CX1573

Deuterium-Filled Ceramic Thyratron

The data to be read in conjunction with the Hydrogen Thyratron Preamble.

ABRIDGED DATA

Hollow-anode, deuterium-filled tetrode thyratron with ceramic/ metal envelope, featuring low jitter, firing time and drift, and current reversal capability. It has been developed specifically for use in the low inductance circuits associated with excimer lasers.

The patented hollow anode structure enables the tube to cope with inverse voltage and current without consequent reduction in its high voltage hold-off capability due to electrode damage.

A reservoir normally operated from a separate heater supply is incorporated.

Peak forward anode voltage	-	35 kV max
Peak forward anode current	-	7.5 kA max
Peak reverse anode current	-	4.0 kA max
Average anode current	-	1.0 A max

GENERAL DATA

Electrical

Cathode (connected internally to one end of heater)	-	Oxide coated
Cathode heater voltage	-	6.3 ± 5% V
Cathode heater current	-	23 A
Reservoir heater voltage (see note 1)	-	5.0 V
Reservoir heater current	-	7.5 A
Tube heating time (minimum)	-	15 min
Anode to grid 2 capacitance	-	15 to 20 pF

Mechanical

Seated height	-	165.1 mm (6.500 inches) max
Clearance required below mounting flange	-	50.8 mm (2.000 inches) min
Overall diameter (mounting flange)	-	111.1 mm (4.375 inches) nom
Net weight	-	1.8 kg (4 pounds) approx.
Mounting position (see note 2)	-	Any
Tube connections	-	See outline

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Cooling

For all applications, either forced-air cooling or total liquid immersion cooling is needed.

Forced-air Cooling: The tube should be cooled by forced-air directed onto the base to maintain the envelope below the maximum rated temperature. A fan of air flow of at least 2.12 m^3/min (75 ft^3/min), depending on the mechanical layout, will be necessary to keep the tube operating temperature within the maximum specified below. A bolt-on anode heat extractor should be used when the tube is operating under extreme conditions of rate of rise and inverse current. Air cooling of the anode and grids is then necessary either from a separate air supply or by use of the air cooling the tube base.

Total Liquid Immersion: The tube should be cooled by total liquid immersion, for example in force-circulated transformer oil (see e2v technologies Technical Reprint No. 108 'The cooling of oil-filled electrical equipment, with special reference to high power line-type pulse generators' by G. Scoles). Care must be taken to ensure that air is not trapped under the tube base.

In addition to 200 W of heater power, the tube dissipates from 100 W/A average anode current, rising to 300 W/A at the highest rates of rise and fall of anode current.

Envelope temperature:

Ceramic, anode and grids	-	150 °C max
Cathode flange and base	-	120 °C max

PULSE LASER SERVICE

MAXIMUM AND MINIMUM RATINGS
(Absolute values)

Anode		Min	Typ	Max	
Peak forward anode voltage	.	-	-	35	kV
Peak inverse anode voltage	.	-	-	35	kV
Peak forward anode current	.	-	-	7.5	kA
Peak reverse anode current	.	-	-	4.0	kA
Average anode current	.	-	-	1.0	A
Pulse duration	.	-	2.0	-	µs
Rate of rise on anode current (see note 3)	.	-	100	-	kA/µs
Pulse repetition rate	.	-	50	-	pps

Grid 2		Min	Typ	Max	
Unloaded grid 2 drive pulse voltage (see note 4)	.	500	-	2000	V
Grid 2 pulse duration	.	0.5	-	-	µs
Rate of rise of grid 2 pulse (see notes 3 and 5)	.	10	-	-	kV/µs
Grid 2 pulse delay (see note 6)	.	0.5	-	3.0	µs
Peak inverse grid 2 voltage	.	-	-	450	V
Loaded grid 2 bias voltage (see note 7)	.	-50	-	-200	V
Forward impedance of grid 2 drive circuit	.	50	-	500	Ω

Grid 1 – Pulsed		Min	Typ	Max	
Unloaded grid 1 drive pulse voltage (see notes 4 and 6)	.	300	-	1000	V
Grid 1 pulse duration	.	2.0	-	-	µs
Rate of rise of grid 1 pulse (see note 3)	.	1.0	-	-	kV/µs
Peak inverse grid 1 voltage	.	-	-	450	V
Loaded grid 1 bias voltage	.		See note 8		
Peak grid 1 drive current	.	0.3	-	1.0	A

