CX1171C
Three-Gap Deuterium Thyratron

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

ABRIDGED DATA

Deuterium-filled, three-gap, high voltage thyratron with ceramic/metal envelope, featuring low jitter, firing time and drift. The design of the control grids permits heavy pre-triggering, which allows the thyratron to switch high peak currents at very high rates of rise of current. Also suitable for switching long pulses.

A reservoir normally operated from a separate heater supply is incorporated. The reservoir heater voltage can be adjusted to a value consistent with anode voltage hold-off in order to achieve the fastest rate of rise of current possible from the tube in the circuit.

Peak forward anode voltage	105	kV max
Peak anode current	4.0	kA max
Average anode current	2.0	A max
Rate of rise of current	>150	kA/μs

GENERAL DATA

Electrical

Cathode (connected internally to one end of heater)	oxide coated	
Cathode heater voltage	$6.3\ ^{+0.5}_{-0.0}$	V
Cathode heater current	22.5	A
Reservoir heater voltage (see note 1)	5.0	V
Reservoir heater current	7.0	A
Tube heating time (minimum)	15	min
Inter-electrode capacitances (approximate):		
anode to gradient grid 2	15 to 20	pF
gradient grid 2 to gradient grid 1	15 to 20	pF
gradient grid 1 to grid 2	15 to 20	pF

Mechanical

Seated height	345.54 mm (13.604 inches) max
Clearance required below mounting flange	38.1 mm (1.500 inches) min
Overall diameter (mounting flange)	111.13 mm (4.375 inches) nom
Net weight	4.0 kg (8.8 pounds) approx
Mounting position (see note 2)	any
Tube connections	see outline

Cooling . . . . oil or coolant immersion

Cooling by oil or coolant immersion is necessary in view of the high voltages present. Further information is contained in the relevant section of the Preamble.

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MAXIMUM AND MINIMUM RATINGS (Absolute values)

These ratings cannot necessarily be used simultaneously, and no individual rating must be exceeded.

Anode (Pulse Modulator Conditions)

	Min	Typical	Max	
Peak forward anode voltage	–	–	105	kV
Peak inverse anode voltage (see note 3)	–	–	105	kV
Peak anode current	–	3.0	–	kA
Peak anode current (pulse repetition rate limited to 60 pps max)	–	–	4.0	kA
Average anode current	–	–	2.0	A
Rate of rise of anode current (see notes 4 and 5)	–	10	–	kA/µs
Pulse repetition rate (see note 6)	–	400	–	pps

Anode (Single-Shot or Fault Conditions)

	Min	Max	
DC forward anode voltage	–	80	kV
Peak anode current	–	10	kA
Total conducted charge:			
capacitor discharge	–	0.1	C
fault conditions (see note 7)	–	4.0	C
Repetition frequency	1 pulse per 10 s max		

Grid 2

	Min	Max	
Unloaded grid 2 drive pulse voltage (see note 8)	500	2000	V
Grid 2 pulse duration	0.5	–	µs
Rate of rise of grid 2 pulse (see note 5)	20	–	kV/µs
Grid 1 - grid 2 pulse delay (see schematic)	0.5	3.0	µs
Peak inverse grid 2 voltage	–	450	V
Loaded grid 2 bias voltage (see note 9)	−50	−180	V
Forward impedance of grid 2 drive circuit	50	500	Ω

Grid 1

	Min	Max	
Peak grid 1 drive current	25	80	A
Unloaded grid 1 drive pulse voltage (see note 8)	300	2000	V
Grid 1 pulse duration	1.0	–	µs
Rate of rise of grid 1 pulse	500	–	V/µs
Peak inverse grid 1 voltage	–	450	V
Loaded grid 1 bias voltage	see note 10		

Grid 0

Connected directly to the cathode flange, pulsed simultaneously with 10% of grid 1 pulse or DC primed with 100 mA (±20%) from a 150 V (±20%) source.

