Waveform Generation

Lecture - 17

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B.Sc (Electronics)

TDC PART - III

Paper – 6

Unit – 8

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➢ Transistor Bi-Stable Multivibrator Circuit Operation (PART – 3)

The operation of the Bi-stable Multivibrator (BMV) circuit illustrated in Fig (3), (4) and (5) is as follows:-

When the **BMV Power supply +V_{CC}** is **switched ON** by closing the **Switch S**, both **Transistors Q1** and **Q2 start conducting**. Then one transistor starts conducting slightly more then the other due to small differences in their operating characteristics of the transistors. This starts a series of events.

Assume arbitrarily that **Transistor Q1** initially **Conducts (ON)** more then **Transistor Q2**. This causes the **Collector voltage** of **Transistor Q1** to drop more rapidly then that of **Transistor Q2**.

If **Transistor Q1** is **Conducting (ON)**, then the fact that **Point A** is nearly **0 V** makes the **Base terminal** of **Transistor Q2** **negative** by the **Potential divider R_2 – R_4**. The resulting negative signal is fed to the **Base terminal** of **Transistor Q2** through **Resistor R_2** and derives it towards **Cut-OFF** and **HOLD Transistor Q2** **Cut-OFF**.

As a result the **Collector voltage** of **Transistor Q2** rises towards **+V_{CC}**. This change in **Collector voltage** of **Transistor Q2** is feed to the **Base terminal** of **Transistor Q1** through **Resistor R_1**.

Similarly, with **Transistor Q2** **Cut-OFF**, the **Potential divider R_1 – R_3** is designed to keep **Base terminal** of **Transistor Q1** at about **0.7 V**. It is ensuring that **Transistor Q1** to go into **Saturation (ON)**. So **Transistor Q1** will remain in **Saturation (ON)** and **Transistor Q2** in the **Cut-OFF (OFF)** condition.

Interestingly it is seen that **Transistor Q1** in **Saturation (ON)** and **HOLD Transistor Q2** **Cut-OFF (OFF)** and **Transistor Q2** in **Cut-OFF (OFF)** and **HOLD Transistor Q1** in **Saturation (ON).** This drives one **Transistor Q1** to the **Saturation (ON)** and the other **Transistor Q2** to the **Cut-OFF (OFF). This is the First Initial Stable State of the Bi-stable Multivibrator** which is shown below in **Figure (3).**

- **The above whole process can be understand in different way, which is as follows:-**

When the **BMV power supply $+V_{CC}$** are **Switched ON** by closing the **Switch S** of the circuit, currents in **Transistor Q1** and **Q2** begin to flow. And due to the difference in characteristics of the transistors, current in one is slightly larger than the other.

Suppose **I_{C1}**of the **Transistor Q1,** is larger than **I_{C2}** of the **Transistor Q2**. Larger **I_{C1}** will **reduce the voltage** of **Point A**, which in consequence **reduce** the **Base voltage** of **Transistor Q2**, and hence **decrease** in **I_{C2}** of the **Transistor Q2.**

Due to **decrease** in **I_{C2}** voltage of **Point B** will be **increased**, which will **increase** the **Base terminal voltage** of **Transistor Q1**, thereby further **increase** in **I_{C1}.** Ultimately **Transistor Q1** will be conducting at **Saturation (ON)** and **Transistor Q2** is in **Cut-OFF (OFF).** On the other hand if initially **I_{C2}** is larger than **I_{C1},** then finally **Transistor Q2** will be conducting at **Saturation (ON)** and **Transistor Q1** will be in **Cut-OFF (OFF).**

If **Transistor Q1** is **Conducting (ON),** then the **Potential (voltage)** of **Point A** is nearly **zero.** The **Negative supply $-V_{BB}$ reverse biases** the **Base-Emitter junction** of **Transistor Q2** by the **potential divider bias** through **Resistors R_2 and R_4**, so **Transistor Q2** is in **Cut-OFF (OFF) condition**, and thus the potential of **Point B** is **$+V_{CC}$**. Thus **Transistor Q1** is **forward bias** through the **Potential divider** bias from **$+V_{CC}$ to $-V_{BB}$ ($R_1 - R_3$).** So **Transistor Q1** will remain in **Saturation (ON)** and **Transistor Q2** in the **Cut-OFF (OFF) condition.**

Interestingly it is seen that **Transistor Q1** in **Saturation (ON)** and **HOLD Transistor Q2** in **Cut-OFF (OFF)** and **Transistor Q2** in **Cut-OFF (OFF)** and **HOLD Transistor Q1** in **Saturation (ON).** This drives one **Transistor Q1** to the **Saturation (ON)** and the other **Transistor Q2** to the **Cut-OFF (OFF). This is the**

