Silicon Controlled Rectifier (SCR)

Lecture – 20

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

by:

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- **SCR Turning-OFF Methods (PART – 8)**
- **Lecture Content :-**
  - **(2) Forced Commutation**
    - **(IV) Class-E Commutation or External Pulse Commutation**

(V) Class-E Commutation or External Pulse Commutation

- Class-E Commutation is one of the Forced Commutation method to Turn OFF an SCR (thyristor). An External Current Pulse is used in this technique to Commutate SCR (thyristor). This is the reason, Class-E Commutation is also known as External Pulse Commutation. This external Current Pulse is obtained form a separate Voltage Source.

Condition for Successful Commutation by Class-E Commutation Method

- The most important condition for reliable commutation of SCR by this technique is that, the **magnitude of Current Pulse must be more than the Load Current.**

- This is also known as **External Pulse Commutation.** In this, an **External Pulse Source** is used to produce the **Reverse Voltage** across the **SCR (thyristor).**

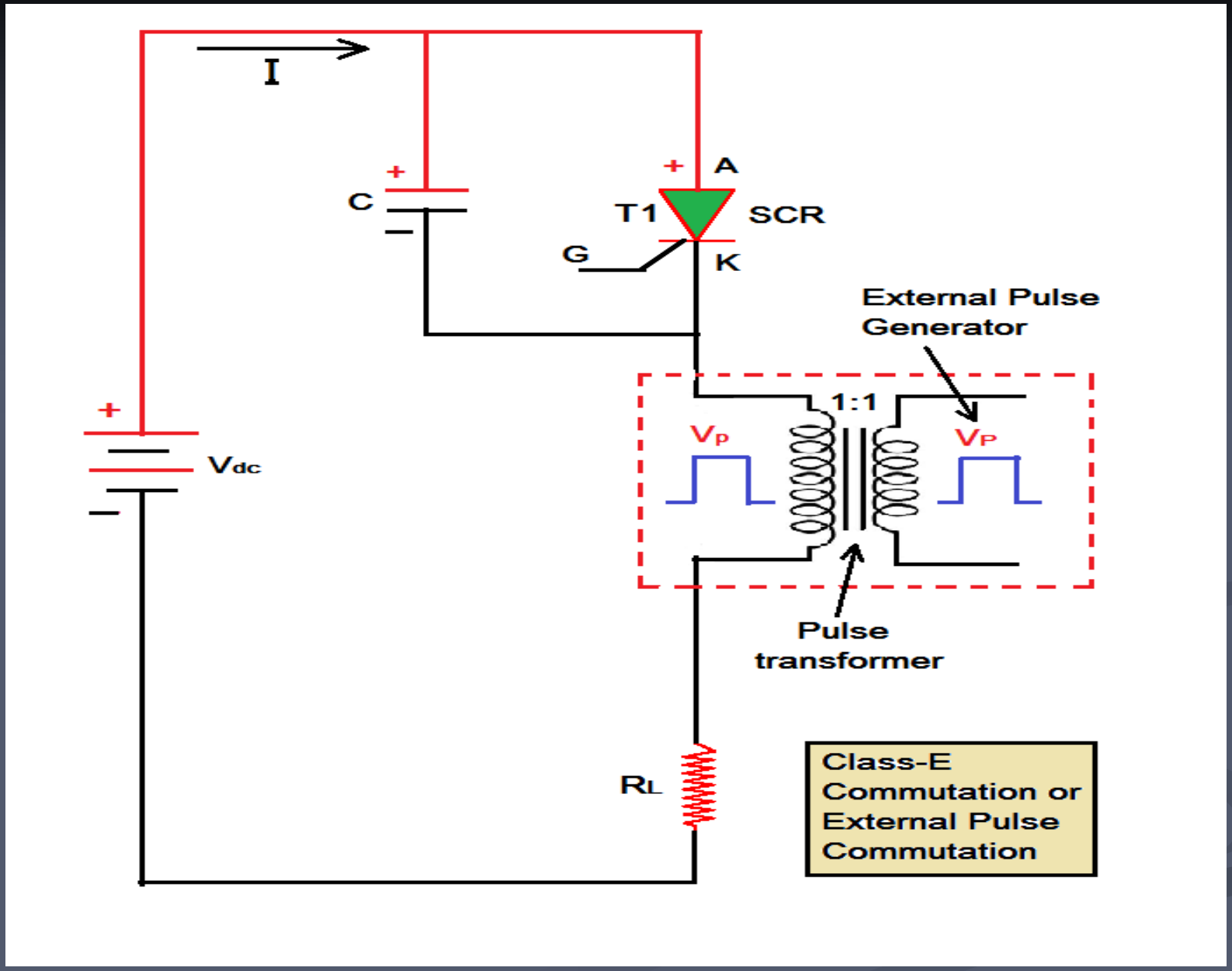
- The circuit below shows the **Class-E Commutation Circuit** which uses a **Pulse Transformer to produce the Commutating Pulse** and is designed with tight coupling between the **Primary and Secondary with a Small Air Gap.**