Cathode

	Min	Max	
Heater voltage	6.3	6.8	V
Heating time	15	–	min

Reservoir

	Min	Max	
Heater voltage (see note 1)	4.5	6.5	V
Heating time	15	–	min

Environmental

	Min	Max	
Ambient temperature	−50	+90	°C
Altitude	–	3	km
	–	10 000	ft

CHARACTERISTICS

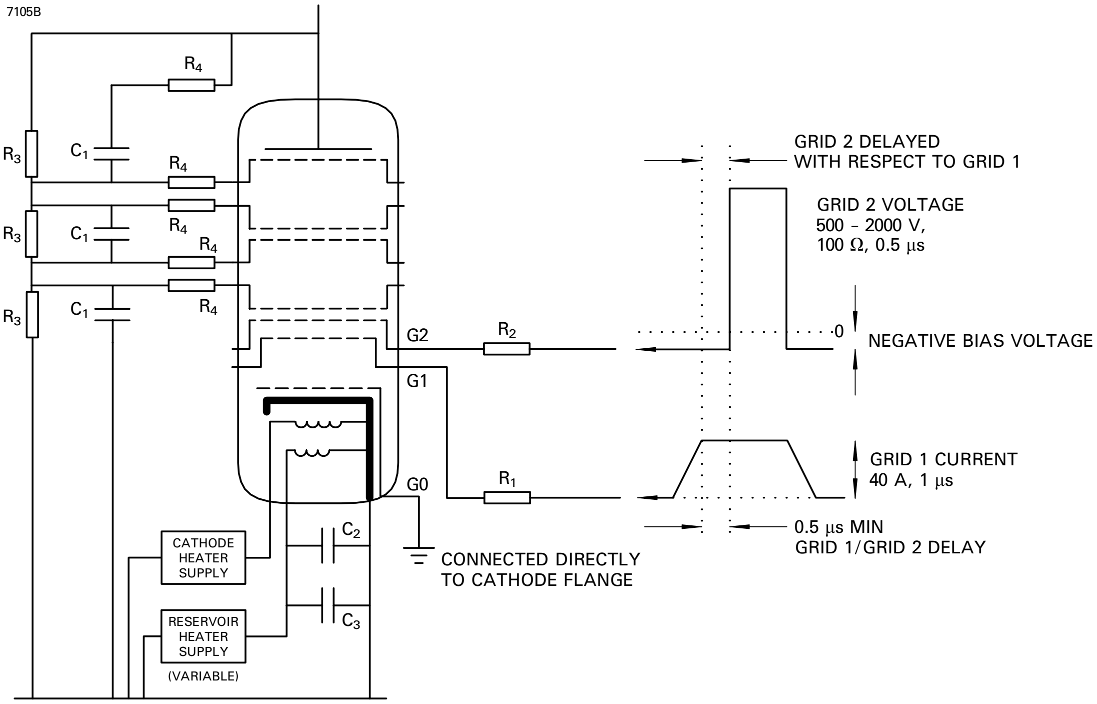
	Min	Typical	Max	
Critical DC anode voltage for conduction (see note 11)	–	5.0	7.0	kV
Anode delay time (see notes 11 and 12)	–	0.1	0.25	µs
Anode delay time drift (see notes 11 and 13)	–	15	50	ns
Time jitter (see note 11)	–	1.0	5.0	ns
Cathode heater current (at 6.3 V)	20	22.5	25	A
Reservoir heater current (at 5.0 V)	6.0	7.0	8.0	A

