Silicon Controlled Rectifier (SCR)

Lecture – 18

TDC PART – I
Paper - II (Group - B)
Chapter - 5

by:

Dr. Niraj Kumar,

Assistant Professor (Guest Faculty)

Department of Electronics

L.S. College, BRA Bihar University, Muzaffarpur.

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- SCR Turning-OFF Methods (PART – 6)
- Lecture Content :-
  - (2) Forced Commutation
  - (III) Class-C Commutation (often called Complimentary Commutation)

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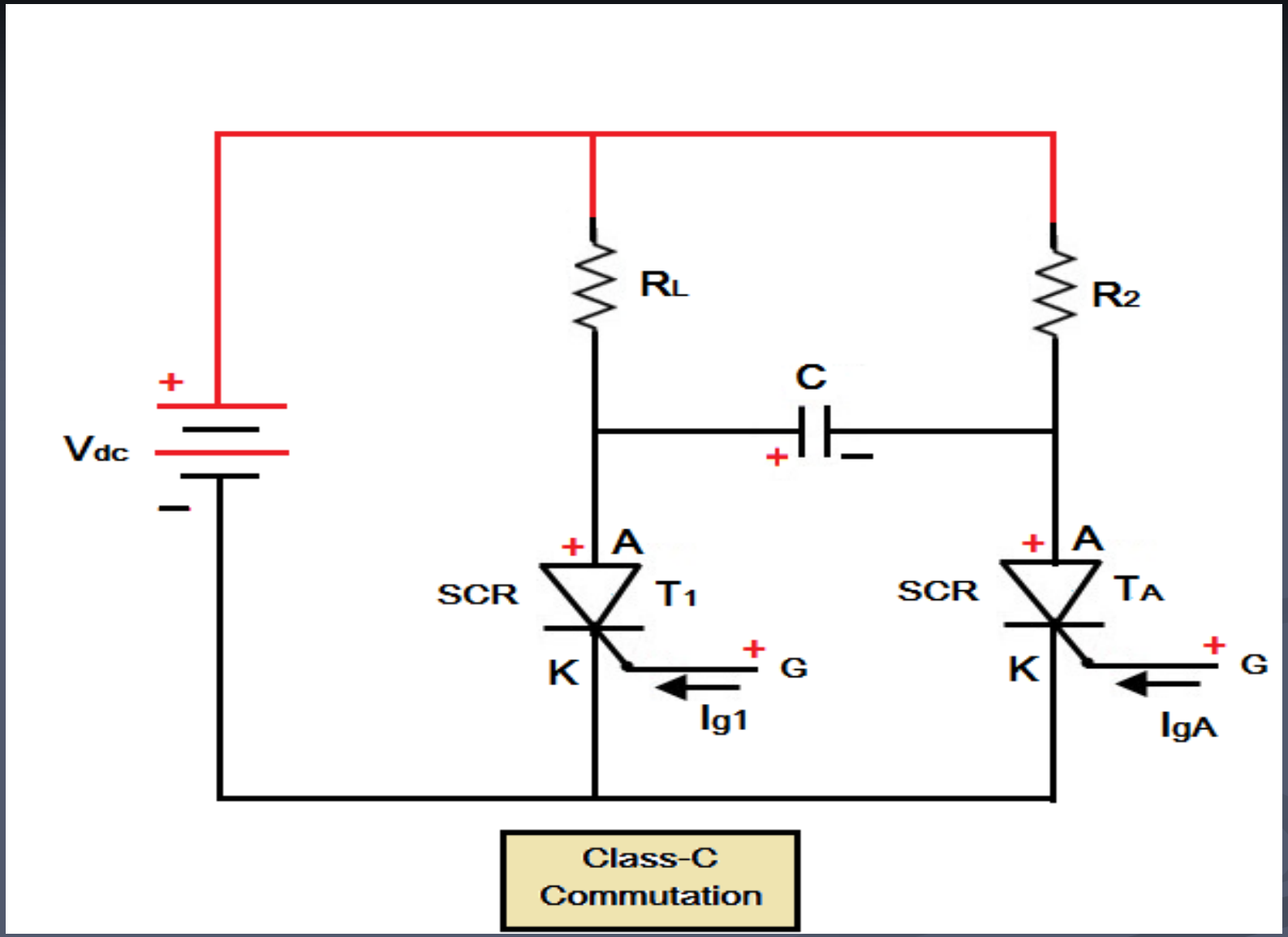
- The **Class-C commutation** circuit diagram is shown in **Figure (90)** below. In this method, the **Main thyristor (SCR T1) that is to be Commutated** is connected in **Series** with the **Load Resistor (RL).** An additional **thyristor (SCR TA),** called the **Auxiliary or Complementary SCR (thyristor)** is connected in **Parallel** with the **Main thyristor (SCR T1).**

