
COLD
CATHODE TUBES

TUBE TYPE
NOMENCLATURE

The type nomenclature for Mullard cold cathode tubes (excluding photocells and stabilisers) consists of one letter followed by a group of three figures which are followed by a second letter.

The first letter is always Z, indicating a cold cathode gas-filled tube.

The first figure indicates the type of base, the significance of the figure being the same as for Mullard receiving valves:

- 2—B8G base
- 3—Octal base
- 4—B8A base
- 5—B9G and other special bases
- 6 & 7—Subminiature construction
- 8—B9A base
- 9—B7G base

The second and third figures are serial numbers indicating a particular design or development.

The second letter indicates the function of the tube:

- A—Amplifier tube (continuous operation)
- B—Binary counter or switching tube
- C—Multistage counter tube
- E—Electrometer trigger or amplifier tube
- G—Gating tube
- M—Indicator (metering) tube
- S—Multistage switching tube
- T—3 electrode trigger tube
- U—4 electrode trigger tube
- W—5 electrode trigger tube

Example:

Z803U 4 electrode cold cathode trigger tube with B9A base.

Construction

The Mullard counter and selector tubes consist of 30 identical rod-shaped cathodes arranged in a circle concentric with the common circular plate anode. The 30 cathodes are divided into three groups of ten and arranged so that every third electrode going around the ring belongs to the same group. The three groups are called main cathodes, guide A cathodes, and guide B cathodes. The order of the electrodes proceeding in a clockwise direction around the tube as seen from the dome is a main cathode, a guide A cathode, guide B cathode, next main cathode etc.

In both the counter tube and the selector tube all the guide A electrodes are connected internally and brought out to a single pin. The guide B electrodes are similarly connected and brought out. In the counter tube the main cathodes 1 to 9 are connected together internally and connected to a single pin. The 0 or tenth main cathode is brought out separately so that the tube can be set to zero and also an electrical output obtained for driving a succeeding tube. In the selector tube all the main cathodes are brought out individually so that an electrical output pulse can be obtained at any point around the tube.

Function of the electrode groups

Main cathodes

The glow normally rests on a main cathode thus providing indication, and electrical output may also be obtained from this cathode. The position of the discharge may be seen through the dome of the tube as an orange 'cathode glow' at the tip of the cathode concerned. The position of the discharge can be related to the number of input pulse by the use of an external numbered escutcheon aligned so that the numbers coincide with the position of the main cathodes.

Guide cathodes (A and B)

The function of the guide cathodes is to transfer the discharge from one main cathode to the next on the receipt of an input signal.

Basic circuit

The basic circuit is shown in Figure 1 on the individual data sheets and is essentially the same for both counter and selector tubes. An h.t. voltage, normally 475V, (which is greater than the anode-cathode ignition voltage) is applied to the circuit and breakdown to one of the main cathodes will, therefore, occur. Breakdown to more than one cathode cannot occur since conduction causes a voltage drop across the anode resistor and reduces the anode voltage across the tube to the maintaining voltage.

The transfer mechanism

The method usually employed to move the discharge around the tube is to convert the input signal into a pair of negative pulses. The first pulse is applied to all guide A cathodes followed immediately by the second pulse applied to all guide B cathodes.

Assume that the discharge is resting on the third main cathode k_3 : when the pulse is applied to guides A the voltage between anode and guides A exceeds the ignition voltage and breakdown can therefore occur. Because of the priming from the discharge to the conducting main cathode k_3 , breakdown will always occur to the adjacent guide A cathode GA_4 . The discharge to k_3 will be extinguished since the anode voltage falls by the magnitude of the applied negative pulse. Similarly breakdown to GB_4 will take place on the arrival of the second pulse and the potential of guides A will return to the bias level. Finally at the end of the second pulse the potential of guides B will also return to the bias level. The anode voltage rises towards a potential equal to the guide bias plus the maintaining voltage. However, when the anode to k_4 voltage exceeds the ignition value the discharge will move to k_4 and the transfer has then been completed. This sequence results in rotation in the clockwise direction. Counting in the anti-clockwise direction can be obtained by applying pulses to guides A and B in the reverse order.

Output pulse

A resistor is connected in series with k_o (in Figure 1) so that an output pulse can be obtained when the discharge rests on k_o . This resistor must be chosen so that when the glow rests on k_o , the voltage on k_o does not exceed the positive guide bias. It is common practice to take the earthy end of the resistor back to a negative bias supply to obtain a larger pulse. However, the magnitude of the bias should not at any time be more negative than -20 volts.

In the selector tube an output can be obtained by inserting a resistor in series with any of the main cathodes.

The maximum value of the main cathode resistor for either selector or counter is given by

$$R_k \text{ max.} = \frac{(V_G + V_k - 10) R_a}{(V_{ht} - V_M - V_G + 10)}$$

and the output voltage for any value of R_k is

$$V_{out} = \frac{(V_{ht} - V_M + V_k) R_k}{(R_k + R_a)}$$

where V_{ht} is the supply voltage

V_M is the maintaining voltage

V_G is the positive guide bias

V_k is bias to k_o (numerical value only)

R_k is the cathode resistor

R_a is the anode resistor

Set zero

The discharge can conveniently be returned to k_o by momentarily disconnecting all cathodes except k_o . An alternative method is to pulse k_o negatively to -120 volts. Care must be taken if this method is adopted that spurious pulses are not fed down the chain of counter tubes at the termination of the pulse.