Four Layer P-N-P-N Switching Devices (Shockley Diode) Lecture – 9

TDC PART – II

Paper - III (Group - A)

Chapter - 4

by:

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Four Layer P-N-P-N Switching Devices (Shockley Diode)

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- **P-N-P-N Diode or Shockley Diode**
- **Lecture Content :-**

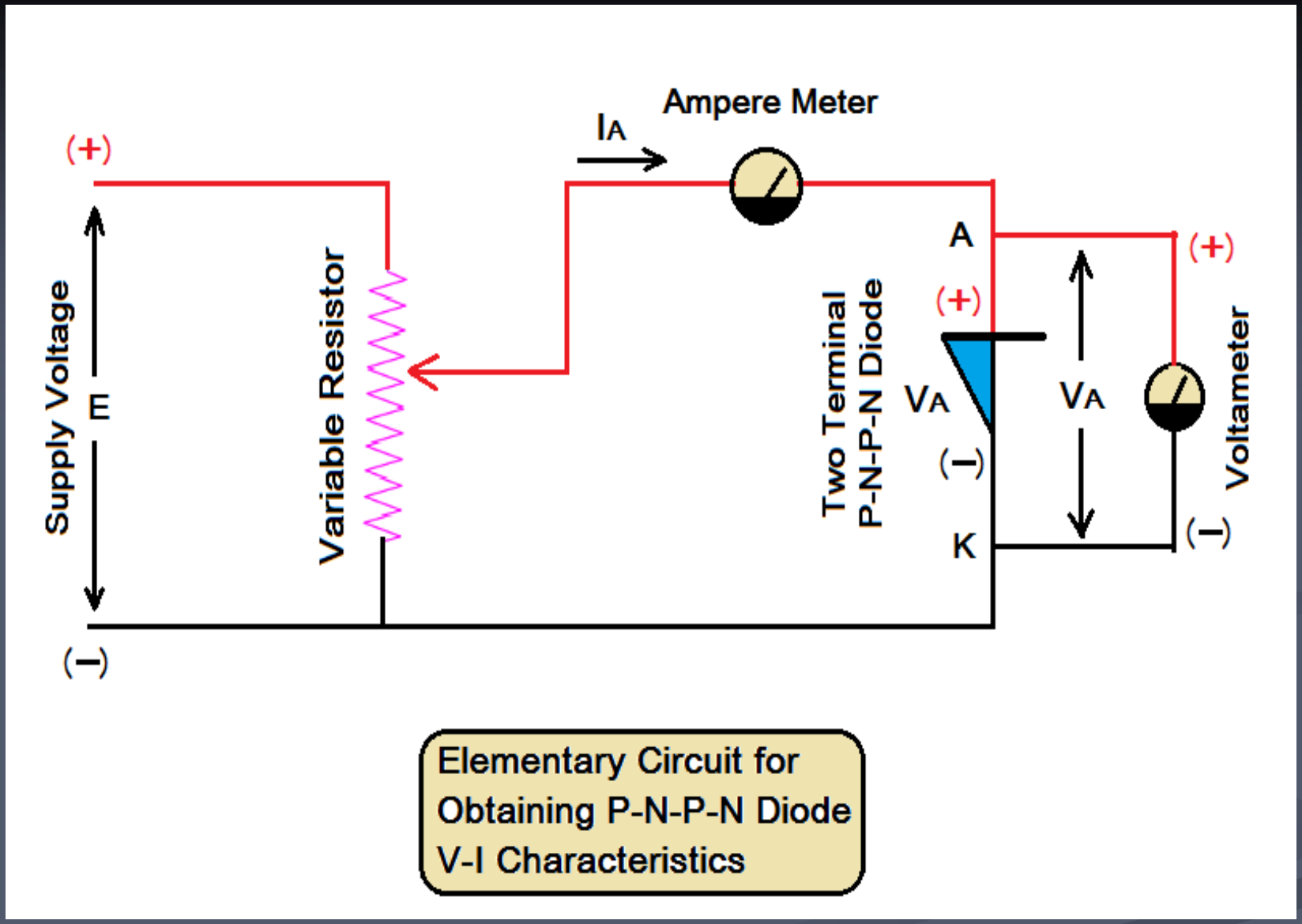
➢ **(7) V-I Characteristics of P-N-P-N Diode or Shockley Diode**