First Initial Stable State of the Bi-stable Multivibrator which is shown below in **Figure (3).**

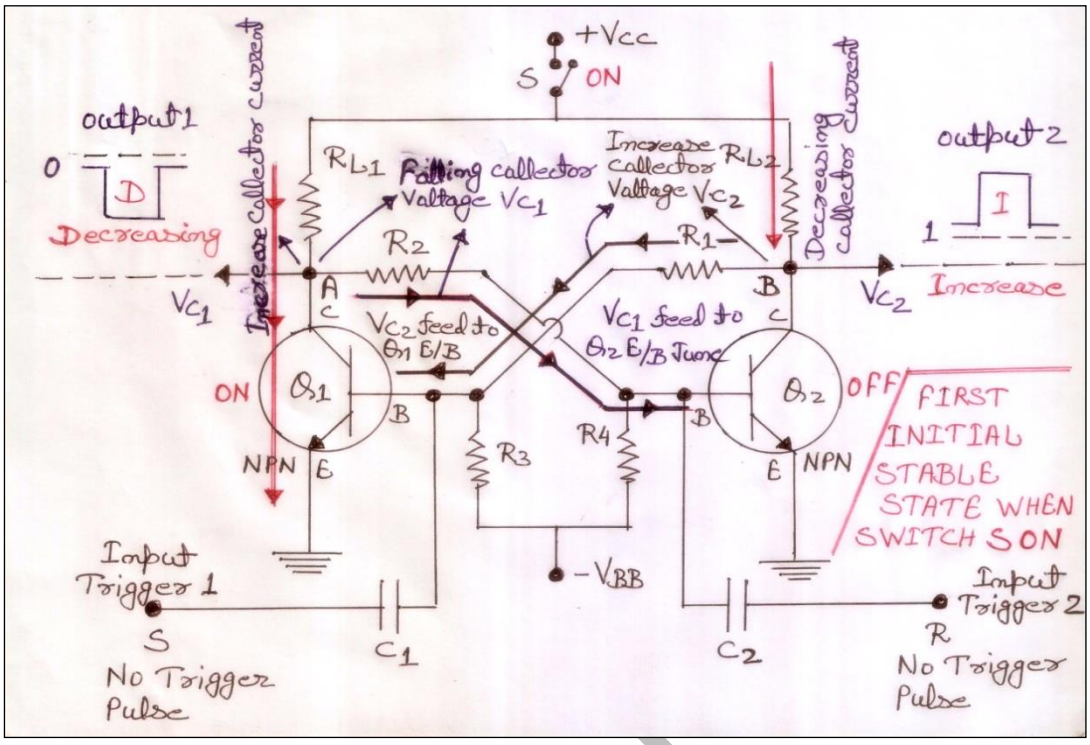

Fig. (3) Shown First Initial stable State of the Multivibrator when BMV Power Switch '**S' ON** and No Trigger Inputs applied.

The **Bi-stable Multivibrator** can be driven from the **First Stable State (Q1 ON and Q2 OFF)** to the **other stable state (Q1 OFF and Q2 ON)** by applying either a **negative trigger pulse** to the **Base terminal** of **Transistor Q1** through **Input Trigger 1 (SET)** or a **positive trigger pulse** to the **Base terminal** of **Transistor Q2** through **Input Trigger 2 (RESET).**

By applying a **negative trigger** at the **Base terminal** of **Transistor Q1** or by applying a **positive trigger pulse** at the **Base terminal** of **Transistor Q2**, this **stable state** can be altered.

So, let us understand this by considering a **negative trigger pulse** at the **Base terminal** of **Transistor Q1** through **Input Trigger 1 (SET).**

Let a **negative trigger pulse** of short duration and sufficient magnitude be applied to the **Base terminal** of **Transistor Q1** through **Capacitor C1**. This **negative trigger pulse reduces** the **forward bias** on the **Transistor Q1 Base terminal** hence it **reduces** the **E/B junction voltage** of **Transistor Q1** then **Transistor Q1 Cut-OFF (OFF)** and causes a **reduction** in **Transistor Q1 Collector current** and, thereby, **increases in Collector voltage V_{C1} of its collector terminal of Transistor Q1 at Point A**.

