SUBJECT: BASIC ELECTRONICS

V-I Characteristics of Diode

Elementrix Classes

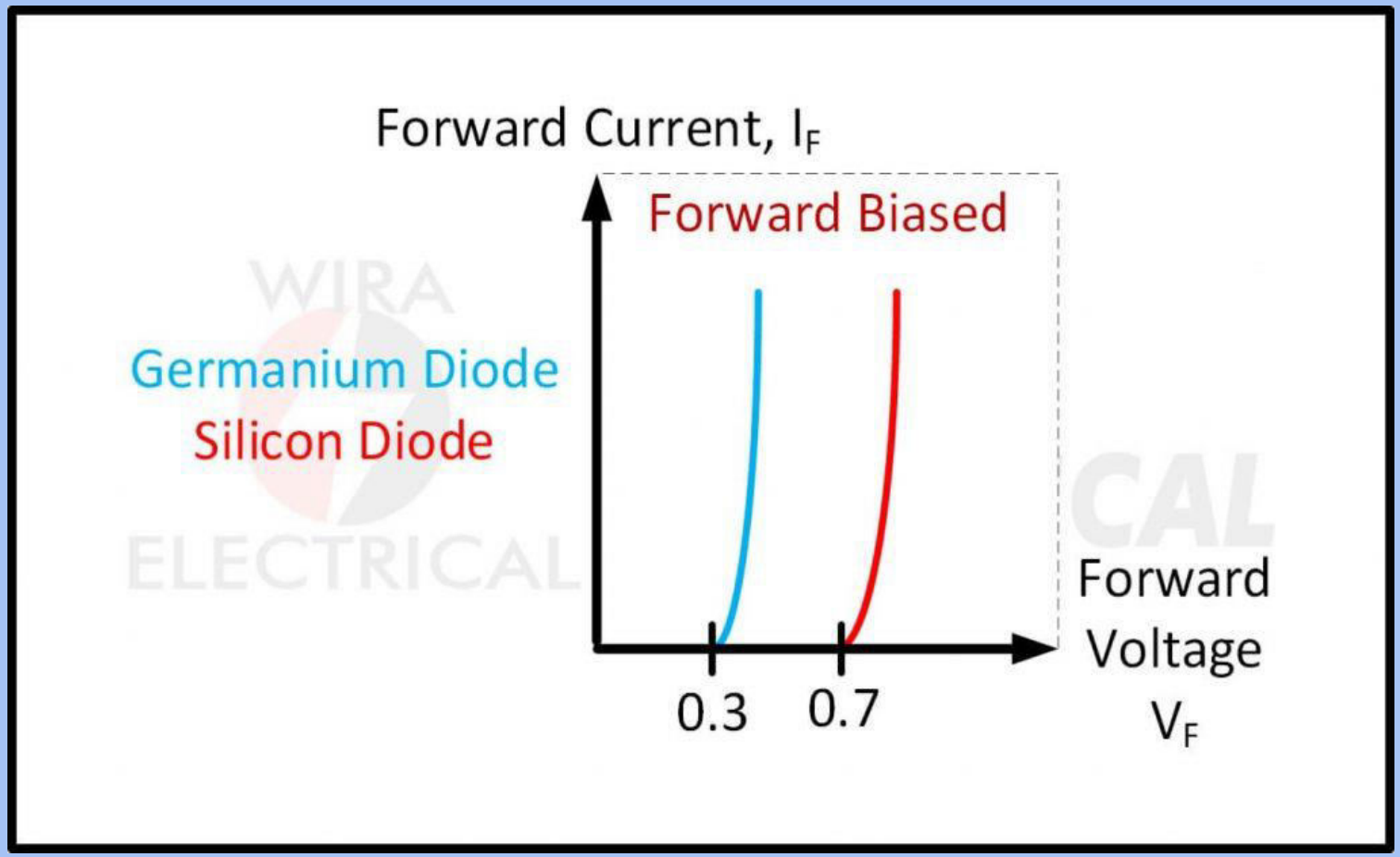
Forward Biased

- The forward bias is when the direction of current enters the diode through the Anode terminal (Forward Current). The current will increase significantly until its maximum value when the voltage applied to the diode is bigger than its voltage requirement (Forward Voltage).

- This explains that in forward biased, the resistance against the current is relatively small.