- **As Figure (90)** shows below, the **Class-C Commutation Circuit Diagram** which consists of two **SCRs (Thyristors)** such as main **SCR (Thyristor) T1** and **Auxiliary SCR (Thyristor) TA** and a **Commutation Capacitor (C).** The **Load Resistance RL** is connected in **Series** with **Main SCR (Thyristor) T1.**

- This **Class-C Commutation Technique** is also known as **Complementary Commutation** as the **commutation of Main SCR (Thyristor) T1** occurs when the **Auxiliary SCR (Thyristor) TA** is **Turned ON.** This **Class-C Commutation Process** is also known as **Complementary Impulse Commutation.**



- **Fig (90)** Shown the Class-C Commutation Circuit Diagram which consists of two SCRs and one Capacitor.

MODE - 0 :-

- Initially, both the **SCRs T1** and **TA** are in **OFF State** and the **Voltage** across **Capacitor is Zero.** The conditions of **SCR T1** and **SCR TA** and **Capacitor (C)** may be represented by,

- **T1 is in OFF State,**
- **TA is in OFF State and**
- **$V_C = 0$**

MODE - 1 :-

- When the **Triggering Pulse** is applied to the **Gate Terminal** of main **SCR T1** at **t = t1**, **SCR T1** will be **Turned ON.** Therefore, **two Circuit Currents,** namely, **Load Current (IL)** and **Capacitor Charging Current (IC)** start flowing through the circuit.

- The **Load Current (I_L)** follows through the following path :-

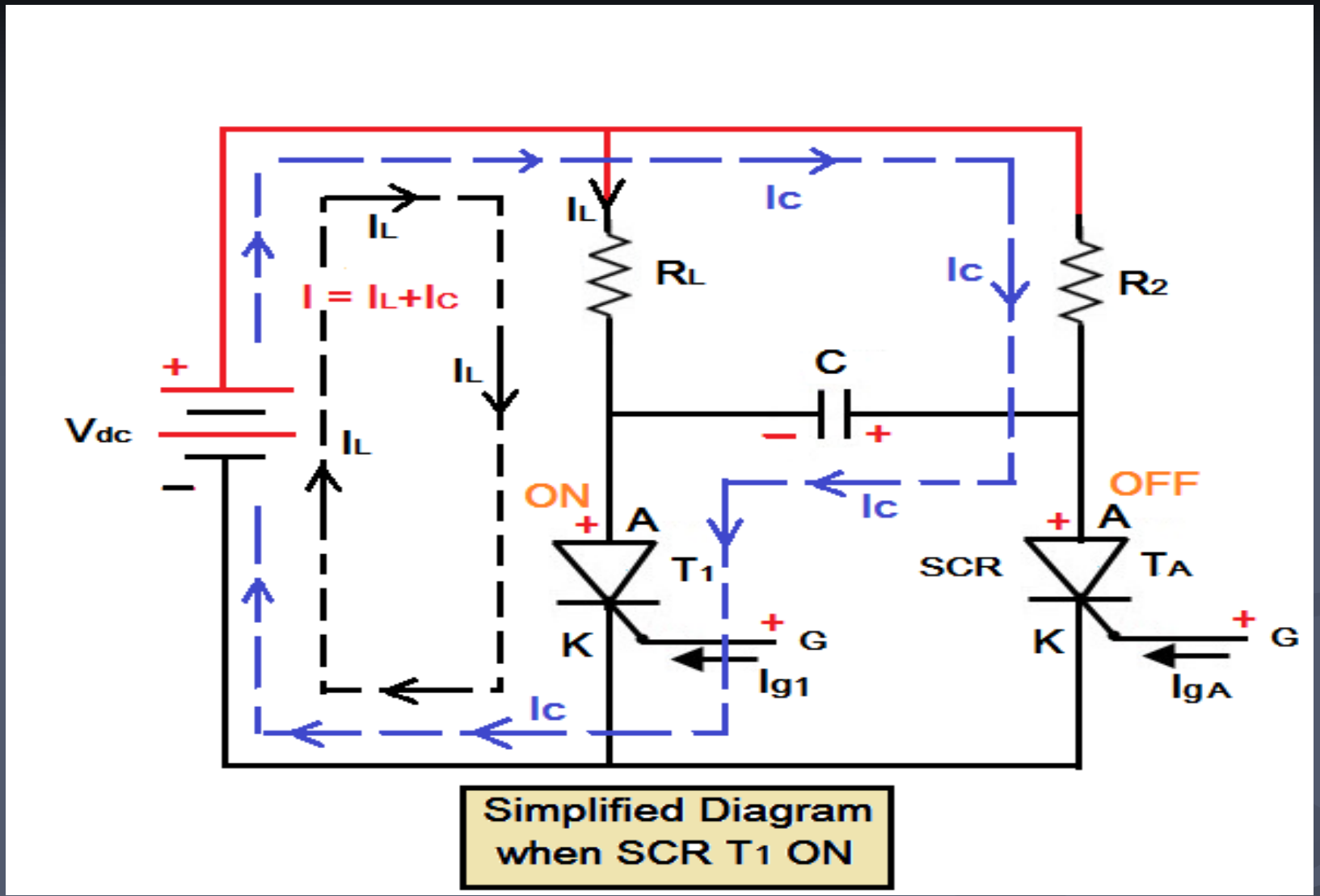
- **$V_{dc}+$ – R_L – T_1 – $V_{dc}–$** and