Grid 1 – DC Primed (see note 7)		Min	Typ	Max	
DC grid 1 unloaded priming voltage	.	75	-	150	V
DC grid 1 priming current	.	75	100	150	mA

Heaters		Min	Typ	Max	
Cathode heater voltage	.		6.3 ± 5%		V
Reservoir heater voltage	.	4.5	-	6.5	V
Tube heating time	.	15	-	-	min

Environmental		Min	Typ	Max	
Ambient temperature	.	-50	-	+90	°C
Altitude	.	- -	- -	3 10,000	km ft

CHARACTERISTICS

		Min	Typ	Max	
Critical DC anode voltage for conduction (see note 9)	.	-	0.5	1.0	kV
Anode delay time (see notes 9 and 10)	.	-	0.1	0.25	µs
Anode delay time drift (see notes 9 and 11)	.	-	15	50	ns
Time jitter (see note 9)	.	-	1.0	5.0	ns
Cathode heater current (at 6.3 V)	.	20	23	26	A
Reservoir heater current (at 5.0 V)	.	6.0	7.5	9.0	A

NOTES

1. The reservoir heater supply must be obtained either from the cathode heater supply or if a separate supply is used it must be decoupled with suitable capacitors (for example a 1 µF capacitor in parallel with a low inductance 1000 pF capacitor) to avoid damage to the reservoir. The recommended reservoir heater voltage for each individual tube is stamped on the tube envelope; for maximum rate of rise of current, the reservoir heater voltage should be set to the highest level compatible with the tube hold-off voltage being maintained.
   Permanent damage may result if the tube is operated below the minimum recommended reservoir voltage.

2. The tube must be fitted using its mounting flange.

3. This rate of rise refers to that part of the leading edge of the pulse between 10% and 90% of the pulse amplitude. The maximum rate of rise of current obtainable will depend on the circuit parameters.

4. Measured with respect to cathode.

5. A lower rate of rise may be used, but this may result in the anode delay time, delay time drift and jitter exceeding the limits quoted.

6. If grid 1 is pulsed, the last 0.25 µs of the top of the grid 1 pulse must overlap the corresponding first 0.25 µs of the top of the delayed grid 2 pulse. Pulsing grid 1 is recommended for high rate of rise of current applications (≥10 kA/µs).

7. When DC priming of grid 1, or with a high grid 1 pulse drive, the loaded grid 2 bias voltage should be between -100 V and -200 V to ensure anode voltage hold-off.

8. DC negative bias voltages must not be applied to grid 1. When grid 1 is pulse driven, its potential may vary between -10 V and +5 V with respect to cathode potential during the period between the completion of recovery and the commencement of the succeeding grid pulse.

9. Typical figures are obtained on test using conditions of minimum grid drive. Improved performance can be expected by increasing grid drive.

10. The time interval between the instant at which the rising unloaded grid 2 pulse reaches 25% of its pulse amplitude and the instant when anode conduction takes place.

11. The drift in delay time over a period from 10 seconds to 10 minutes after reaching full voltage.

HEALTH AND SAFETY HAZARDS

e2v technologies thyratrons are safe to handle and operate, provided that the relevant precautions stated herein are observed. e2v technologies does not accept responsibility for damage or injury resulting from the use of electronic devices it produces. Equipment manufacturers and users must ensure that adequate precautions are taken. Appropriate warning labels and notices must be provided on equipment incorporating e2v technologies devices and in operating manuals.