- Keep in mind that the forward voltage of a diode depends on its material. The most common diode is silicon diodes which have forward voltage of 0.7 V and 0.3 V for Germanium diodes.

  It means as long as the voltage applied to the diode is bigger than 0.7 V (Silicon) or 0.3 V (Germanium), it will pass the current.


Forward Current, I_F
Forward Biased
Germanium Diode
Silicon Diode
0.3
0.7
Forward Voltage V_F

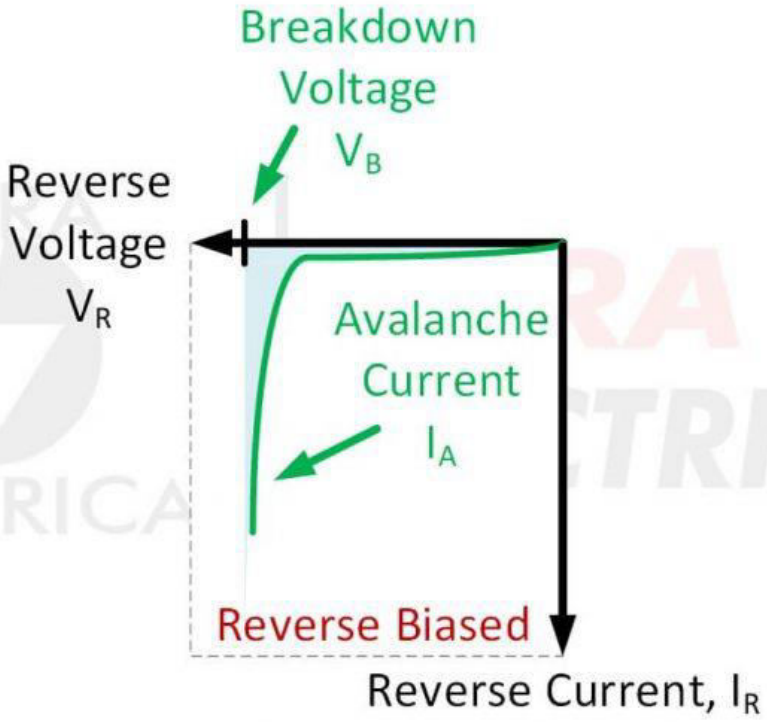
Reverse Biased

- As opposed to forward biased, the reverse bias is when the direction of current enters the diode through the Cathode terminal (Reverse Current). The diode can withstand the voltage (Reverse Voltage) up to a certain limit (Breakdown Voltage) before it breaks and the current leak (Avalanche Current) in the opposite direction with maximum value.

- After the diode breaks, it will not block any reverse current.

- There is a difference between breaking down and destroying. If the reverse voltage surpasses the breakdown voltage, the reverse current will flow. It will still work fine as a diode as long as the reverse voltage doesn’t exceed its maximum reverse voltage, Peak Reverse Voltage or Peak Inverse Voltage (PRV or PIV).