- the **Capacitor Charging Current (Ic)** flows through the path :-

- **$V_{dc}+$ – R_2 – C+ – C– – T_1 – $V_{dc}–$**

- At **Steady State Condition, Capacitor (C)** is **fully charging** to the **Supply Voltage (V_{dc})** with **the polarity** as shown in **Figure (91)** below. The condition of **SCR T_1** and **SCR T_A** and **Capacitor (C)** may be represented by,

- **T_1 is in ON State,**
- **T_A is in OFF State and**
- **$V_C = V_{dc}$**



- **Fig (91)** Shown the **Class-C Commutation** Simplified Circuit Diagram which consists of two SCRs and one Capacitor with SCR T_1 is in ON State and SCR T_A is in OFF State.

MODE - 2 :-

- When a **Triggering Pulse** is applied to **Auxiliary SCR TA** at **t = t2,** **SCR TA** will be **Turned ON.** As soon as **SCR TA is Turned ON** and **start conducting,** a **Negative Polarity Voltage** of the **Capacitor (C)** is applied to **Anode (A)** of **SCR T1** and simultaneously, the **Positive Polarity** of **Capacitor (C)** is applied to the **Cathode (K).** Subsequently, **SCR T1** will be **Reverse Biased** and **Turned OFF** immediately.