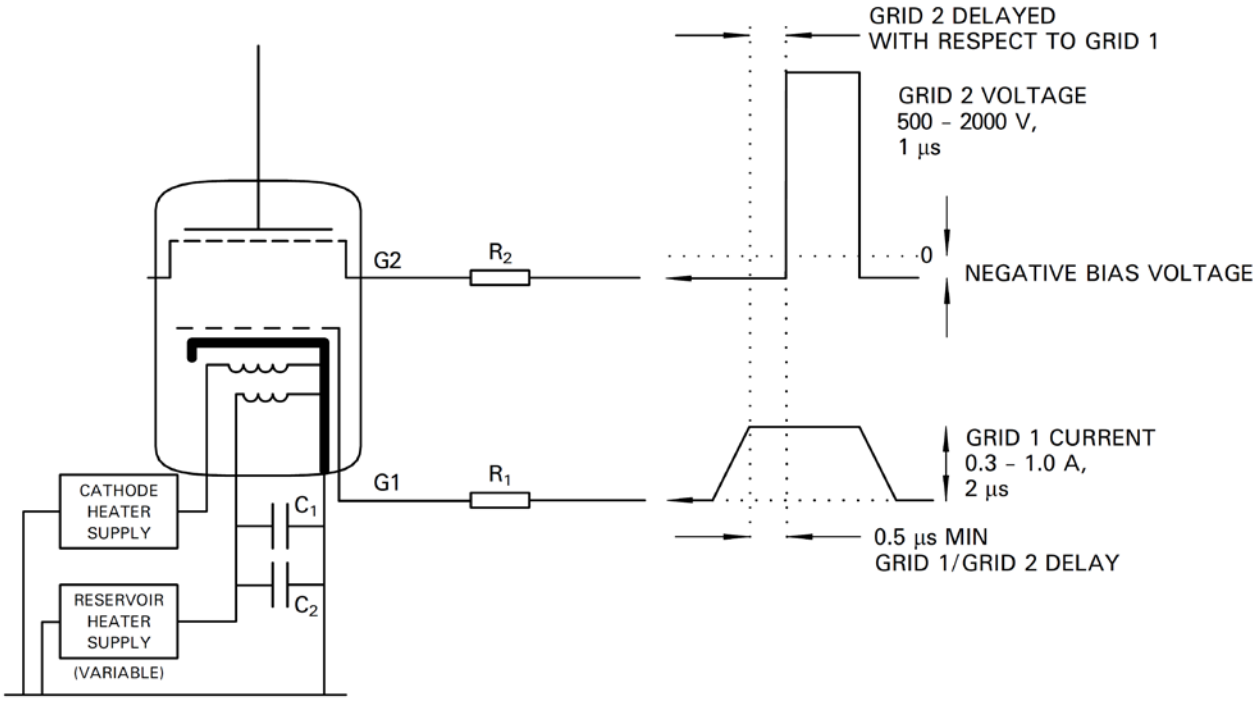
High Voltage

Equipment must be designed so that personnel cannot come into contact with high voltage circuits. All high voltage circuits and terminals must be enclosed and fail-safe interlock switches must be fitted to disconnect the primary power supply and discharge all high voltage capacitors and other stored charges before allowing access. Interlock switches must not be bypassed to allow operation with access door open.

X-Ray Radiation

All high voltage devices produce X-rays during operation and may require shielding. The X-ray radiation from hydrogen thyratrons is usually reduced to a safe level by enclosing the equipment or shielding the thyratron with at least 1.6 mm (1/16 inch) thick steel panels.
Users and equipment manufacturers must check the radiation level under their maximum operating conditions.

SCHEMATIC DIAGRAM



RECOMMENDED GRID, CATHODE AND RESERVOIR HEATER CONNECTIONS

R_1 = Grid 1 series resistor. 12 W vitreous enamelled wirewound is recommended, of a total impedance to match the grid 1 drive pulse circuit.

R_2 = Grid 2 series resistor. 12 W vitreous enamelled wirewound is recommended, of an impedance to match the grid 2 drive pulse circuit.

C_1, C_2 - reservoir protection capacitors with a voltage rating ≥500 V;