➢ **(I) Reverse Blocking Mode (OFF-State)**

P-N-P-N Diode or Shockley Diode

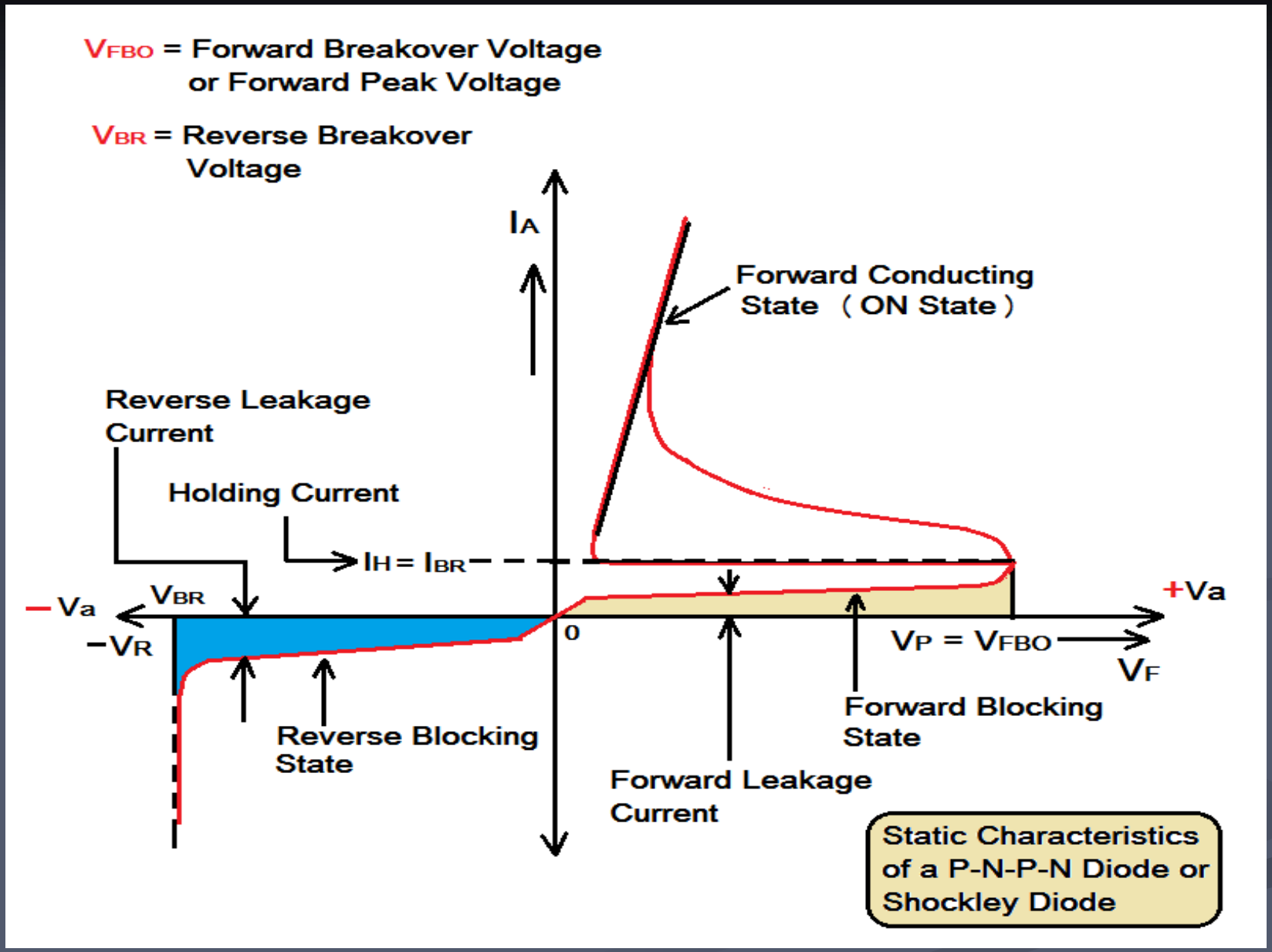
- **(7) V-I Characteristics of P-N-P-N Diode or Shockley Diode**