Now this **increased Collector voltage V_{C1}** feed to **E/B junction of Transistor Q2**. The **rising collector voltage** appears across the **Emitter-Base (E/B) junction of Transistor Q2** as it is connected to the **Collector terminal** of **Transistor Q1** at **Point A** via **Resistor R_2**. As **rising Collector voltage** of **Transistor Q1**, result **Transistor Q2 Saturated (ON),** then collector current of **Transistor Q2 increases** and, therefore, its **Collector voltage V_{C2} decreased.**

The **decreasing Collector voltage V_{C2} at Point B of the Transistor Q2** appears across the **Emitter-Base (E/B) junction of Transistor Q1** through **Resistor R1** where it **further Reverse Biases the Emitter-Base (E/B) junction** of **Transistor Q1** to make **Transistor Q1 Cut-off (OFF)** then **Collector current of Transistor Q1** to **decrease** and **Collector voltage V_{C1} of Transistor Q1 to increase at Point A**. After few cycles, the **Transistor Q2** is driven into **Saturation (ON)** and **Transistor Q1** to **Cut-OFF (OFF). This is the Second Stable State of the Bi-stable multivibrator.** The circuit will now **remain** in **this Second Stable State (Q1 OFF and Q2 ON). Second Stable State** when **negative trigger pulse** applied to the **Transistor Q1** through **Input Trigger 1** is shown below in **Figure (4)**.

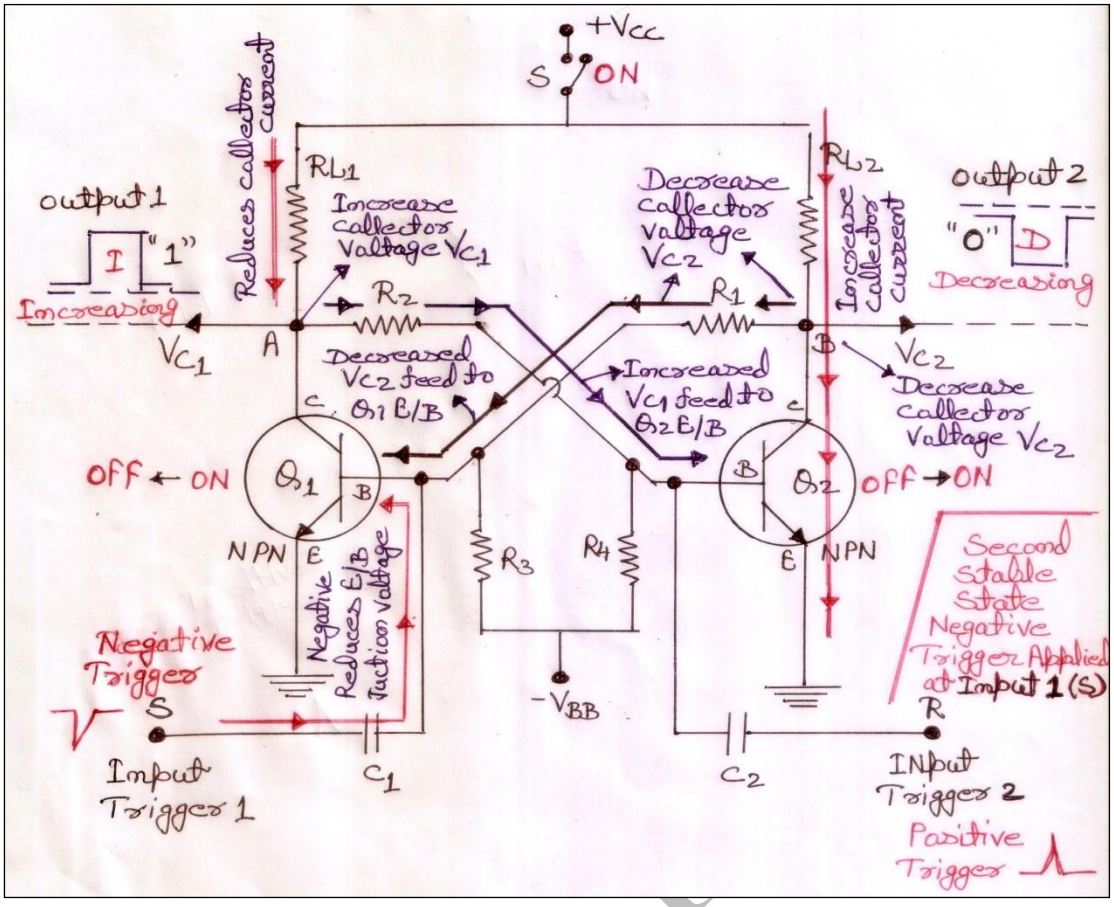

Fig. (4) Shown Second stable state when negative trigger pulse applied to the transistor Q1 through Input 1 or Positive trigger pulse applied to the transistor Q2 through Input 2.

