Silicon Controlled Rectifier (SCR)

Lecture – 17

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

by:

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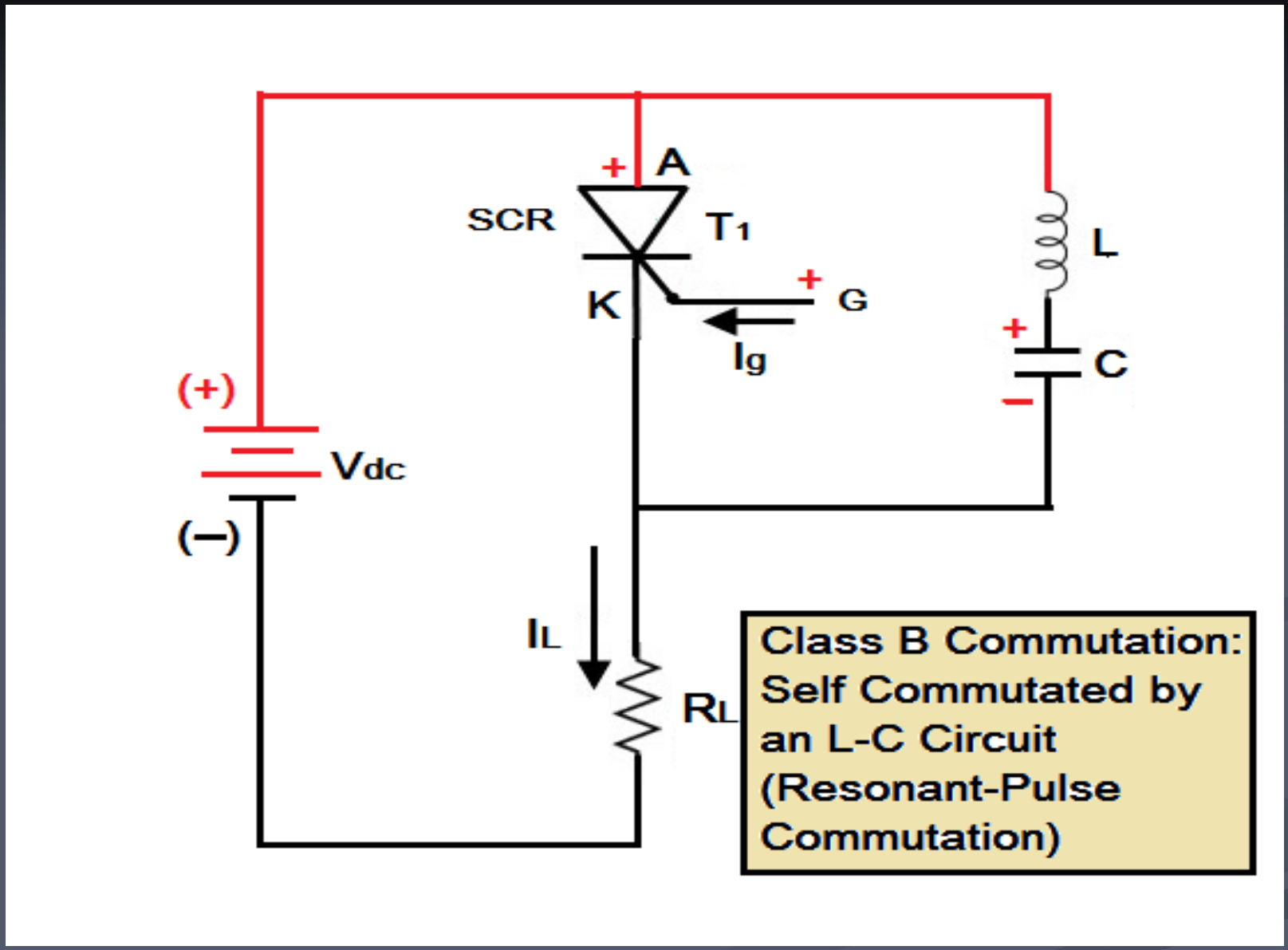
- SCR Turning-OFF Methods (PART – 5)
- Lecture Content :-
  - (2) Forced Commutation
  - (II) Class-B Commutation - (also known as Resonant Pulse Commutation)

