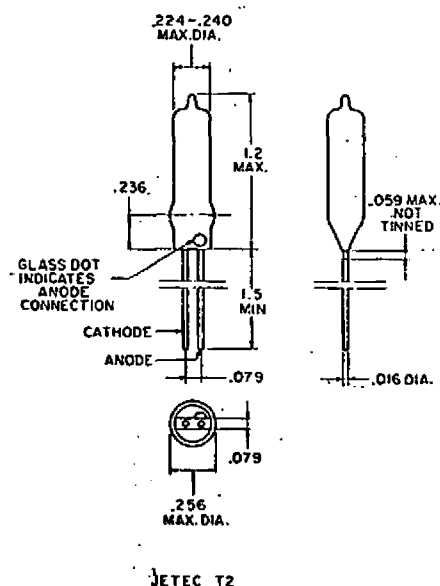


AMPEREX TUBE TYPE 8228

TENTATIVE DATA

The Amperex 8228 is a subminiature cold-cathode voltage reference tube for use in stable regulated power supplies, dc amplifiers, oscilloscope calibrators and similar applications.

Featuring an extremely low temperature coefficient of .0015% per °C, the 8228 affords excellent regulation and uniformity. The rugged construction of this extremely small voltage reference tube insures reliability. It is designed for a life of 30,000 hours.



GENERAL CHARACTERISTICS

ELECTRICAL

Absolute Maximum Ratings

	Min.	Max.
Cathode Current	2	4 ma
Peak Starting Current ($T_{max} = 20$ secs.)	--	10 ma ¹
Peak Inverse Voltage	--	100 volts
Bulb Temperature		
Operating	-55°C	+125°C
Storage and Standby	-55°C	+100°C

¹ To maintain maximum reference voltage stability this limit is restricted to once every 4 hours.

8228

Characteristics ($T_{amb} = 20$ to 30°C)

	Min.	Typ.	Max.
Cathode Current (Preferred Operating Point)	--	3	-- ma
Starting Voltage	115		-- volts ²
DC Operating Voltage ($I_C = 3$ ma)	80.1	81.0	81.9 volts ³
Incremental Resistance ($I_C = 3$ ma)	--	200	350 ohms ⁴
AC Impedance ($I_C = 2.5$ ma to 3.5 ma)	--	--	400 ohms ⁵
Temperature Coefficient of Operating Voltage at $I_C = 3$ ma:			
Averaged over $t_{bulb} = +20^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	--	-1.2	-2 mv/°C
Averaged over $t_{bulb} = -55^{\circ}\text{C}$ to $+20^{\circ}\text{C}$	--	-3.2	-4 mv/°C
Jump Voltage ($I_C = 2$ ma to 4 ma)	--	--	5 mv
Noise Voltage			
Oscillation	--	--	1 mv
Vibration	--	--	100 mv ⁶
Ignition Breakdown Delay (In darkness $E_b = 115$ V)	--	--	5 msec.

Life Performance

Life Expectancy - Continuous Operation

$I_C = 3$ ma

30,000 hours

Variation in DC Operating Voltage at

$I_C = 3$ ma, $t_{bulb} = 45^{\circ}\text{C}$

0 to 1 hour

$\Delta V_a = 100$ mv

0 to 100 hours

$\Delta V_a = 200$ mv

0 to 2000 hours

$\Delta V_a = 300$ mv

Variation in DC Operating Voltage

During Storage and Standby

0 to 2000 hours ($t_{bulb} = 25^{\circ}\text{C}$)

$\Delta V_a = 100$ mv

0 to 100 hours ($t_{bulb} = 100^{\circ}\text{C}$)

$\Delta V_a = 100$ mv

² Circuit design should provide ignition voltage of 120 V minimum.

³ Equilibrium conditions reached within 2 minutes after ignition.

⁴ This is slope of V/I characteristic measured at a specified current.

⁵ This is impedance of anode-cathode gap measured at $I_C = 3$ ma dc with 0.5 ma ac peak superimposed at 100 cycles.

