

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

### ABRIDGED DATA

Deuterium filled, double-gap, hollow anode thyatron with ceramic envelope, featuring high coulomb capability and short delay to switch on. It has been developed specifically for use in crowbar applications.

A separate reservoir is incorporated which is set up to operate at the same voltage as the heater. The thyatron is designed to operate continuously at 40 kV dc without spurious firing.

Peak forward anode voltage . . . . .	40	kV max
Peak forward anode current . . . . .	1.5	kA max
Peak reverse anode current . . . . .	1.0	kA max
Conducted charge . . . . .	6.0	C max

### GENERAL

#### Electrical

Cathode (connected internally to one end of heater) . . . . .	oxide coated
Cathode heater voltage . . . . .	$6.3 \pm 2\%$ V
Cathode heater current . . . . .	20 A
Reservoir heater voltage (see note 1) . . . . .	$6.3 \pm 2\%$ V
Reservoir heater current (at 6.3 V) . . . . .	5 A
Tube heating time (minimum) (see note 2) . . . . .	5 minutes

#### Mechanical

Seated height . . . . .	186.0 mm (7.323 inches) max
Clearance required below mounting flange . . . . .	31.8 mm (1.250 inches) min
Overall diameter (mounting flange) . . . . .	111.1 mm (4.375 inches) nom
Net weight . . . . .	2.2 kg (4.75 pounds) approx
Mounting position (see also cooling below) . . . . .	any
Tube connections . . . . .	see outline

#### Cooling

For all applications either forced-air or total liquid immersion is needed. For forced-air cooling a flow of air must be directed onto the base of the tube and the air must then be able to flow past the base and body as indicated in Fig. 1.

Maximum temperature of envelope . . . . .	150 °C
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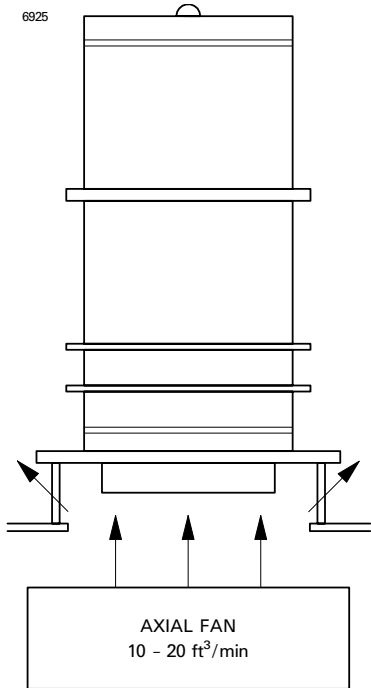


Fig. 1 Recommended cooling arrangement

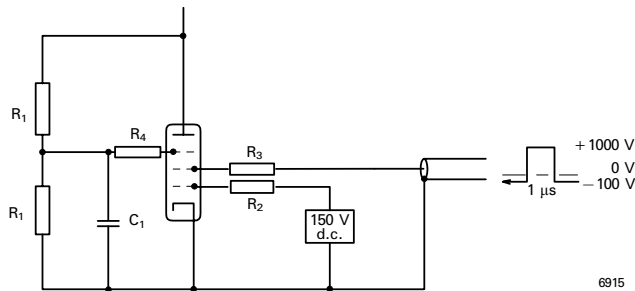


Fig. 2 Recommended grid connections

### Recommended Values

$R_1 = 10 - 25 \text{ M}\Omega$  High voltage resistors of sufficient power rating for operating anode voltage.

$R_2 = 1000 \Omega$  12 W Vitreous enamelled wirewound to set grid 1 current.

$R_3 = 100 \Omega$  12 W Vitreous enamelled wirewound.

$R_4 = 470 \Omega - 1 \text{ k}\Omega$  12 W Vitreous enamelled wirewound resistor.

$C_1 = 300 \text{ pF} - 1 \text{ nF}$  Capacitor rated to full HT voltage.

**Note** It is recommended that  $R_2$  and  $R_3$  be mounted as close to the tube as possible.

## MAXIMUM AND MINIMUM RATINGS (Absolute values) CROWBAR SERVICE

	Min	Typical	Max	
<b>Anode</b>				
Peak forward anode voltage (see note 3)	-	-	40	kV
Peak forward anode current (see notes 4 and 5)	-	-	1.5	kA
Peak reverse anode current	-	-	1.0	kA
Rate of rise of anode current (see note 6)	-	50	-	kA/ $\mu$ s
Conducted charge:				
capacitor discharge	-	-	0.7	C
power supply follow-on (see note 4)	-	-	6	C

### Triggering

The CX2708 has two trigger grids, designated grid 1 and grid 2 (see outline drawing). For crowbar applications the CX2708 is normally triggered with a single pulse to grid 2 (with negative bias) and DC priming to grid 1 (see Fig. 2); the DC priming current and/or the voltage developed at the grid 1 terminal may be used as an interlock to indicate that the thyatron is ready to fire and also to indicate when the thyatron is reaching end of life (see note 7).