- **An Elementary Circuit Diagram** for obtaining **V-I Characteristics** of a **P-N-P-N Diode or Shockley Diode** is shown in **Figure (18)** below. The **Anode (A) and Cathode (K)** are connected to **Main Source (Supply Voltage E)** through an **"Ampere Meter" and a Voltage finding meter "Voltmeter"** connected in **Parallel in device.**



- **Fig. (18)** Shown an elementary circuit diagram for obtaining V-I Characteristics of a P-N-P-N Diode or Shockley Diode.

- **Figure (19)** shown below a **Static V-I Characteristics of a P-N-P-N Diode.** Here **V_A** is the **Anode (A) Voltage** across **P-N-P-N Diode** terminals **Anode (A), Cathode (K)** and **I_A** is the **Anode (A) Current.**



- **Fig. (19)** Shown Static V-I Characteristics of a P-N-P-N Diode or Shockley Diode.

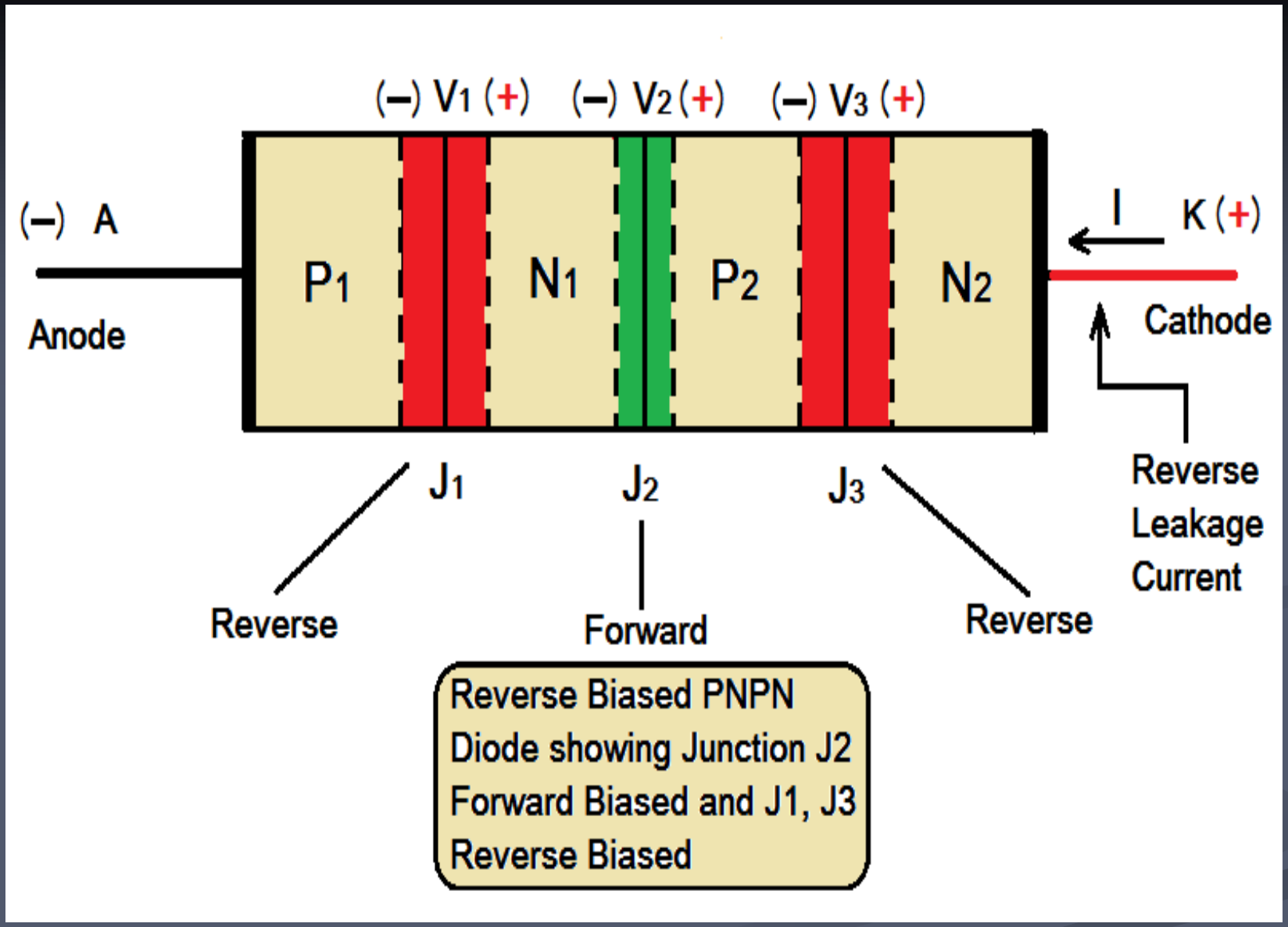
- Typical **P-N-P-N Diode V-I Characteristics** shown above in **Figure (19)** reveals that a **P-N-P-N Diode** has **Three Basic Mode of Operation**; namely,

