

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

## ABRIDGED DATA

Deuterium-filled pentode thyatron with ceramic envelope, featuring high peak current, high rate of rise of current and low jitter. It has been developed specifically for use in low inductance circuits.

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.

### Pulse Modulator Service

Peak forward anode voltage . . . . .	35	kV max
Peak forward anode current . . . . .	10	kA max
Average anode current . . . . .	2.0	A max
Rate of rise of current . . . . .	> 100	kA/ $\mu$ s

### Single-Shot, Crowbar and Fault Conditions

Peak forward anode voltage . . . . .	30	kV max
Peak forward anode current . . . . .	10	kA max
Total conducted charge:		
capacitor discharge . . . . .	0.1	C max
fault conditions . . . . .	4	C max
Repetition frequency . . . . .	1 pulse per 10 s	max

## GENERAL

### Electrical

Cathode (connected internally to one end of heater) . . . . .	oxide coated
Cathode heater voltage . . . . .	6.3 $\begin{matrix} + 0.5 \\ - 0.0 \end{matrix}$ V
Cathode heater current . . . . .	25 A
Reservoir heater voltage (see note 1) . . . . .	5.5 V
Reservoir heater current . . . . .	7.5 A
Tube heating time (minimum) . . . . .	15 min

### Mechanical

Seated height . . . . .	172.2 mm (6.781 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

### 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<sup>3</sup>/min (75 ft<sup>3</sup>/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 per ampere 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 APPLICATIONS MAXIMUM AND MINIMUM RATINGS (Absolute values)

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

	Min	Typical	Max	
<b>Anode (Pulse Modulator Service)</b>				
Peak forward anode voltage (see note 3)	-	-	35	kV
Peak inverse anode voltage	-	-	35	kV
Peak forward anode current	-	-	10	kA
Average anode current	-	-	2.0	A
Pulse duration	-	2.0	-	μs
Rate of rise of anode current (see note 4)	-	> 100	-	kA/μs
Pulse repetition rate	-	100	-	pps

### Anode (Single-Shot, Crowbar and Fault Conditions)

DC forward anode voltage	-	-	30	kV
Peak anode current	-	-	15	kA
Total conducted charge:				
capacitor discharge	-	-	0.1	C
fault conditions (see note 5)	-	-	4.0	C
Repetition frequency	-	-	1 pulse per 10 s max	

### Grid 2 (Voltage driven)

Unloaded grid 2 drive pulse voltage (see note 6)	500	-	2000	V
Grid 2 pulse duration	-	0.5	-	μs
Rate of rise of grid 2 pulse (see notes 4 and 7)	10	20	-	kV/μs
Grid 2 pulse delay (see note 8)	-	-	3.0	μs
Peak inverse grid 2 voltage	-	-	450	V
Loaded grid 2 bias voltage (see note 9)	-100	-	-180	V
Forward impedance of grid 2 drive circuit	50	-	500	Ω

### Grid 1 (Pulse current driven)

Peak grid 1 drive current (see note 9)	10	50	100	A
Unloaded grid 1 drive pulse voltage (see note 6)	500	-	2000	V
Grid 1 pulse duration	-	2.0	-	μs
Rate of rise of grid 1 pulse	200	-	-	V/μs
Peak inverse grid 1 voltage	-	-	450	V

### Grid 0 (Monitor, see note 10)

Directly connected to the cathode flange, or DC primed with 100 mA ( $\pm 20\%$ ) from a 120 V ( $\pm 20\%$ ) source.

### Heaters

Cathode heater voltage	6.3	6.3	6.8	V
Reservoir heater voltage (see note 1)	4.5	5.5	6.5	V
Tube heating time	15	-	-	min

### Environmental

Ambient temperature	0	-	+ 40	°C
Altitude	-	-	3	km
	-	-	10 000	ft

## CHARACTERISTICS

	Min	Typical	Max	
Critical DC anode voltage for conduction (see note 11)	-	0.5	1.0	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 6.8 V)	22	25	28	A
Reservoir heater current (at 5.0 V)	6.0	7.0	8.0	A

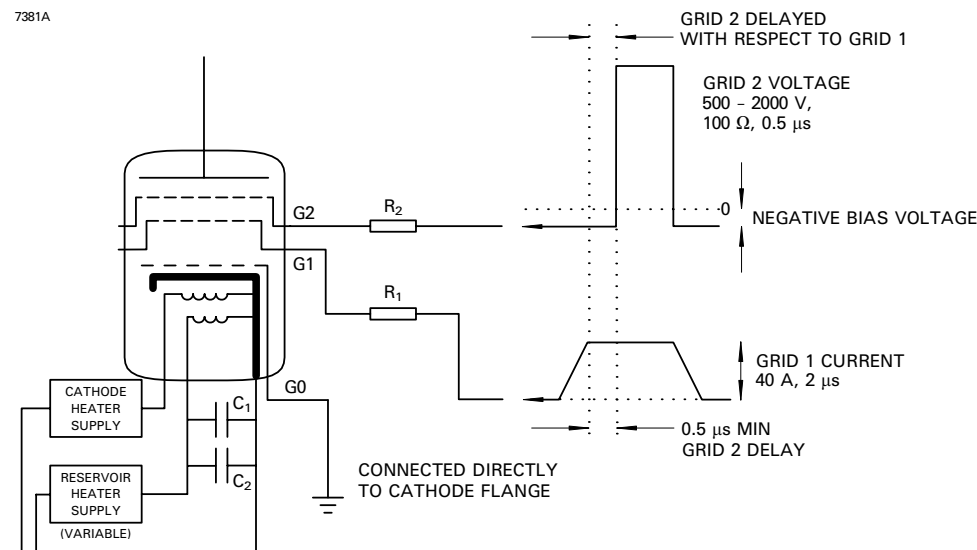
## NOTES

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  $\mu\text{F}$  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. Under standard resonant charging conditions, a maximum anode voltage of 35 kV is specified. If command charging techniques are used and the anode voltage applied for  $\lesssim 5$  ms then the CX1154C may be operated up to 40 kV.
4. 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 anode current obtainable will depend to a large extent on the external circuit parameters.
5. Under fault conditions, most of the coulombs are often in the power supply follow-on current, rather than the storage capacitor discharge.