### Triggering (See Fig. 2)

#### a) Grid 2 Pulse

Unloaded grid drive voltage (see note 8)	800	1000	2000	V
Grid pulse duration	-	1	-	$\mu$ s
Rate of rise of grid pulse voltage (see notes 9 and 10)	4	10	-	kV/ $\mu$ s
Loaded grid 2 bias voltage	-50	-100	-150	V
Source impedance of grid drive circuit	50	100	200	$\Omega$

#### b) DC on Grid 1

DC grid 1 unloaded priming voltage	75	-	150	V
DC grid 1 priming current	50	100	250	mA

### Heaters

Cathode and reservoir heater voltage	6.17	6.3	6.43	V
Cathode heater current (at 6.3 V)	19	20.5	22	A
Reservoir heater current (at 6.3 V)	4.0	5.0	6.0	A
Tube heating time (see note 2)	10	-	-	min

## Environmental

Ambient temperature . . . . .	+ 10	-	+ 50	°C
Altitude . . . . .	-	-	10 000	ft
	-	-	3	km

## CHARACTERISTICS

### Tube triggered normally

Critical DC anode voltage for conduction (see note 11) . . . . .	-	1.0	2.0	kV
Anode delay time (see notes 11 and 12) . . . . .	-	0.15	0.4	µs

### Under crowbar conditions (See note 5)

Critical DC anode voltage for conduction . . . . .	<5	-	-	kV
Firing delay (see note 13) . . . . .	-	-	2	µs

## NOTES

1. The reservoir heater must be decoupled with a suitable capacitor to avoid damage by spike voltages. The reservoir voltage sets the gas pressure in the thyatron, which determines the high voltage hold-off. Therefore the reservoir voltage must be kept within the specified limits.
2. 7 minutes are required for the cathode to achieve optimum temperature. The thyatron will, however, operate satisfactorily to protect the load after a heating time of 5 minutes. In the event of a power failure after the initial 7 minutes then the pre-heat time must be at least three times the off time, to a maximum of five minutes.
3. The maximum permissible peak forward voltage for instantaneous starting is 40 kV. The tube is tested such that it must hold-off 40 kV for a 24 hour period without spurious firing.
4. In crowbar service, most of the conducted charge is often in the power supply follow-on rather than the storage capacitor discharge.
5. Typical crowbar circuits are:

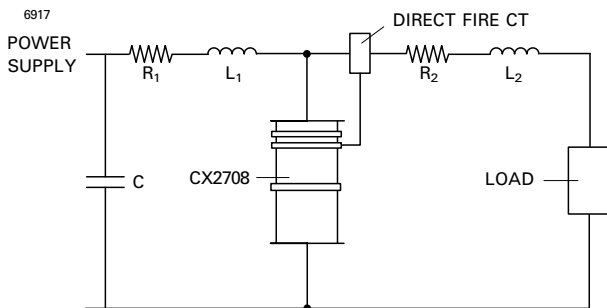


Fig. 3

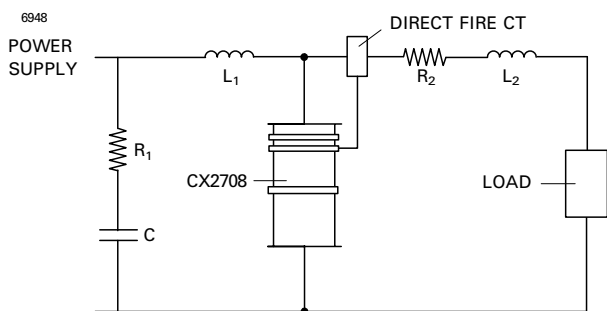


Fig. 4

$L_1$  and  $L_2$  are stray inductances.  $L_2$  should be equal to or greater than  $L_1$ .  $C$  is the filter/storage capacitor.