NOTES

1. The reservoir heater must be decoupled with a suitable capacitor to avoid damage by spike voltages. The recommended reservoir heater voltage is stamped on individual tube envelopes. For maximum rate of rise of current, this voltage should be set to the highest level compatible with maintenance of anode voltage hold-off. The reservoir voltage should be stabilised to ±0.05 V.
2. The tube must be fitted using its mounting flange.
3. The peak inverse voltage including spike must not exceed 10 kV for the first 25 µs after the anode pulse. Amplitude and rate of rise of inverse voltage contribute greatly to tube dissipation and electrode damage; if these are not minimised in the circuit, tube life will be shortened considerably. The aim should be for a maximum inverse voltage of 3 - 5 kV peak with a rise time of >0.5 µs.
4. For single-shot, very low frequency and burst mode applications this parameter can exceed 150 kA/µs. The ultimate value which can be attained depends to a large extent upon the external circuit.
5. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
6. Triggered charging techniques are recommended because this thyratron has a long recovery time (100 - 200 µs) due to the gradient grid drift space. The amount of time required for recovery is affected by gas pressure, peak current, pulse duration and load mismatch which keeps the thyratron in a conducting state.
7. Under fault conditions, most of the coulombs are often in the power supply follow-on current, rather than the storage capacitor discharge.
8. Measured with respect to cathode. When grid 1 is pulse driven, 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.
9. A negative bias must be applied to grid 2 to ensure reliable anode voltage hold-off. The higher grid 1 is pulsed, the larger the grid 2 negative bias must be to prevent the tube firing on the grid 1 pulse.
10. DC negative bias voltages must not be applied to grid 1.
11. Typical figures are obtained on test using conditions of minimum grid drive. Improved performance can be expected by increasing grid drive.

12. 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.
13. The drift in delay time over a period from 10 seconds to 10 minutes after reaching full voltage.