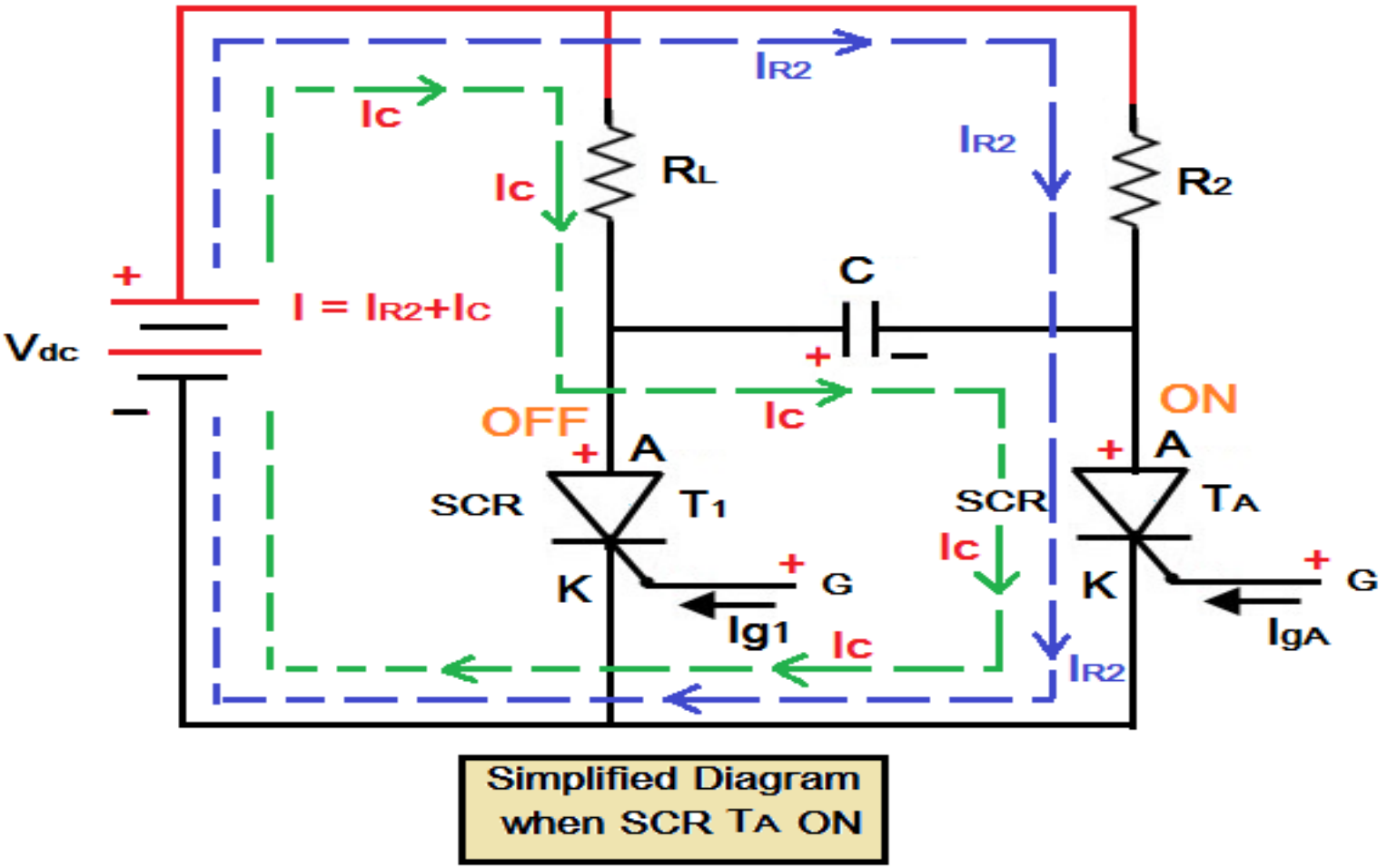
- Therefore, the **Commutation of main SCR T1** is possible by **Tuning ON** the **auxiliary SCR T_A.**

- Then the **Capacitor (C)** is charged through the **load and its polarity** becomes reverse. The **charging path of Capacitor (C)** is,

- **V_{dc+} – R_L – C+ – C– – $T_{A(a-k)}$ – V_{dc-}**

- At the end of this **MODE - 2 of Operation**, as shown in **Figure (92)** below the conditions of both **SCR T_1 and SCR T_A** and **Capacitor (C)** may be represented by,

- **T_1 is in OFF State,**
- **T_A is in ON state and**
- **$V_C = -V_{dc}$**



- **Fig (92)** Shown the Class-C Commutation Simplified Circuit Diagram which consists of two SCRs and one Capacitor with SCR T_1 is in OFF State and SCR T_A is in ON State.