- **(I) Reverse Blocking Mode (OFF-State)**
- **(II) Forward Blocking Mode (OFF-State)**
- **(III) Forward Conducting Mode (ON-State)**

- These **three modes of operation** are now discussed below one by one;

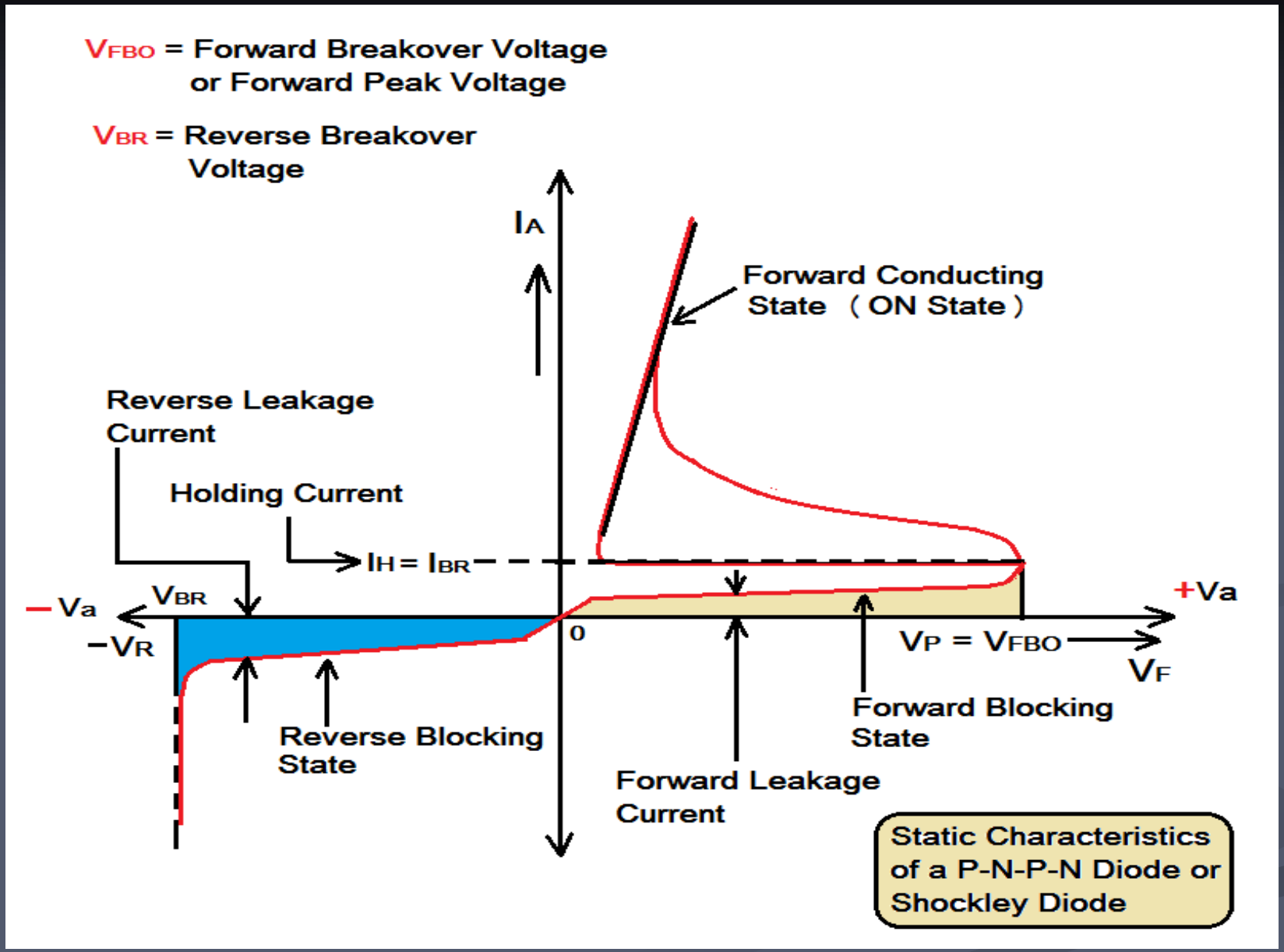
(I) Reverse Blocking Mode (OFF-State)