(II) Class-B Commutation - (also known as Resonant Pulse Commutation)

- **Class-B Commutation or Resonant Pulse Commutation** is a **Forced Commutation Technique** to **Turn OFF an SCR (thyristor).** In this technique, **SCR** is **Turned OFF** by gradual build-up of **Resonant Current** in the **Reverse Direction** i.e. from **Cathode** to **Anode** of **SCR.** This technique is also known as **Current Commutation** and occurs in **DC circuit** not in **AC circuit.**

- This is also a **Self Commutation** circuit in which commutation of **SCR** is achieved automatically by **L and C components,** once the **SCR (thyristor) is Turned ON.** The major difference between the **Class-A and Class-B SCR Commutation techniques** is that in case of **Class-B Commutation,** the **LC Resonant Circuit** is **connected across (Parallel) the SCR** but not in **series with Load Resistor (R)** as in case of **Class-A Commutation** and hence the **L and C components** do not carry the **Load Current (I_L).**

- **Figure (86)** shows below the **Class-B Commutation circuit** which consist of **SCR (thyristor) T1** and **L-C circuit. Class-B Commutation** is a **Self-Commutation process** by an **L-C circuit.** The **L-C Resonating Circuit** is connected across the **SCR (thyristor).** This circuit is also known as **Resonant Pulse Commutation.**



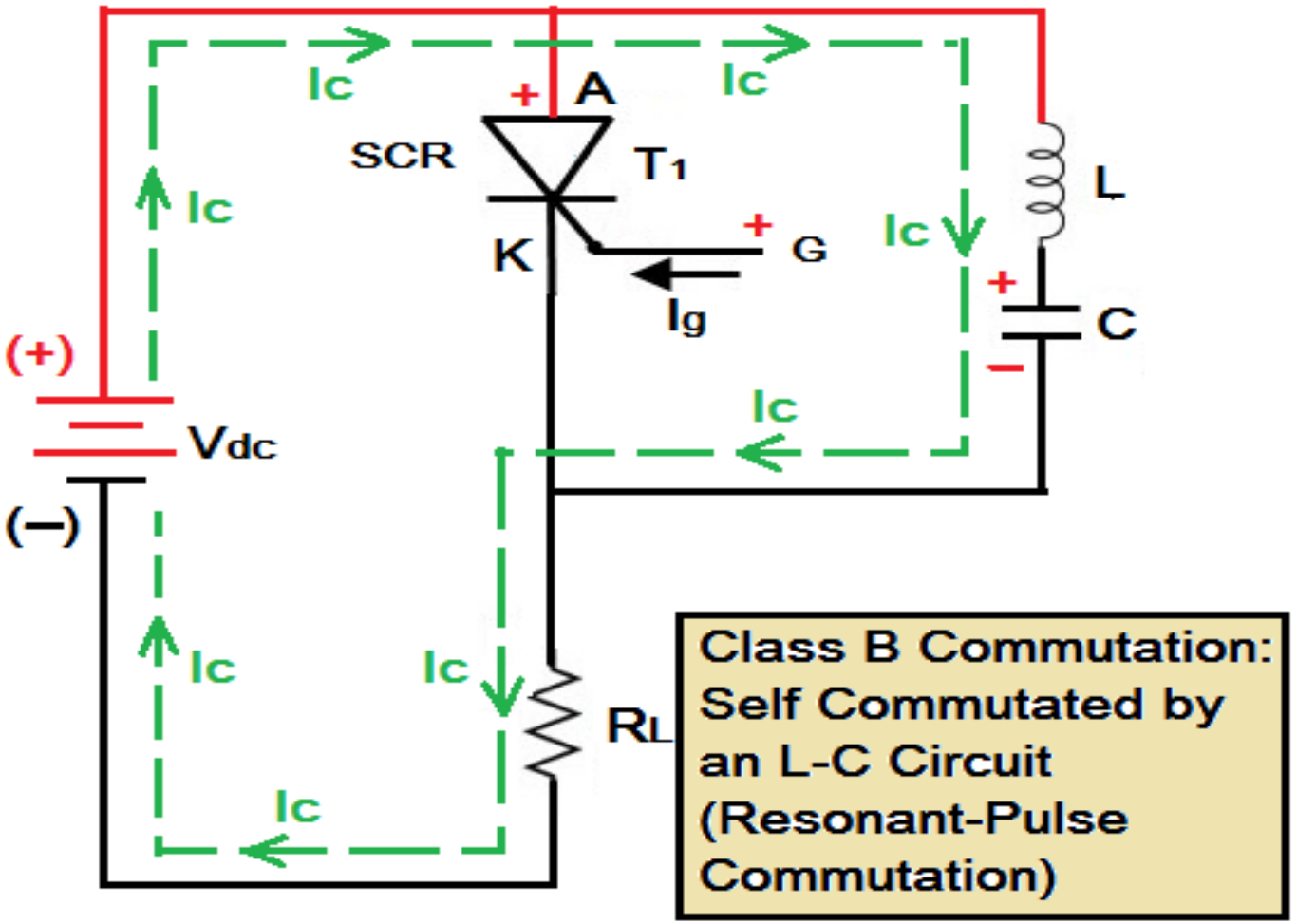
- **Fig (86)** Shown Circuit Diagram of **Class-B Commutation or Resonant-Pulse Commutation.**