- The transformer is designed with sufficient **Iron and Air Gap** so as not to **Saturate.** It is capable of carrying the **Load Current** with a **Small Voltage Drop** compared with the **Supply Voltage V_{dc}.**

- If the **SCR (thyristor) need to be Commutated, Pulse Duration** equal to the **Turn OFF Time** of the **SCR (thyristor) is** applied. When the **SCR (thyristor)** is **triggered, Load Current flows through the Pulse Transformer.**

- If the **Pulse** is applied to the **Primary of the Pulse Transformer,** an **emf** or **Voltage** is induced in the **Secondary of the Pulse Transformer.**

- **Figure (99)** shows below the **Class-E Commutation Circuit.** In this commutation method, the **reverse voltage** applied to the **current carrying SCR (thyristor)** from an **External Pulse Source.** This commutation is also known as **External Pulse Commutation.** In this case, the **Commutating Pulse** is applied through a **Pulse Transformer** which is design in such way that there should be **Tight Coupling between the Primary and Secondary Winding of Pulse Transformer.**



- **Fig (99)** Shown **Class-E Commutation** Circuit Diagram.

- The **Pulse Transformer** is also designed with a **Small Air Gap** so that there will not be any **Saturation** when a **Pulse Voltage** is applied to its **Primary.** Whenever the **Commutation of SCR (thyristor) T1** is required, the **Pulse Duration** equal to or **Slightly Greater** than the specified **Turn OFF Time of SCR (thyristor) T1** must be applied.

MODE – 1 :-

- When the **SCR (thyristor) T_1 is Triggered and Turned ON,** the **Current starts to flow** through the **Pulse Transformer** and **Load Resistance R_L.** The **Current** flows through the following path,

