CX1157

HYDROGEN-FILLED CERAMIC THYRATRON

Service Type CV6241

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

ABRIDGED DATA

Hydrogen-filled tetrode thyratron with ceramic envelope, featuring low jitter and low anode delay time drift. Suitable for use at high pulse repetition rates and in applications requiring ruggedness and compactness. A hydrogen reservoir operating from the heater supply is incorporated.

Peak forward anode voltage	20	kV max
Peak anode current	350	A max
Average anode current	500	mA max
Anode heating factor	7.0×10^9	V.A.p.p.s. max
Peak output power	3.5	MW max

GENERAL

Electrical

Cathode (connected internally to one end of heater)	oxide coated	
Cathode heater voltage	6.3 ± 7½%	V
Cathode heater current	7.5	A
Reservoir heater voltage (see note 1)	6.3 ± 7½%	V
Reservoir heater current	1.5	A
Tube heating time (minimum)	3.0	min

Mechanical

Seated height	3.000 inches (76.20mm) max
Clearance required below mounting flange	1.250 inches (31.75mm) min
Overall diameter (mounting flange)	2.250 inches (57.15mm) nom
Net weight	10 ounces (284g) approx
Mounting position (see note 2)	any
Tube connections	see outline

Cooling . . . . . natural, forced-air or liquid

Where natural cooling is insufficient to maintain the envelope temperatures below the specified rated values, cooling by forced-air, or by oil or coolant immersion may be used.

The temperature of the anode terminal and the base, measured at the points indicated on the outline drawing, must not exceed the values specified below.

Anode terminal	250	°C max
Base	220	°C max

PULSE MODULATOR SERVICE

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Max	
Anode			
Peak forward anode voltage (see note 3) . .	–	20	kV
Peak inverse anode voltage (see note 4) . .	–	20	kV
Peak anode current	–	350	A
Average anode current	–	500	mA
Rate of rise of anode current (see notes 5 and 6)	–	2500	A/μs
Anode heating factor	–	7.0×10^9	V.A.p.p.s.
Grid 2			
Unloaded grid 2 drive pulse voltage (see note 7)	200	750	V
Grid 2 pulse duration	1.0	–	μs
Rate of rise of grid 2 pulse (see note 6) . .	1.0	–	kV/μs
Grid 2 pulse delay	0.5	3.0	μs
Peak inverse grid 2 voltage	–	200	V
Loaded grid 2 bias voltage (see note 8) .	−50	−200	V
Forward impedance of grid 2 drive circuit	100	1000	Ω
Grid 1 – D.C. Primed (See note 9)			
D.C. grid 1 unloaded priming voltage . . .	75	150	V
D.C. grid 1 priming current	50	150	mA

MAXIMUM AND MINIMUM RATINGS – continued

Grid 1 – Pulsed	Min	Max	
Unloaded grid 1 drive pulse voltage (see note 7)	300	750	V
Grid ¶ pulse duration	2.0	–	μs
Rate of rise of grid 1 pulse (see note 6)	1.0	–	kV/μs
Peak inverse grid 1 voltage	–	200	V
Loaded grid 1 bias voltage		see note 10	
Peak grid 1 drive current	0.15	0.5	A

Cathode			
Heater voltage	6.3 ± 7½%		V
Heating time	3.0	–	min

Reservoir			
Heater voltage (see note 1)	6.3 ± 7½%		V
Heating time	3.0	–	min

Environmental (See note 11)			
Ambient temperature	–55	+130	°C
Altitude	–	10 000	ft
	–	3	km

CHARACTERISTICS

	Min	Typical	Max	
Critical d.c. anode voltage for conduction (see note 12)	–	0.2	0.3	kV
Anode delay time (see notes 12 and 13)	–	0.15	0.25	μs
Anode delay time drift (see notes 12 and 14)	–	20	50	ns
Time jitter (see note 12)	–	1.0	5.0	ns
Recovery time		see note 15 and curves		
Heater and reservoir current (at 6.3V)	7.5	9.0	10.5	A

SINGLE SHOT OR CROWBAR SERVICE

In applications requiring a very rapid rate of rise of anode current, the CX1157 geometry allows it to be mounted in a coaxial structure in order to minimize the total circuit inductance. Operation of the tube under the following ratings results in short anode delay times and very low time jitter.

