

FERRANTI

COLD CATHODE TETRODE

Type EN40 is a cold cathode tetrode gas discharge valve intended for use as a stroboscopic light source, particularly in applications employing photographic recording.

The light emitted is "whitish" in colour and of high actinic value.

Operation can be controlled by pulses of low energy.

PHYSICAL SPECIFICATION.

Base	...	...	International Octal.
Max. Seated Height	...	...	89 mm. (3½ in.).
Max. Overall Length	...	...	103 mm. (4½ in.).
Max. Diameter Base	...	...	32 mm. (1½ in.).
Length of Arc	...	...	24 mm. (1½ in.).
Mounting Position	...	...	Any.*

PIN CONNECTIONS.

Pin 1—No connection.	Pin 5—Trigger No. 1.
Pin 2—No connection.	Pin 6—No Pin.
Pin 3—Anode.	Pin 7—No connection.
Pin 4—Trigger No. 2.	Pin 8—Cathode.

RATINGS.

Maximum Anode Voltage (Static)	440 volts.
Maximum Anode Voltage (working)	350 volts.
Minimum Anode Voltage (working)	250 volts.
Peak Inverse Anode Voltage	300 volts.
Maximum Mean Anode Current	100 mA.
Maximum Average Grid Current	10 mA.

CHARACTERISTICS.

†† Static Trigger Voltage (tr_2 to tr_1)	70–120 volts.
Maximum Flashing Frequency	150 per sec.
† Peak Anode Current	250 amps.
Minimum Trigger Current required	—

$V_a = 350$	...	...	50 μA .
$V_a = 250$	...	...	300 μA .

TYPICAL OPERATION.

DC Supply Voltage	...	...	300–330 volts.
† Trigger Electrode No. 2			
Voltage (V_{tr2})	...	...	50 volts.
§ Trigger Pulse Amplitude (V_{tr1})	...	...	150 volts.
Charging Resistor	...	...	3500 ohms.
Discharge Capacitor for operation			
at 6–35 c.p.s.	...	...	4 μF .
30–50 c.p.s.	...	...	3 μF .
45–80 c.p.s.	...	...	2 μF .
80–150 c.p.s.	...	...	1 μF .

For further information refer to "Notes on Operation" overleaf.

*Vertically base up or horizontally preferred.

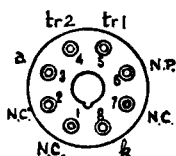
† A minimum peak current of 5 amps. is recommended. This ensures the formation of an arc discharge with an anode-cathode volt drop of approx. 20 volts. If the peak current is less than 5 amps. a glow discharge is likely to form with a volt drop of 70 volts which may result in permanent damage to the valve.

†† tr_1 negative with respect to tr_2 . The limits quoted refer to operation with a trigger voltage having a low rate of change. For pulse operation a higher trigger voltage is generally necessary.

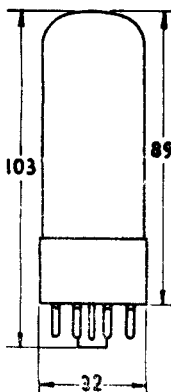
‡ At instant of triggering.

§ V_{tr1} negative with respect to cathode.

EN40



Base
Connections
Underside View
of Base

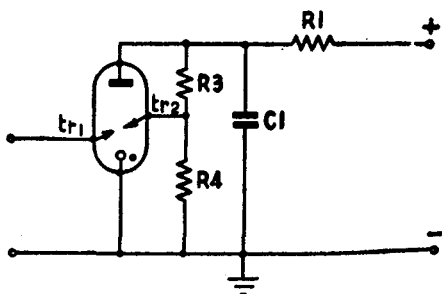


Dimensions
shown are in
millimetres
(max.)



NOTES ON OPERATION.

The basic circuit for the operation of this valve is shown below. A capacitor C1 is connected across anode and cathode and charged through a series resistance R1. If a sufficient voltage is now applied between electrodes tr₁ and tr₂ to initiate a glow discharge, this will cause breakdown of the main anode to cathode gap. The capacitor C1 discharges within a few microseconds, and the valve emits a bright flash of light of similar duration.



The recommended triggering method is to apply a positive voltage from the potentiometer R3-R4 to tr₂, and a negative pulse to tr₁, the flashing frequency being controlled by the pulses on tr₁.

A suitable triggering pulse for tr₁ may be derived by differentiating a square pulse to give a pulse of 150 volts or higher, with a width of approximately 30-100 microseconds at half amplitude. Alternatively, square pulses of approximately 200 volts, with widths of 20-400 microseconds may be used.

The duration of the pulse must be limited to the time required for the anode discharge capacitor to recharge to about 80 volts as, during de-ionization time, pulses of greater length are liable to cause a glow discharge in the main gap with consequent serious deterioration of the cathode, or to initiate a second discharge when the anode reaches 80 volts. This discharge may in turn initiate a series of uncontrolled flashes quite independent of the trigger pulse and at a higher repetition rate.

(A glow discharge is characterised by a more diffused appearance and is of a less intense colour than the required arc discharge.)

For short pulses, higher values of initiating currents are required than those quoted in the specification.

For maximum light output, the time constant of the discharge capacitor and its charging resistance must be such as to ensure a nearly complete recharge between flashes. This requires that the time constant is not greater than about one third of the flash interval (for a 96% recharge). At higher frequencies it may not be possible to ensure such a complete recharge as, if the charging rate is faster than the valve recovery rate, a spurious discharge will occur as indicated above.

Suitable values of discharge capacitor and charging resistance are given under "Typical Operation" overleaf.

The mean anode current may be calculated as follows:—

$$I_a (\text{mean}) = \frac{CVf}{1000} \text{ mA.}$$

where C = discharge capacitor in μF .

V = voltage on discharge capacitor at instant of triggering.

f = flash frequency per second.

In equipments which operate over a wide frequency band, the whole range of frequency is preferably covered in steps by switching different capacitor values in accordance with the recommendations regarding charging time.

The circuit resistance connected between cathode and tr₁ and cathode and tr₂ must have a value of at least 1000 ohms.