- **V+ - T_1 - Primary of pulse transformer - R_L - V-**

MODE – 2 :-

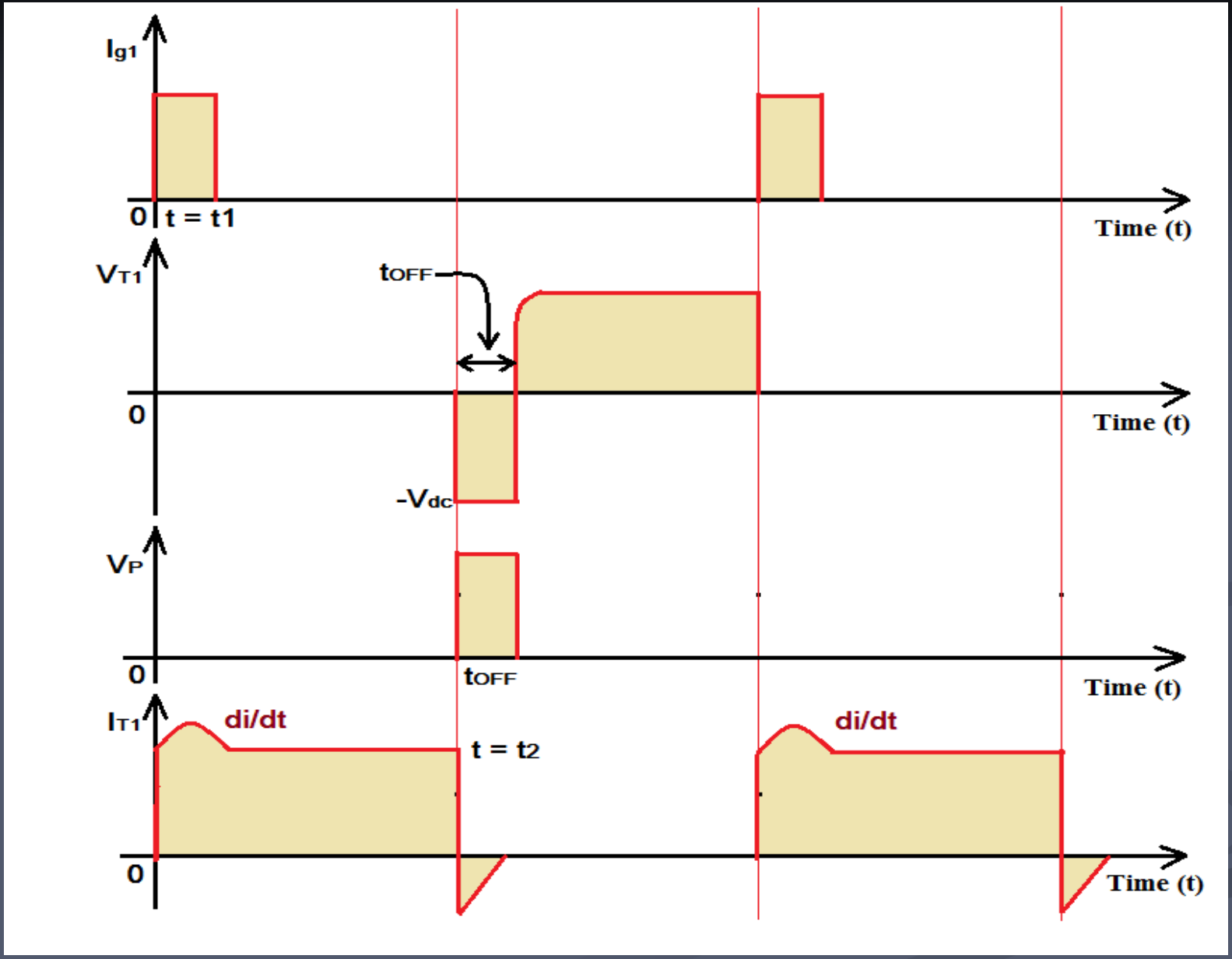
- When an **External Pulse Voltage V_P** is applied across the **Primary** of the **Pulse Transformer,** a **Voltage** will be induction in the **Secondary of the Pulse Transformer.**

- This induced **Voltage** in the **Secondary** appears as **Reverse Voltage ($-V_P$)** across the **SCR (thyristor) T_1.**

- That means to **Turn OFF SCR (thyristor) T1** a **Positive Pulse** is applied to the **Cathode Terminal** and **Negative Pulse** is applied to the **Anode Terminal** of the **SCR** from an **External Pulse Generator** via the **Pulse Transformer.**

- Subsequently, **SCR (thyristor) T1** gets **Turned OFF**. Since the frequency **of Induces Pulse Voltage** is **very high,** the **Capacitor C** is only charged to about **1 volt** and for the duration of the **Turn-OFF Pulse** the **Capacitor** provides **almost Zero Impedance.**

- When the **SCR (thyristor) T1** is **Turned OFF** completely, the **Load Current decays to Zero.** Before the computation process, the **Capacitor Voltage** remains at a value of about **1 volt.** The **Voltage and Current Waveforms** of **Class-E Commutation** is illustrated in **Figure (100)** below.



- **Fig (100) Shown** Voltage and Current Waveforms of Class-E Commutation.

- Thus the pulse from the **transformer Reverses** the **Voltage across the SCR (thyristor),** and it supplies the **Reverse Recovery Current** and **holds the Voltage Negative** for the required **Turn-OFF Time.**

- Since the **Minimum Energy is required for commutation** and both the **time ratio** and **Pulse Width Regulations** are **easily incorporated**, and **this type of commutation method is Very Efficient.**

to be continued .....