MAXIMUM AND MINIMUM RATINGS (Absolute values)

	Min	Typical	Max	
Anode				
Peak forward anode voltage (see note 16)	–	–	20	kV
Peak anode current (see note 17)	–	–	3000	A
Average anode current	–	–	300	mA
Grid 2				
Unloaded grid 2 drive pulse voltage	0.5	1.0	2.0	kV
Grid 2 pulse duration	0.25	–	5.0	μs
Rate of rise of grid 2 pulse (unloaded)	10	30	–	kV/μs
Loaded grid 2 bias voltage	−50	−150	−200	V
Forward impedance of grid 2 drive circuit	50	50	500	Ω
Grid 1				
Grid 1 drive current (d.c.)	50	70	100	mA
Cathode				
Heater voltage	5.8	6.8	7.0	V
Reservoir				
Heater voltage	5.8	6.8	7.0	V

CHARACTERISTICS

Anode delay time (see note 18)	–	30	75	ns
Rate of rise of anode current (see notes 18 and 19)	–	100	–	kA/μs
Time jitter (see note 20)	–	<1.0	2.0	ns

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 to avoid damage to the reservoir.
2. • The tube must be mounted by means of its mounting flange.
3. The maximum permissible peak forward voltage for instantaneous starting is 16kV and there must be no overshoot.
4. The peak inverse voltage including spike must not exceed 5.0kV for the first 25 microseconds after the anode pulse.
5. For single shot or burst mode applications this parameter can exceed 100kA/μs. The ultimate value which can be attained depends to a large extent upon the external circuit.
6. This rate of rise refers to that part of the leading edge of the pulse between 25% and 75% of the pulse amplitude.
7. Measured with respect to cathode. When grid 1 is pulse driven, the last 0.25μs of the top of the grid 1 pulse must overlap the corresponding first 0.25μs of the top of the delayed grid 2 pulse.
8. The tube may be operated with a loaded grid 2 bias voltage of 0 to −50V provided that care is taken to ensure that the peak grid 1 drive current is sufficiently low to prevent triode firing (tube control by the grid 1 pulse).
9. When d.c. priming is used on grid 1, a negative bias of 100 to 200V must be applied to grid 2 to ensure anode voltage hold-off. D.C. priming is especially suitable in crowbar service.
10. D.C. negative bias voltages must not be applied to grid 1. When grid 1 is pulse driven, the potential of grid 1 may vary between −10 and +5V with respect to cathode potential during the period between the completion of recovery and the commencement of the succeeding grid pulse.
11. To ensure a high standard of ruggedness, all tubes are subjected to the following tests. After each mechanical test all the tubes must then satisfy all electrical tests.

    (a) Vibration — The tubes are vibrated at 50Hz with acceleration of 10g for one minute in the direction of the cathode axis and then in one direction perpendicular to the cathode axis. See note 2.

    (b) Recovery Time — The tubes are tested for recovery at zero grid 2 bias voltage with a maximum limit of 35μs.

The tubes are subjected to the following tests on a sampling basis.

(c) Operation under Vibration – The tubes are vibrated at 10g in each of three planes at a sweep rate of one octave per minute from 20 to 500 to 20Hz, under normal operating conditions. See note 2.

(d) Survival under Vibration and Heater Cycling – The tubes are vibrated at 10g at a sweep rate of one octave per minute from 5 to 500Hz for 70 hours in each plane together with heater cycling of a 10 minute on/off cycle. See note 2.

(e) Long Duration Shock – The tubes are tested at 125g for ten milliseconds with two blows in each plane. See note 2.

(f) High Temperature Test – The tubes are tested at a base temperature of 220°C and an anode temperature of 250°C under normal operating conditions for 5 hours. This implies an ambient temperature of 130°C.

(g) Low Temperature Instant Start – The tubes are cooled to −20°C and subjected to a 3-minute warm up period with 5.8V on the heater. The tubes must withstand a snap start at 10kV and operate satisfactorily.

(h) Standby-Life – The tubes are run with 6.3V heater voltage applied for 500 hours.

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

13. The time interval between the instant when the unloaded grid 2 voltage passes cathode potential and the instant when anode conduction takes place.

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

15. The recovery characteristics are controlled on a sampling basis.

16. For crowbar applications where the tube is required to hold off d.c. anode voltage for longer than 20ms, the maximum peak forward anode voltage is 16kV. If the reservoir voltage is increased above normal, the d.c. hold-off voltage may be reduced.