SCHEMATIC DIAGRAM

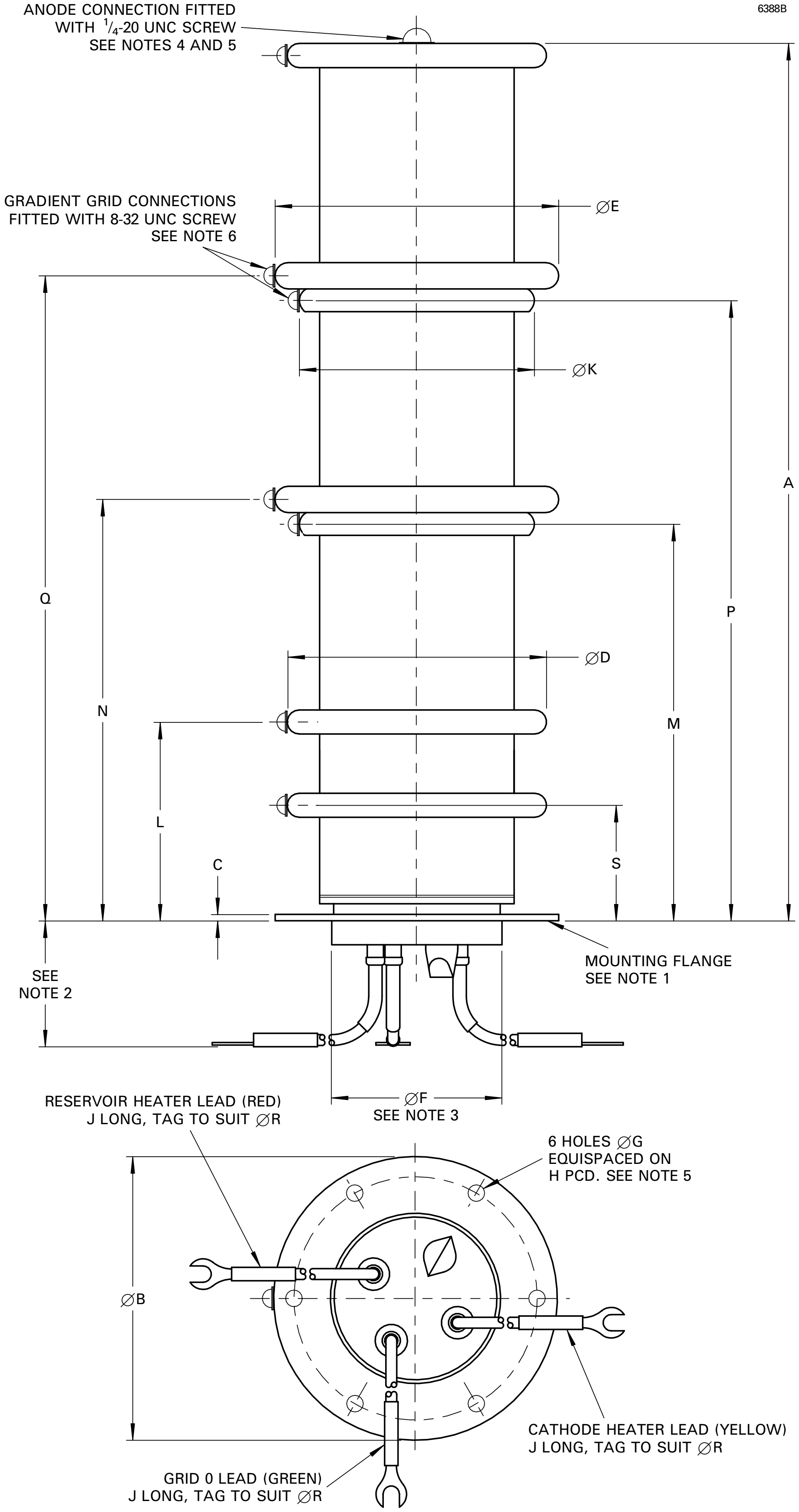


RECOMMENDED GRID, CATHODE AND RESERVOIR HEATER CONNECTIONS

R_1	=	Grid 1 series resistor. 12 W vitreous enamelled wirewound is recommended, of a total impedance to set the grid 1 pulse current.
R_2	=	Grid 2 series resistor. 12 W vitreous enamelled wirewound is recommended, of an impedance to match the grid 2 drive pulse circuit.
R_3	=	5 to 25 MΩ high voltage resistors with a power rating consistent with the forward anode voltage.
R_4	=	470 Ω 2.5 W vitreous enamelled wirewound resistors.
C_1	=	300 to 500 pF capacitors with a voltage rating equal to the peak forward voltage. These capacitors may be needed to divide the voltage correctly across each gap when charging times are less than 5 ms approx.
C_2, C_3	=	Reservoir protection capacitors with a voltage rating $\geqslant$500 V;
C_2	=	1000 pF low inductance (e.g. ceramic),
C_3	=	1 μF (e.g. polycarbonate or polypropylene).

Components R_1, R_2, C_2 and C_3 should be mounted as close to the tube as possible.

OUTLINE
(All dimensions without limits are nominal)



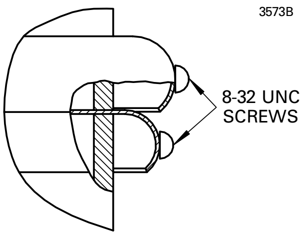
Ref	Millimetres	Inches
A	343.00 ± 2.54	13.504 ± 0.100
B	111.13	4.375
C	2.50 ± 0.25	0.098 ± 0.010
D	101.6 ± 1.6	4.000 ± 0.063
E	111.13 ± 1.60	4.375 ± 0.063
F	69.85 max	2.750 max
G	6.5	0.256
H	95.25	3.750
J	190.5 min	7.500 min
K	92.08 ± 1.60	3.625 ± 0.063
L	76.9	3.027
M	154.4	6.078
N	164.1	6.461
P	242.2	9.535
Q	251.9	9.917
R	6.35	0.250
S	44.3	1.744

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 38 mm (1.500 inches) must be allowed below the mounting flange.
3. The recommended mounting hole is 73 mm (2.875 inches) diameter.
4. The face of the anode stud is parallel to the bottom face of the flange to within 1°.
5. The mounting holes, the outside diameter of the stress rings and the outside diameter of the anode stud are concentric within 1 mm.
6. The grid connections are in line with the mounting hole to within ±5° of the centre line.

Detail of Gradient Grid Connections
(See page 3)



HEALTH AND SAFETY HAZARDS

e2v technologies hydrogen 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 equipments 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 doors 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.