- When **Cathode (K) Terminal** is made **Positive** with respect to **Anode (A), P-N-P-N Diode** is said to be **Reverse Biased** as shown in **Figure (20)** below. **Junction J1** and **Junction J3** are seen to be **Reverse Biased** whereas **Junction J2 is Forward Biased.** The device behaves as if **Two Diodes are connected in Series with Reverse Voltage** applied across them.



- **Fig. (20)** Shown Reverse Biased P-N-P-N Diode with Junctions J1, and J3 are Reverse Biased but Junction J2 is Forward Biased.

- In this **Reverse Blocking Mode**, a **Small Leakage Current, called Reverse Leakage Current** of the order of a few **milli amperes (mA)** or a **few micro-amperes (μA)** depending upon the diode rating flows as Shown above in **Figure (20).** It may be also seen from **Static V-I Characteristics of a P-N-P-N Diode or Shockley Diode** shown in **Figure (21) below.**



- **Fig. (21)** Shown Static V-I Characteristics of a P-N-P-N Diode or Shockley Diode.

- This **Reverse Blocking Mode** called the **OFF-State** of the **P-N-P-N Diode.** If the **Reverse Voltage** is **Increased,** then at a **Critical Breakdown Level, called Reverse Breakdown Voltage V_{BR},** an **Avalanche Breakdown occurs at Junction J1 and Junction J3** and the **Reverse Current Increases Rapidly.**

- A **Large Current** associated with **Reverse Breakdown Voltage V_{BR}** gives **Rise** to **More Losses** in **P-N-P-N Diode.** This may lead to **P-N-P-N Diode Damage** as the **Junction Temperature may Exceed its Permissible Temperature rise.** It should, therefore, be ensured that **Maximum Working Reverse Voltage** across a **P-N-P-N Diode** does not exceed **Reverse Breakdown Voltage V_{BR}.**

- When **Reverse Voltage** applied across a **P-N-P-N Diode** is less than **Reverse Breakdown Voltage V_{BR},** the **device offers High Impedance in the Reverse Direction.** The **P-N-P-N Diode in the Reverse Blocking Mode may therefore be treated as an Open-Switch.**

to be continued .....