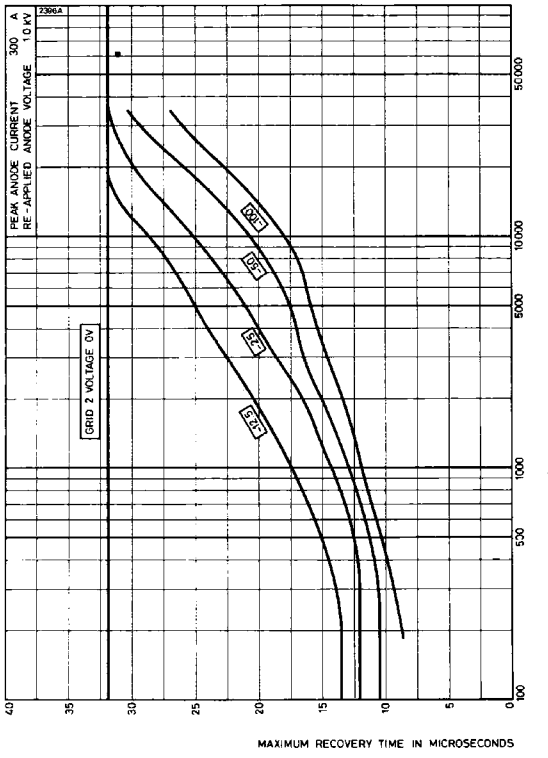
17. For pulse durations not exceeding 0.25μs.

18. Shorter anode delay time and higher rate of rise of anode current may be obtained by increasing the cathode and reservoir heater voltages from 6.3 to 6.8V.
19. The rate of rise of anode current obtainable is also dependent on the total circuit inductance and transmission line type matching.
20. With the grid drive conditions specified, the anode delay time jitter will normally be less than 1.0ns.

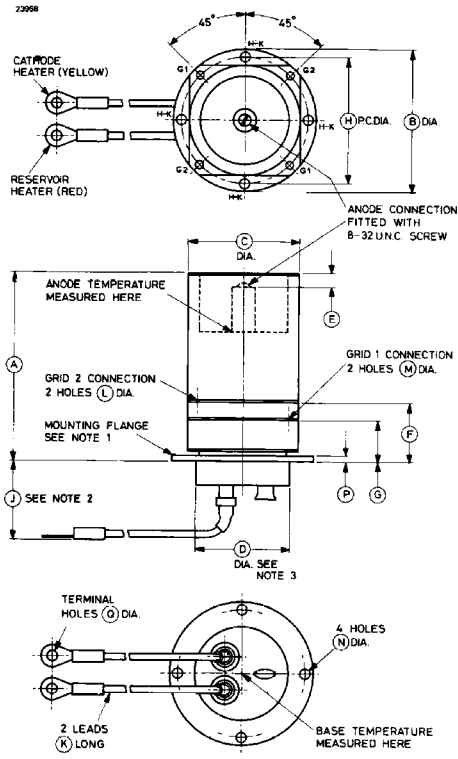
X-RAY WARNING

X-rays may be emitted by the CX1157 but the radiation is usually reduced to a safe level by the metal panels of the equipment in which the tube operates.

MAXIMUM RECOVERY CHARACTERISTICS



OUTLINE


23958
45°
45°
H-K
CATHODE HEATER (YELLOW)
G1
G2
H-K
H-K
(H) P.C.DIA.
(B) DIA.
RESERVOIR HEATER (RED)
G2
G1
H-K
ANODE CONNECTION FITTED WITH 8-32 U.N.C. SCREW
(C) DIA.
ANODE TEMPERATURE MEASURED HERE
(E)
(A)
GRID 1 CONNECTION 2 HOLES (M) DIA.
GRID 2 CONNECTION 2 HOLES (L) DIA.
MOUNTING FLANGE SEE NOTE 1
(F)
(J) SEE NOTE 2
(P)
(G)
(D) DIA. SEE NOTE 3
TERMINAL HOLES (Q) DIA.
4 HOLES (N) DIA.
2 LEADS (K) LONG
BASE TEMPERATURE MEASURED HERE

Outline Dimensions (All dimensions without limits are nominal)

Ref	Inches	Millimetres
A	3.000 max	76.20 max
B	2.250	57.15
C	1.750 ± 0.031	44.45 ± 0.79
D	1.437	36.50
E	0.220 ± 0.015	5.59 ± 0.38
F	0.940	23.88
G	0.658	16.71
H	2.031 ± 0.010	51.59 ± 0.25
J	1.250 min	31.75 min
K	6.000	152.4
L	0.120	3.05
M	0.120	3.05
N	0.165	4.19
P	0.100	2.54
Q	0.165	4.19

Millimetre dimensions have been derived from inches.

Outline Notes

1. The mounting flange is the connection for the cathode, cathode heater return and reservoir heater return.
2. A minimum clearance of 1.250 inches (31.75mm) must be allowed below the flange.
3. The recommended mounting hole is 1.500 inches (38.10mm) diameter.

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