⁶ Sinusoidal vibration, 10 to 50 cycles, 2.5 g peak acceleration.

8228

Environmental Ratings ⁷

Shock Rating

500 g

NRL impact machine for electronic devices;
five blows with 30° hammer angle in each
of four different planes.

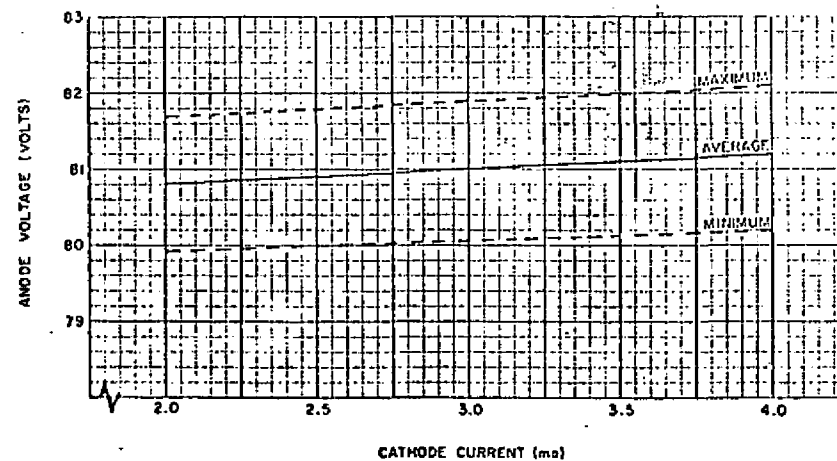
Vibration Rating

2.5 g peak

Vibrated for 32 hours at 50 cycles per
second in each of three different planes

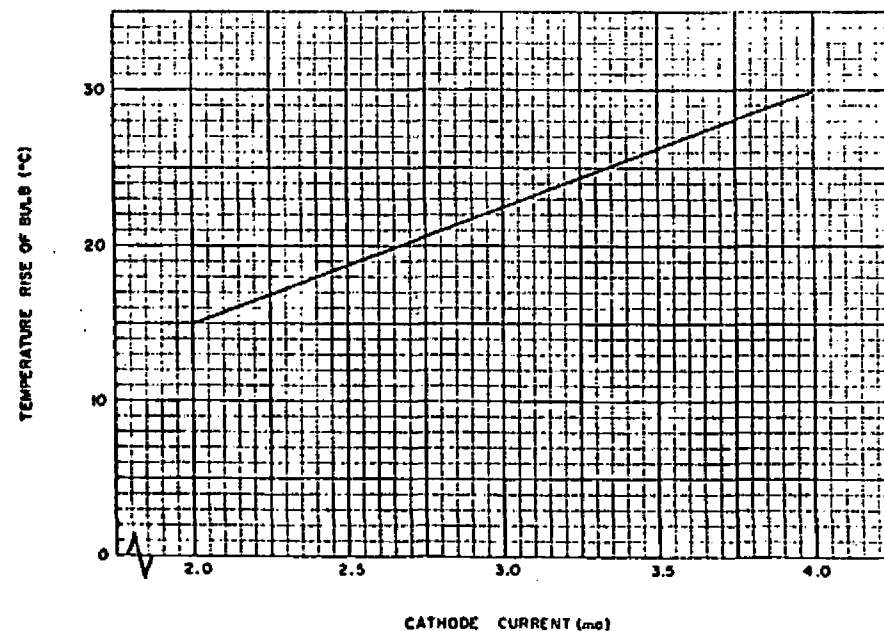
Circuit Note - Maximum external shunt capacitor = 0.1 μ f maximum

8228



ANODE VOLTAGE VS CATHODE CURRENT

FIGURE 1



APPROX. TEMPERATURE RISE OF BULB VS CATHODE CURRENT (IN FREE AIR)

FIGURE 2

⁷ These are quality evaluation conditions only. The tube is not intended to be operated continuously under these conditions.