6. Measured with respect to cathode.
7. 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.
8. At least the last 0.25  $\mu\text{s}$  of the top of the grid 1 pulse must overlap the corresponding first 0.25  $\mu\text{s}$  of the top of the delayed grid 2 pulse.
9. The higher grid 1 is pulsed, the larger must the grid 2 negative bias be, to prevent the tube firing on the grid 1 pulse.
10. For modulator applications, the grid 0 lead is normally connected directly to the cathode flange and not used. Alternatively, the grid 0 may be DC primed and the grid 0 current and/or voltage used as a 'thyatron ready to fire' interlock. This may be especially useful in crowbar applications.
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

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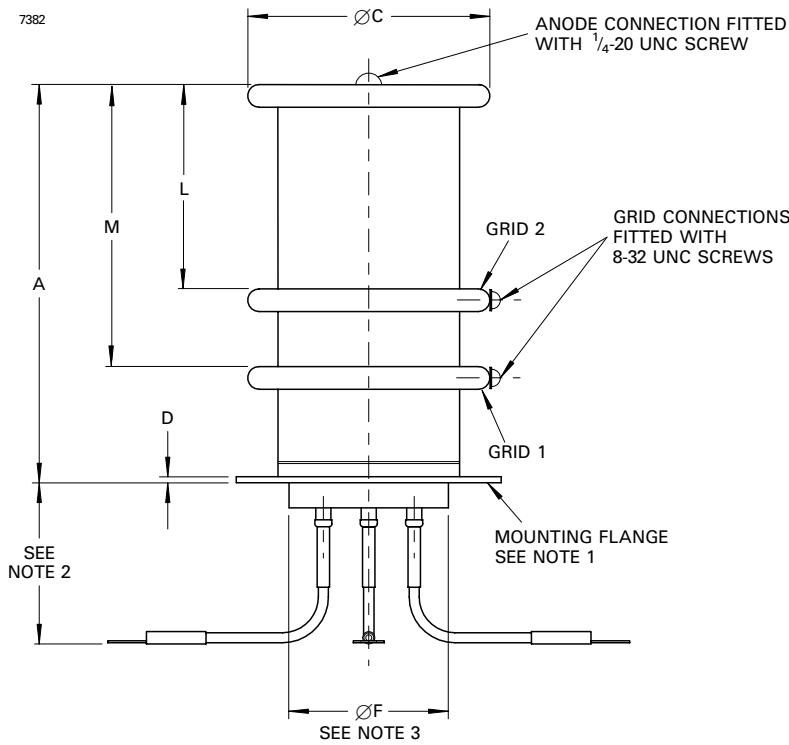


## RECOMMENDED GRID, CATHODE AND RESERVOIR HEATER CONNECTIONS

- $R_1, R_2$  = Grid 1 and grid 2 series resistors. 12 W vitreous enamelled wirewound are recommended.
- $C_1, C_2$  = reservoir protection capacitors with a voltage rating  $\geq 500$  V;  
 $C_1$  = 1000 pF low inductance (e.g. ceramic),  
 $C_2$  = 1  $\mu\text{F}$  (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.

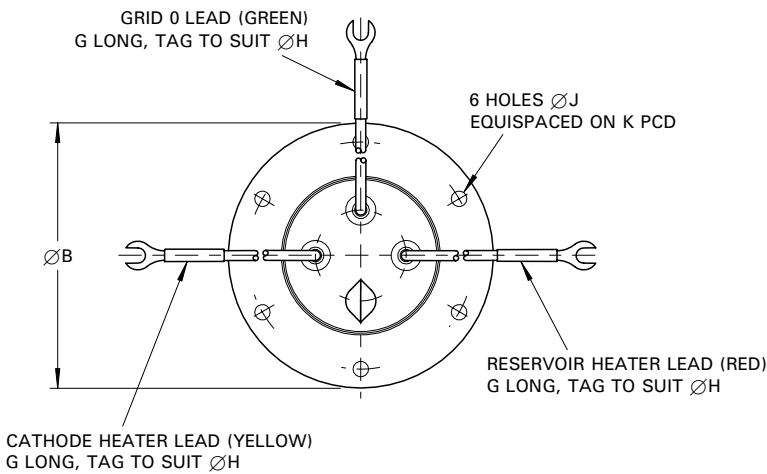
# OUTLINE

(All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	172.24 max	6.781 max
B	111.1	4.375
C	101.6	4.000
D	2.54	0.100
F	69.85 max	2.750 max
G	177.8 min	7.000 min
H	6.35	0.250
J	6.5	0.256
K	95.25	3.750
L	85.73	3.375
M	116.66	4.593

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 mounting flange.
3. The recommended mounting hole is 73.03 mm (2.875 inches) diameter.

## 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 1/16-inch (1.6 mm) thick steel panels.

Users and equipment manufacturers must check the radiation level under their maximum operating conditions.

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