Class D Commutation

Commutation : Commutation is the process of turning Off, a conducting thyristor is called Commutation

Class D-auxiliary commutation (an auxiliary SCR switching a charged capacitor)
Figure 1 shows the typical Class D commutation circuit. In this commutation method, an auxiliary thyristor (T2) is required to commutate the main thyristor (T1), Assuming ideal thyristors and the lossless components, and then the waveforms are as in Fig. 2. Here, inductor L is necessary to ensure the correct polarity on capacitor C.
Thyristor T1 and load resistance RL form the power circuit; Whereas L, D and T2 form the commutation circuit.

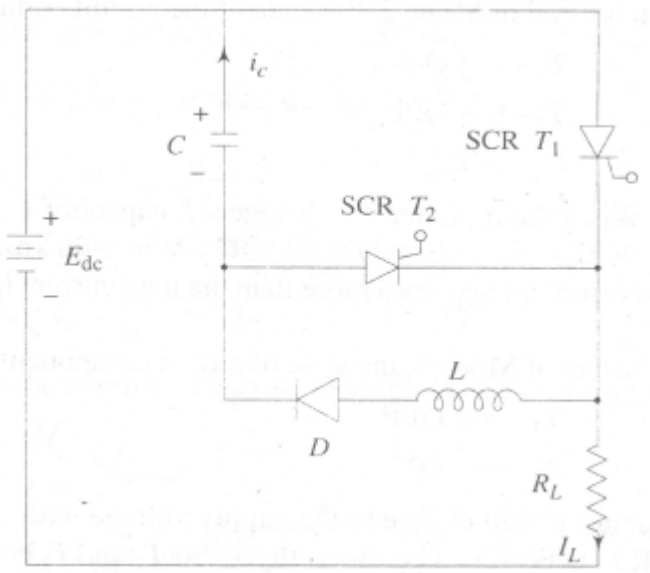

Fig.1

Circuit Operations:

(a) Mode 0:

(Initial Operation) When the battery Edc is connected, no current flows as both thyristors are OFF.

Hence, initially, the state of the circuit components becomes

T1-OFF

T2-OFF

Ec=0

(b) Mode 1:

Initially, SCR T2 must be triggered first in order to charge the capacitor C with the polarity shown.

This capacitor C has the charging path Edc_+ —C_+ —C_-—T2—RL—Edc_- As soon as capacitor C is fully charged, SCR T2 turns-off. This is due to the fact that, as the voltage across the capacitor increases, the current through the thyristor T2 decreases since capacitor C and thyristor T2 form the series circuit.

Hence the state of circuit components at the end of Mode 1 becomes,

T1- ON

T2 - OFF

Ec=Edc

(c) Mode 2:

When thyristor T1 is triggered, the current flows in two paths:

(a) Load current IL flows through Edc_+—T1—RL—k $_L$-Edc_-_

(b) Commutation current (Capacitor-discharges through) flows through C_+ —T1—L—D—C_-.

After the capacitor C has completely discharged, its polarity will be reversed, i.e., its upper plate will acquire negative charge and the lower plate will acquire positive charge. Reverse discharge of capacitor C will not be possible due to the blocking diode D.

Therefore, at the end of Mode 2, the state of the circuit components becomes

T- ON

T2-OFF

Ec=Edc

(d) Mode 3:

When the thyristor T2 is triggered, capacitor C starts discharging through the path C_+—$T2_{(A-K)}$—$T1_{(K-A)}$

—C_-. When this discharging current (commutating current Ic) becomes more than the load current I_L

thyristor T1 gets OFF.

Therefore, at the end of Mode 3, the state of circuit component becomes

T1-OFF

T2- ON

Again, capacitor C will charge to the supply voltage with the polarity shown and hence SCR T2 gets OFF. Therefore, thyristors T1 and T2 both get OFF, which is equivalent to Mode 0 operation. This type of commutation circuit is very versatile as both time ratio and pulse width regulation is readily incorporated. The commutation energy may readily be transferred to the load and so high efficiency is possible. This method is used in Jone's chopper circuit.

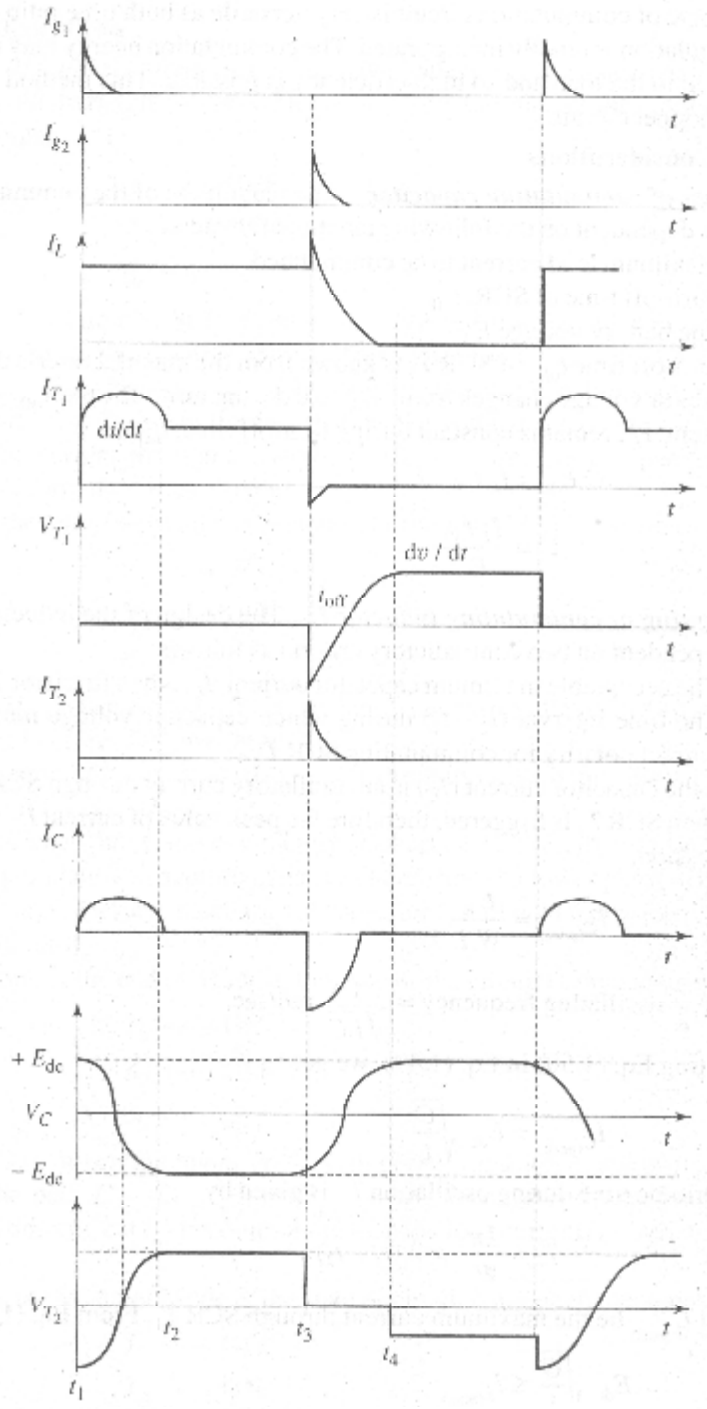
I_{g_1}
I_{g_2}
I_l
I_{T_1}
di/dt
V_{T_1}
dv / dt
t_{on}
I_{T_2}
I_C
$+ E_{dc}$
V_C
$- E_{dc}$
V_{T_2}
t_1
t_2
t_3
t_4
t

Fig. 2