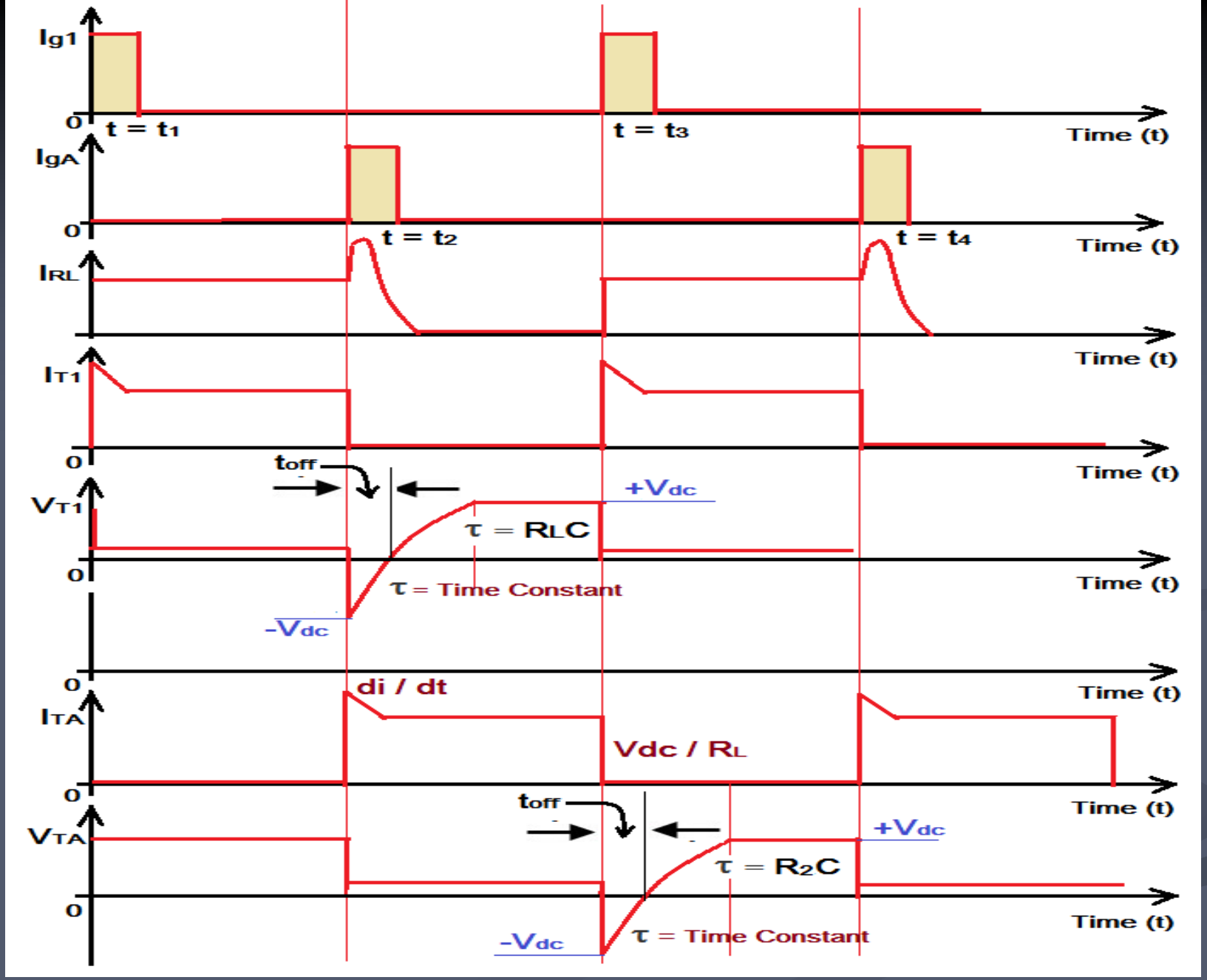
MODE - 3 :-

- Again, when **SCR T_1** is **Triggered** and **Turned ON at t = t2.** Then **Auxiliary SCR T_A** will be **Turned OFF** immediately as **Reverse Bias Voltage** is applied across **SCR T_A** and **Capacitor (C)** starts to **charge in Reverse Direction.** At the end of this **MODE - 3** of **Operations SCR T_1** and **SCR T_A** and **Capacitor (C)** may be represented by,

- **T_1 is in ON State,**
- **T_A is in OFF State and**
- **$V_C = V_{dc}$**

- Therefore, this **MODE - 3 operations is equivalent to MODE - 1** operation.

- The **Voltage** and **Current waveforms of Class-C Commutation** at the various points on the **Commutation Circuit** are shown in **Figure (93)** below.



- **Fig (93)** Shown Voltage and Current Waveforms of Class – C Commutation

- This commutation is mainly used in **Single Phase Inverters** with a Centre Tapped Transformers. An example of this **Class-C of Commutation** is the well known **Mc Murray-Bedford Inverter**. With the aid of certain accessories, the **Class- C Commutation** is very useful at **Operating Frequencies below about 1000 Hz (1kHz)** and therefore this commutation technique is used in **Inverter.** The **Characteristics** of **Class-C Commutation** are **Sure** and **Most Reliable Commutation.**

to be continued .....