Application Notes – Trigger Circuits

The flashtube discharge is initiated by means of a high voltage pulse V_z (trigger voltage) which must be high than the static breakdown voltage of the tube.

V_z ranges between 2kV and 20kV. The difference between V_z and V_0 must be sufficient to avoid spontaneous triggering.

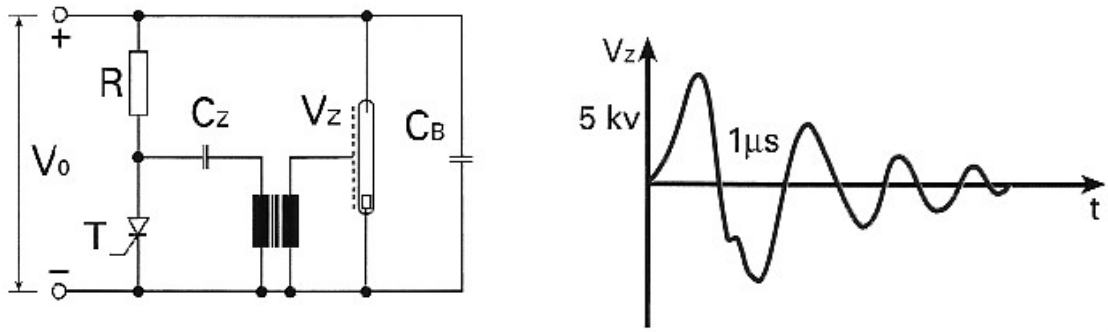
It is recommended that:

$$\frac{V_Z}{V_0} \approx 10$$

V_z is generated by a pulse transformer (trigger coil) at a transformation ratio of 1:20 to 1:100. A thyristor (or mechanical switch) discharges a trigger capacitor C_z via the primary side of the trigger coil. On the secondary side a damped high voltage oscillation is produced, the form of which greatly depends on the trigger coil and the external circuitry.

1. Capacitive external triggering

This is the simplest form of triggering. In this case, the trigger electrode of the tube has been insulated from anode and cathode. However, it extends over the entire arc length.



Capacitive external triggering

Since the capacity of the trigger electrode is approximately 10pF against the cathode and anode, the secondary side of the trigger coil can be highly resistive, resulting in a compact construction of the coil.

The polarity of the first half wave of the trigger circuit can influence the trigger ability.

Shown below is an example of trigger parameters with Heimann trigger coils.

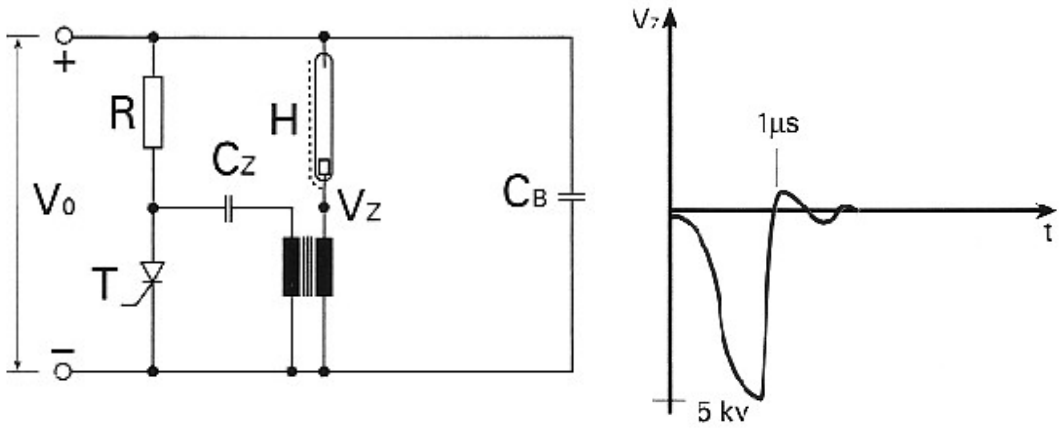
ZS	1031	1052	1092
C_Z (µF)	0.1	0.047	0.022
V_0 (V)	300	300	250
V_Z 1. peak (kV)	+8.0	+9.0	+6.2
V_Z 2. peak (kV)	- 8.5	- 4.4	- 6.8
f (kHz)	120	360	1200

As V_z is proportional to V_0, all intermediate values can be easily calculated.

Advantages of external trigger are:
- Small size, low cost components
- Low primary and secondary currents

Disadvantages of external triggering are:
- Relatively high trigger delay time (approximately 10±5 µs)
- Produces electromagnetic interferences in case of long wires in circuit.

2. Direct Series Triggering



Direct series triggering

The secondary winding of the trigger coil is either on the anode or cathode side of the tube and conducts, in any case, the entire discharge current.

The optional trigger electrode H can be connected with anode or cathode.

In comparison to the capacitive external triggering, the advantages of direct series triggering are:

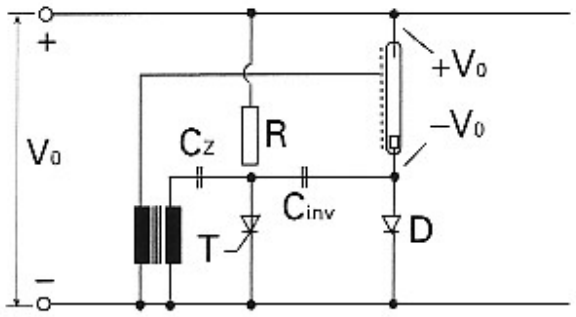
- Short trigger delay time (<1μs) with minimum jitter.
- Low emission of electromagnetic interferences.

Disadvantages of direct series triggering are:

- Large size, high cost components.

3. Trigger with doubling of anode voltage (V_0)

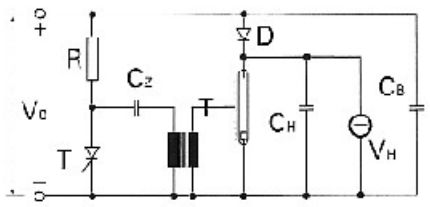
This simple circuit facilitates the triggerability of flashtubes with high Xenon-fill-pressure considerably. When firing T, the discharge of C_z produces in the trigger coil the usual trigger events. Simultaneously also C_{inv} is discharged bringing down the cathode potential of the flashtube to –V0 for a few microseconds. So the effective anode voltage is V_0.



Trigger with doubling of anode voltage (V0)

4. Booster

The booster is an auxiliary anode voltage $V_H>V_0$ which is applied to a capacitor $C_H<<C_B$ and blocked against V_0 by diode D. When triggered, the tube takes V_H as anode voltage. This circuit is suitable in cases of high variations in the operating voltage V_0 or when the tube-fill pressure is high (luminous efficiency).



Capacitive triggering with additional booster