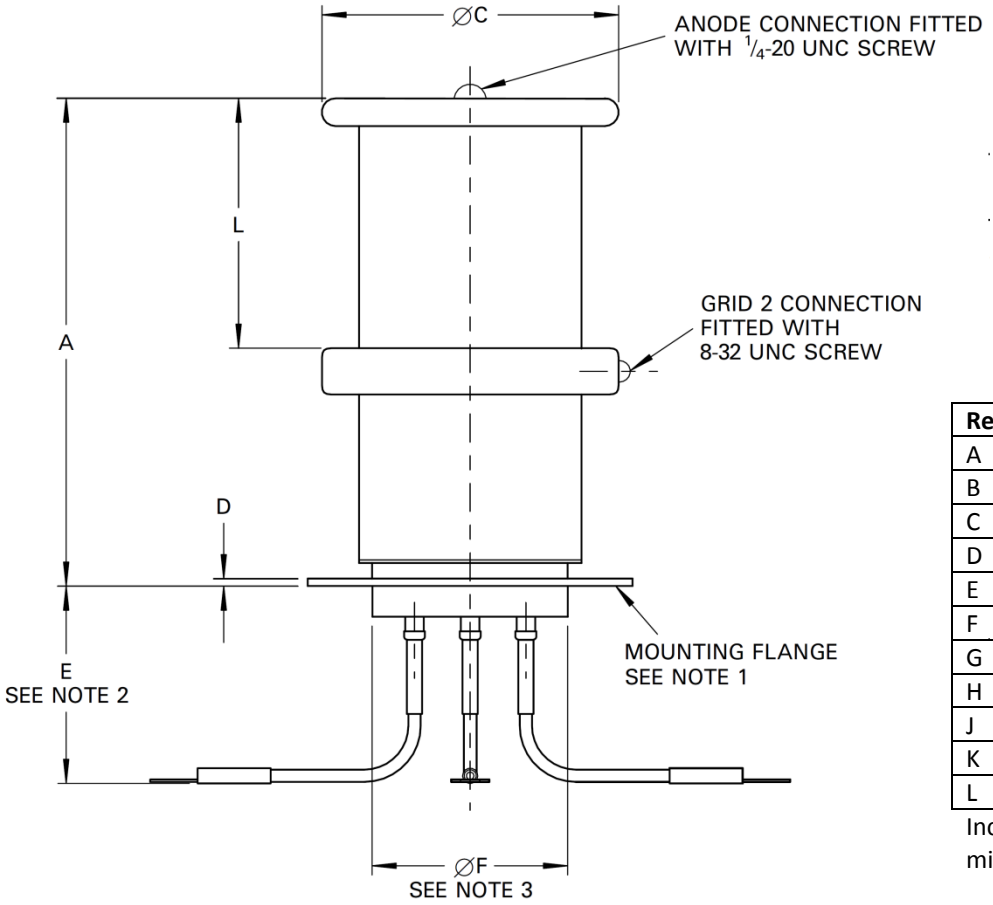
C_1 = 1000 pF low inductance (e.g. ceramic),

C_2 = 1 μF (e.g. polycarbonate or polypropylene).

Components R_1, R_2, C_1 and C_2 should be mounted as close to the tube as possible.

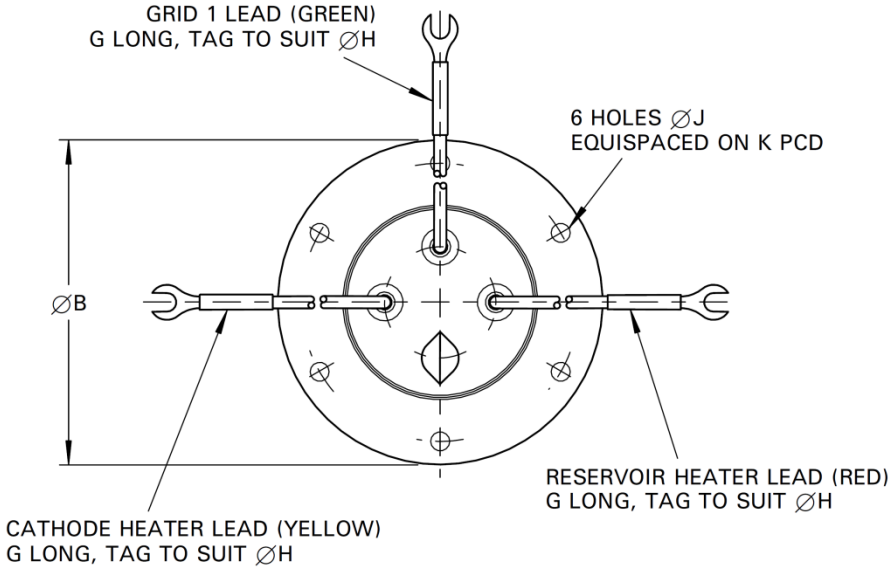
OUTLINE

(All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	165.1 max	6.500 max
B	111.1	4.375
C	101.6	4.000
D	2.54	0.100
E	50.8 min	2.000 min
F	69.85 max	2.750 max
G	152.4	6.000
H	6.35	0.250
J	6.5	0.256
K	95.25	3.750
L	85.73	3.375

Inch dimensions have been derived from millimetres



Outline Notes

1. The mounting flange is the connection for the cathode, cathode heater return and reservoir heater return.
2. A minimum clearance of 50.8 mm (2.000 inches) must be allowed below the flange.
3. The recommended mounting hole is 73.03 mm (2.875 inches) diameter.