- In **Class-B Commutation** circuit diagram shown in **Figure (86)** above, the **LC Resonant Circuit** is not directly connected with a load. **It is connected Parallel with the SCR**. Hence, the full **Load Current (I_L)** will not pass through the **SCR.** The circuit diagram of **Resonant-Pulse Commutation** is as shown in the **Figure (86)** above with waveforms of **SCR Current (I_{SCR}), SCR Voltage (V_{SCR}), Gate Current (I_g)** and **Load Current (I_L)** shown in **Figure (89)** below.

MODE – 1 :-

- Initially the **Supply Voltage V_{dc}** is applied to the circuit **t = 0** and the **Capacitor Starts to Charge** and it finally charged to **Voltage V_{dc}** with **Upper Plate Positive** and **Lower Plate Negative,** shown in **Figure (87)** below. The **Charging of Capacitor** is done by **Capacitor Charging Current Ic** flowing through the following path,

$V_{dc}+ - L - C+ - R_L - V_{dc}-$



- **Fig (87)** Shown Class-B Commutation **MODE – 1** Condition of Capacitor Charging Current Ic .

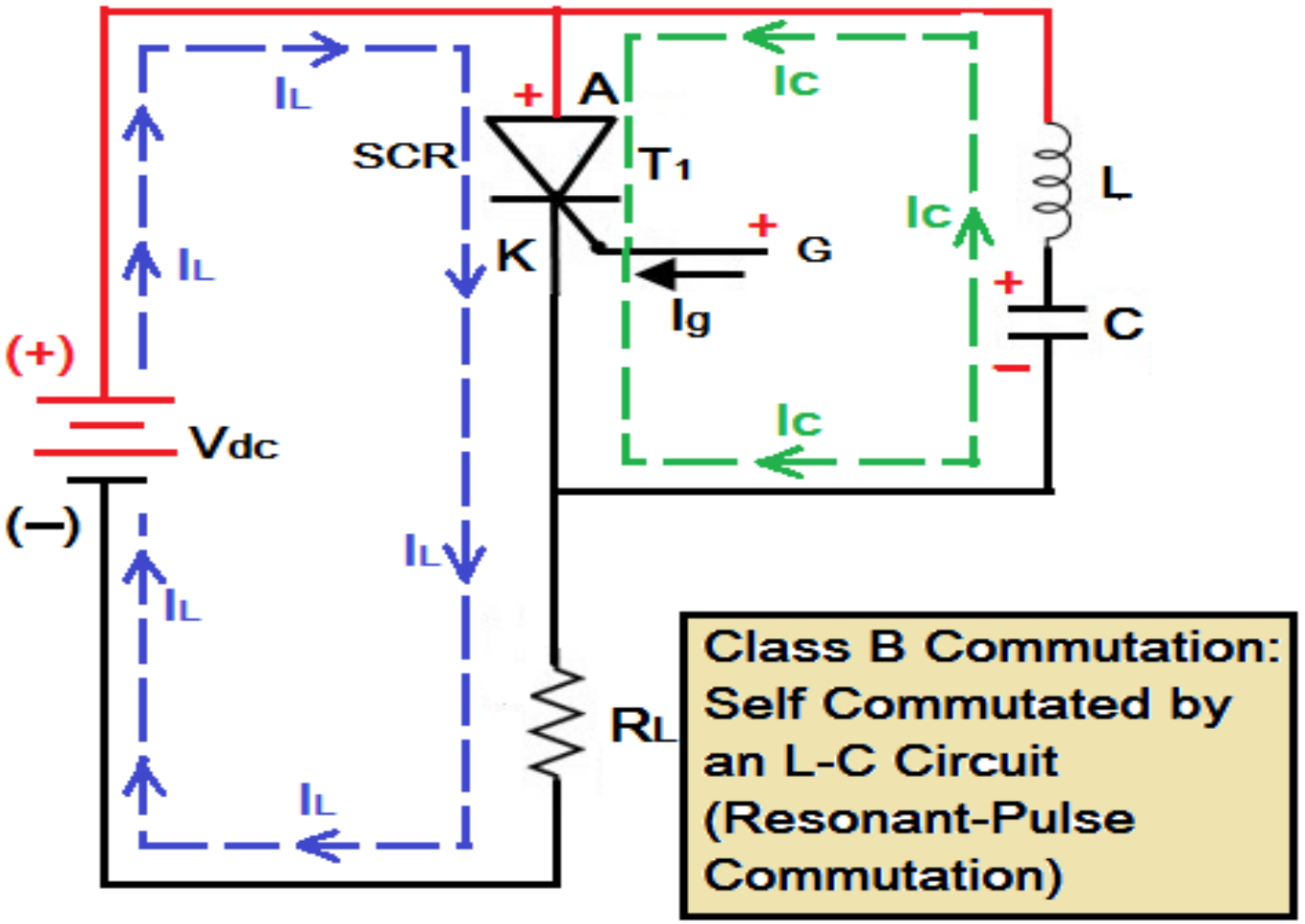
MODE – 2 :-

- When the **Gate Pulse** is applied to **SCR (thyristor) T1 at t = t1** than **SCR (thyristor) T1** will be **Turned ON,** a **Constant Load Current I_L or Anode Current I_A flows** through **Load R_L and Capacitor Discharging Current Ic** flows through **Capacitor C which is** shown in **Figure (88) below.** The **Load Current I_L** flowing through the following path,

  V_{dc+} – T1 – R_L – V_{dc-}

- And once the **SCR is Turned ON,** the **Capacitor (C) is starts Discharging through** the path,

  C+ – L – T1 – C-



- **Fig (88)** Shown Class-B Commutation **MODE – 2** Condition of flowing of Load Current IL and Capacitor Discharging Current Ic .

MODE – 3 :-

- When the **Capacitor C** is **completely discharged**, it starts to charge with **Reverse Polarity**. Due to **Reverse Polarity of capacitor voltage,** the **Commutating Current Ic** opposes the **flow** of the **Load Current I_L or Anode Current (I_A).** Since SCR (**thyristor**) **T_1** is a **unidirectional device,** the **Net Current I_{T1} flows** through **SCR (Thyrisor) T_1** is,