Now, if this **Second Stable State** has to be **changed again, and back to Initial Stable State where Transistor Q1 Saturation (ON) and Transistor Q2 Cut-OFF (OFF),** then a **negative trigger pulse** is applied to the **Base terminal of Transistor Q2 through Input Trigger 2** or a **positive trigger pulse** is applied to the **Base terminal** of **Transistor Q1 through Input Trigger 1. The above condition is shown below in Figure (5).**

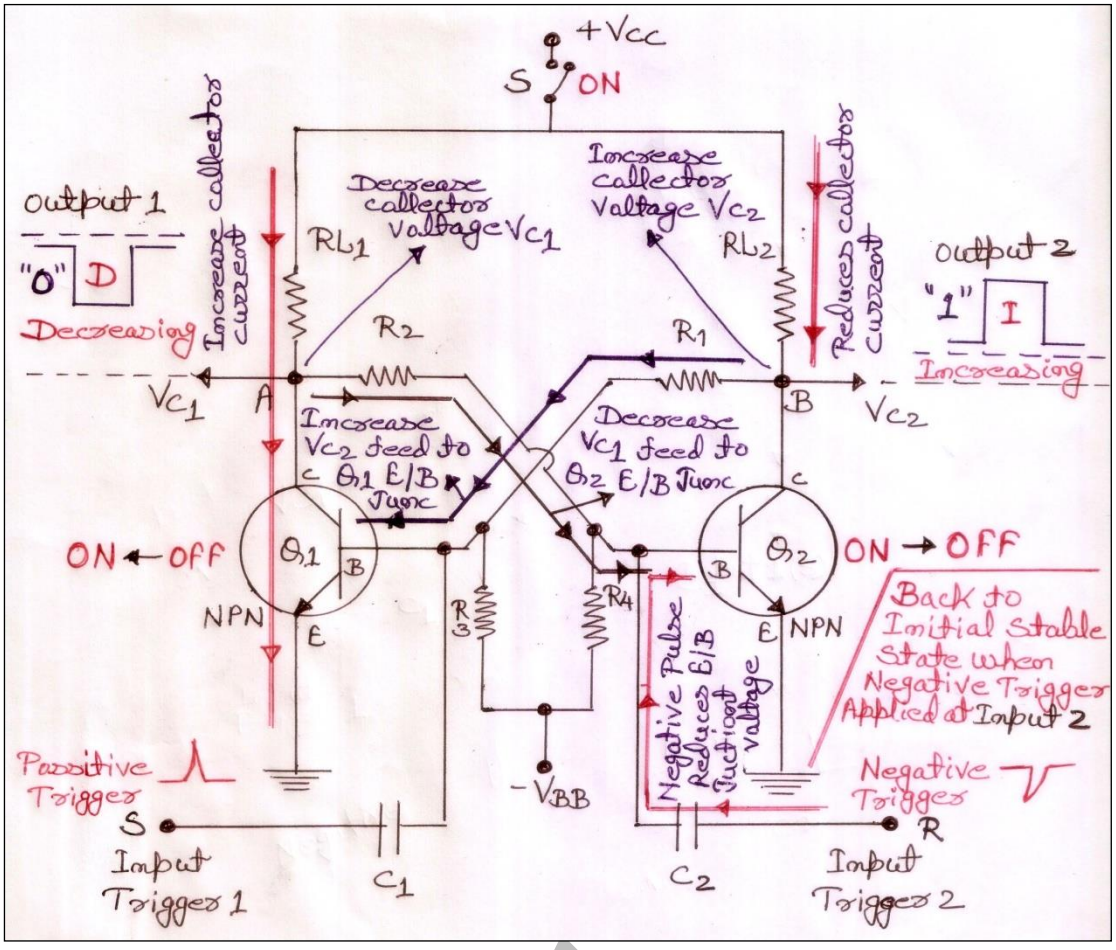

Fig. (5) Shown Back to initial stable state of BMV can be achieved when negative trigger pulse applied to the transistor Q2 through Input 2 or Positive trigger pulse applied to the transistor Q1 through Input 1.

⇨ Detailed **of the Transistor Bi-Stable Multivibrator Output Waveforms, Its Advantage, Disadvantage and Applications** are discussed in next **Lecture – 18.**

to be continued .....

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