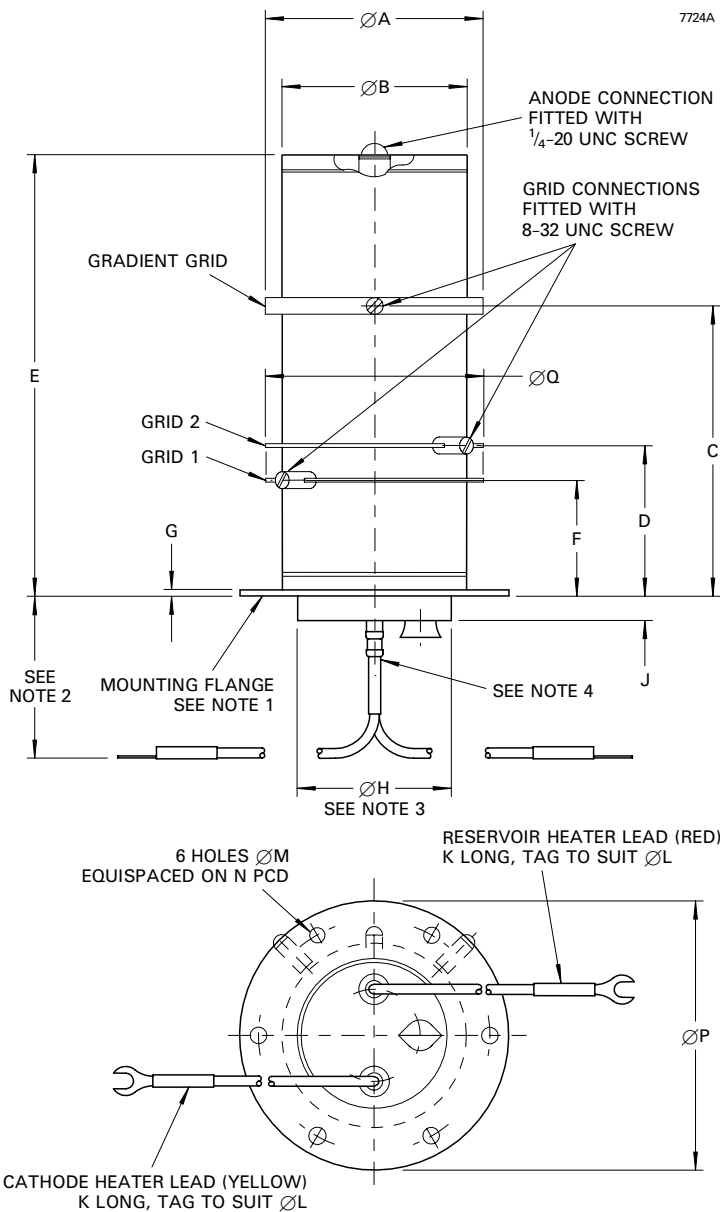
$R_1$  and  $R_2$  are surge limiting resistors.  $R_2$  should be equal to or greater than  $R_1$ .  $R_1$  must limit the peak current to 1.5 kA at the maximum operating voltage (i.e.  $R_1 = 26.6 \Omega$  min at 40 kV).

In crowbar operation the thyatron is called upon to fire against a rapidly falling anode voltage. An analysis of the circuits in Figs. 3 and 4 above can be found in e2v technologies Technical Reprint No. 122.

6. Measured from 10% to 90%. The ultimate rate of rise of current which can be attained depends to a large extent upon the external circuit.
7. The voltage developed at the grid 1 terminal, in a new thyatron, is in the range 17 - 19 V with a grid 1 DC priming current of 60 mA. As the thyatron cathode ages this voltage rises and for crowbar applications, where conventional power supplies are used, the thyatron may be deemed to have reached end of life, where it may fail the standard 40 SWG 'wire test', when the grid 1 voltage has risen above 24 V.
8. Measured with respect to cathode.
9. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
10. A lower rate of rise may be used, but this may result in the anode delay time exceeding the limits quoted.
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. This maximum delay is obtained using a direct fire current transformer as shown in Figs. 3 and 4 above, at the minimum power supply voltage of 5 kV.

# OUTLINE

(All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	90.0	3.543
B	77.80 max	3.063 max
C	119.42	4.702
D	62.06	2.443
E	186.0 max	7.323 max
F	47.76	1.880
G	2.5	0.098
H	69.85 max	2.750 max
J	12.70 max	0.500 max
K	190.50 min	7.500 min
L	6.35	0.250
M	6.5	0.256
N	95.25	3.750
P	111.13	4.375
Q	92.5	3.642

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 31.8 mm (1.25 inches) must be allowed below the mounting flange.
3. The recommended mounting hole is 73.03 mm (2.875 inches) diameter.
4. Both the heater leads are attached with permanent crimp connections.

## 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.

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