necessary. This may be accomplished by an airblast into the anode cup for modest requirements (10 CFM), by compressed air directed through the cooling chamber, or by liquid coolants circulated through the cooling chamber. A minimum flow of 1 gallon per minute of water is required. The water inlet temperature shall not be less than 5°C, nor the outlet temperature higher than 95°C. Maximum water pressure under a normal condition is 50 psi (100 psi may be tolerated for short periods). Pressure drop is approximately 1 psi. Distilled water is recommended. Any water with less than 10 grains per gallon hardness is satisfactory.

Note 4:

During the first 25 microseconds after conduction, the peak inverse anode voltage shall not exceed 10 kv.

Note 5:

A resistance divider of 20 to 40 megohms should be connected between anode and cathode. The center tap of this divider should be connected to the second or gradient grid. It is recommended that this arrangement be employed whether low voltage operation is required or not. This divider is a necessity for keyed grid operation.

Note 6:

The root mean square anode current shall be computed as the square root of the product of peak current and the average current.

Note 7:

The pulse produced by the dirver circuit shall have the following characteristics when viewed at the socket with the tube removed.

A.	Amplitude	750 - 4000 volts
B.	Duration	2 microseconds (at 70% points)
C.	Time of Rise	0.35 microseconds (Min.)
D.	Impedance	10 - 100 ohms

Note 8:

The limits of anode time delay, delay drift and jitter are based on using a marginal trigger without employing the auxiliary electrode. Using the highest permissible trigger voltage and lowest trigger source impedance materially reduces these values and the auxiliary electrode further reduces these values well below the limits specified.

Note 9:

The auxiliary electrode provides a means to prime the discharge so as to reduce delay time and delay time variation to a negligible amount. For example, delay variation may be held to less than 20 nanoseconds over a range of power from 2 to 60 kilowatts.

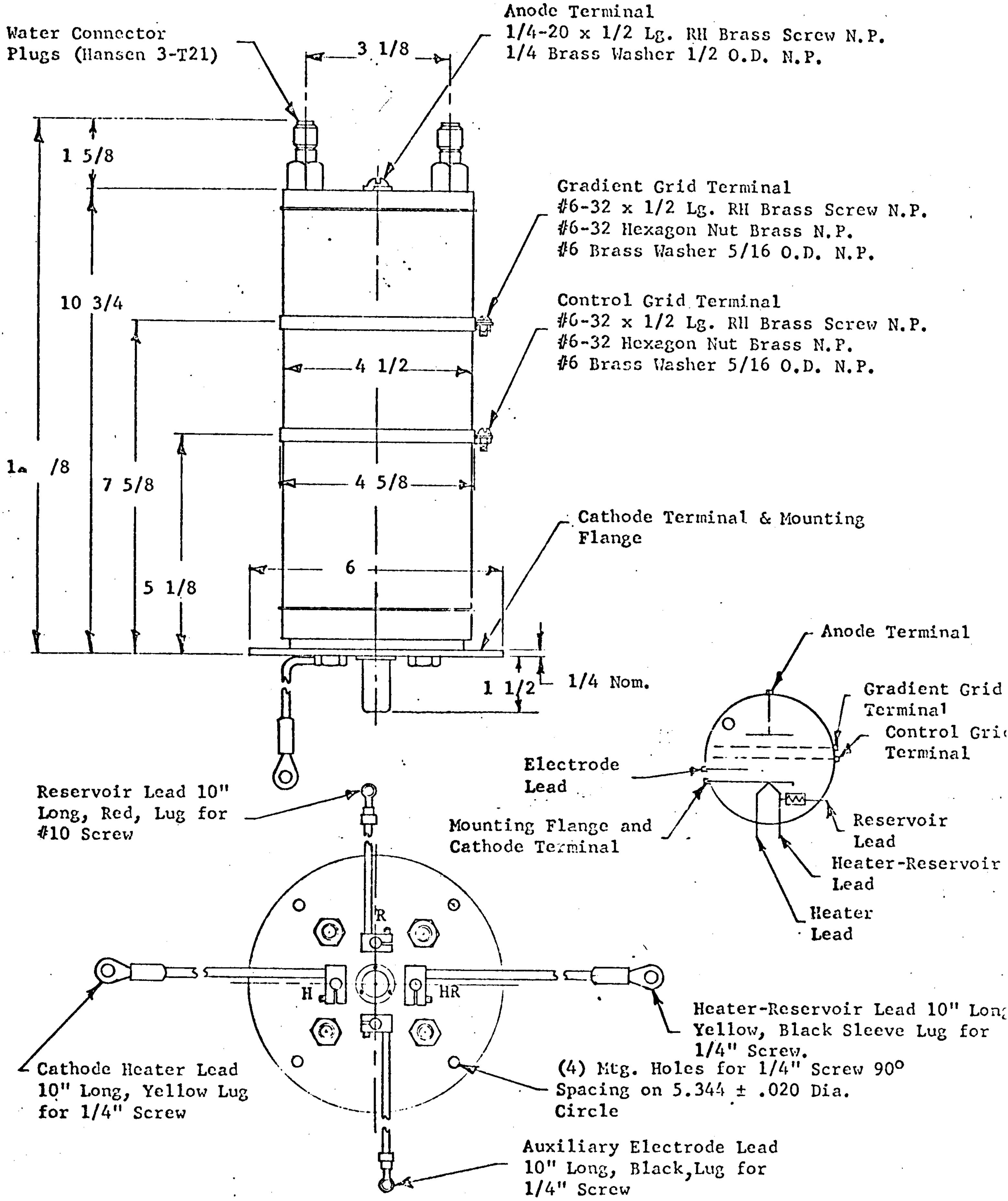
The auxiliary discharge may be produced in may ways including maintaining a simple dc keep-alive glow (200 - 300 ma, 200-300 v.) between the electrode and the cathode. The auxiliary electrode may also be connected through a current limiting resistor (200 - 300 ohms) to the grid trigger source. This should preferably be done at a point in the circuit such that the control grid pulse is delayed withrespect to the electrode pulse. The usual grid spike protective pi network will noramlly provide this delay.

When not used the auxiliary electrode should be connected to the cathode through a 300 ohm resistor.

Additional information for specific applications can be obtained from the

ITT Electron Tube Division
Electron Tube Applications Section
P. O. Box 100
Easton, Pennsylvania 18042

Tolerances ±1/4



F-104

OUTLINE