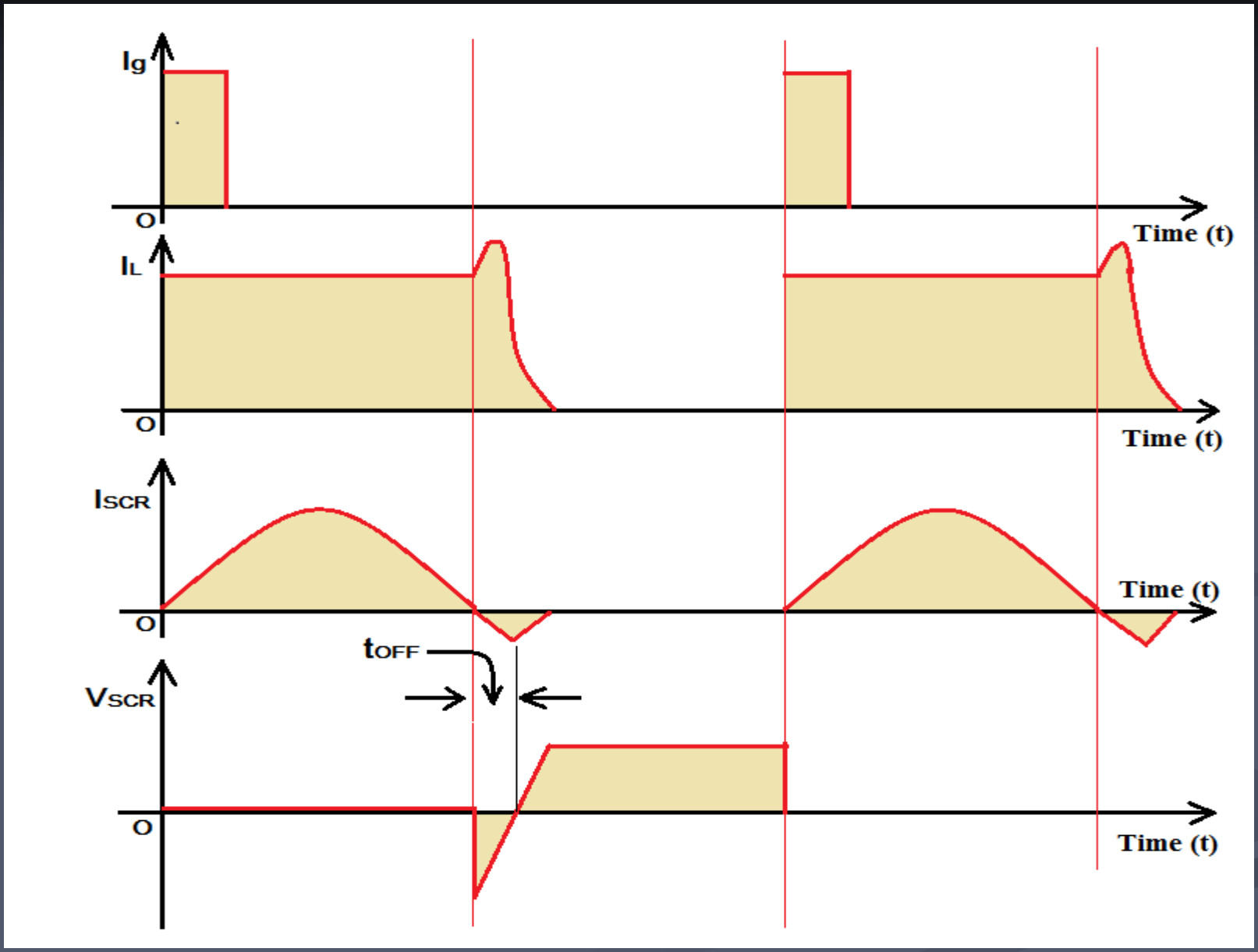
$$I_{T1} = I_L - I_c$$

- When the **Commutating Current (Ic)** is higher than the **Anode Current (I_A)** or **Load Current (I_L)** causes **Anode Current (I_A)** of **SCR** is decreases and when the **Anode Current (I_A)** is less than the **Holding Current (I_H)** the **SCR** will automatically **Turn OFF** and the **Capacitor (C)** charges with original polarity.

MODE – 4 :-

- When **SCR (thyristor) T1** is **Turned OFF, Capacitor C again starts to charge** with **Upper Plate Positive** and **Lower Plate Negative.** Whenever **Capacitor C is fully charged,** SCR (**thyristor) T1 will operate in the Forward Blocking State** and it will be **Turned ON** when a **Trigger Pulse is applied to SCR (thyristor) T1.**

- It is clear from Voltage and Current Waveforms of Class-B Commutation shown in **Figure (89) below,** that if the **SCR (thyristor) T1 is Turned ON** by applying a **Gate Pulse** and **Loads Current IL or Anode Current IA flows through SCR (thyristor) T1** and load for certain specified time duration. After the specified time period, **SCR (thyristor) T1 will be Turned OFF due to Self-Commutation.**



- **Fig (89)** Shown Voltage and Current Waveforms of Class-B Commutation.

- In the above process, the **SCR is Turned ON** for some time and then **automatically Turned OFF for some time.** This is a continuous process and the **desired frequency of ON/OFF depends on the values of L and C.** This type of commutation is mostly used in **Chopper Circuits.**

to be continued .....