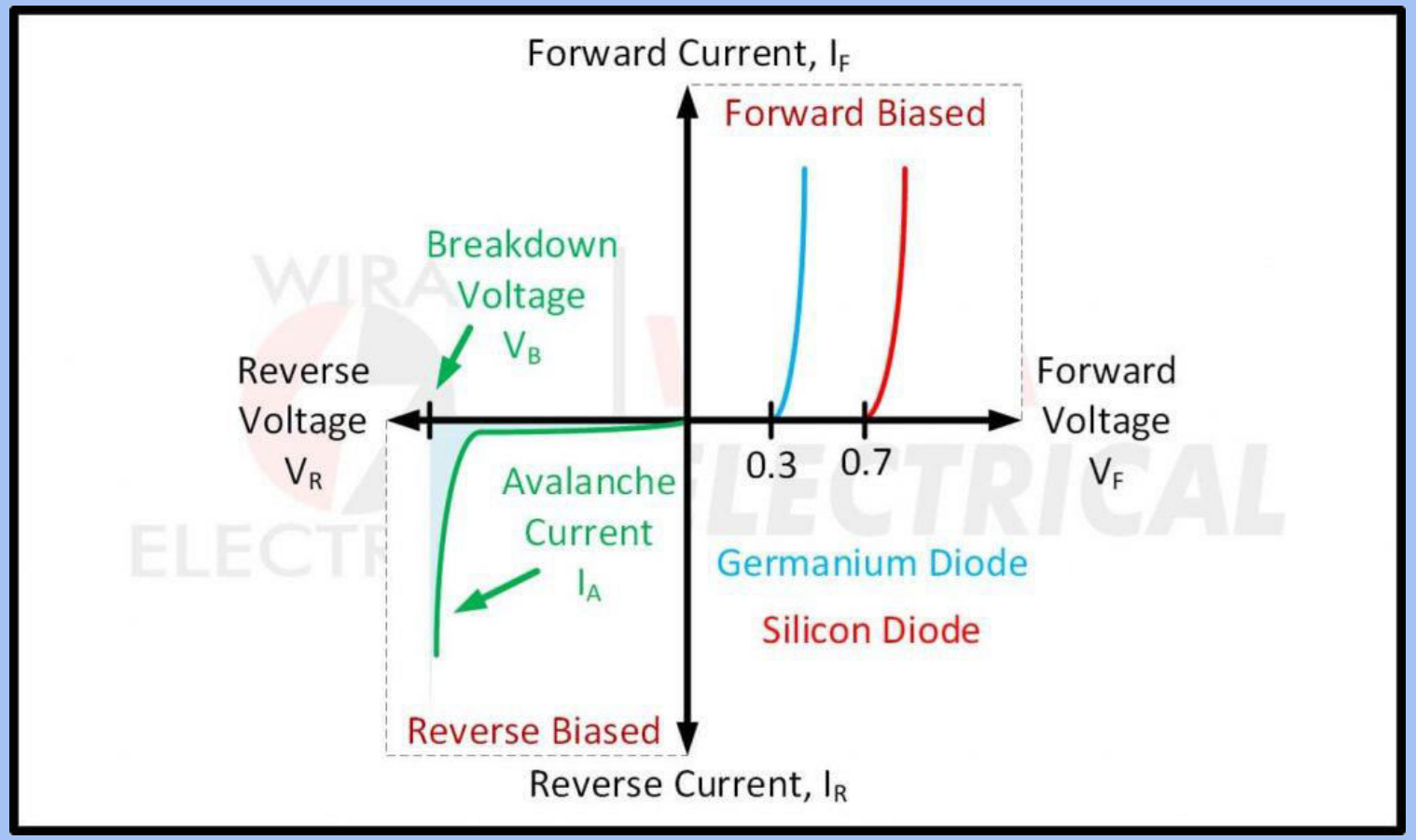
- As soon as the reverse voltage exceeds the peak reverse voltage, the diode is destroyed and we have to replace it with a new one. A diode should have peak inverse voltage much higher than the applied voltage to it.


Breakdown
Voltage
V_B
Reverse
Voltage
V_R
Avalanche
Current
I_A
Reverse Biased
Reverse Current, I_R

Characteristics Curve of Diode

- The main characteristics of diodes we should pay attention to the most are the forward voltage V_F, forward current I_F, reverse voltage V_R, and reverse current I_R. The regions consisting of these four represent the forward and reverse operation regions.

- The curve between the voltage and current through the circuit represents the VI properties of P-N junction diodes. While current is measured along the y-axis, voltage is measured along the x-axis. The P-N junction diode's V-I characteristic curve is shown in the graph.


Forward Current, I_F
Forward Biased
Breakdown
Voltage
V_B
Reverse
Voltage
V_R
Forward
Voltage
V_F
0.3
0.7
Avalanche
Current
I_A
Germanium Diode
Silicon Diode
Reverse Biased
Reverse Current, I_R

Terms used in V-I Characteristics

Forward Voltage (V_F)/Threshold Voltage (V_T): Voltage to initiate current flow in the forward direction.

Forward Current (I_F): Current flowing in the forward-biased condition.

Reverse Voltage (V_R): Voltage applied across a diode in the reverse-biased direction.

Reverse Current (I_R) : Current flowing through the diode when it's under reverse bias.

Reverse Saturation Current(I_S): Reverse saturation current is the small current that flows through a diode in the reverse-biased condition, primarily due to minority charge carriers.

Knee Voltage/Cut in voltage: Voltage where the VI curve sharply turns upward in the forward direction.

Peak Inverse Voltage (PIV): It's the maximum reverse voltage that a diode can withstand without experiencing breakdown or permanent damage.

Breakdown Voltage (V_{BR}): Voltage causing significant reverse current.

Avalanche Breakdown: Reverse breakdown caused by accelerated carriers colliding with atoms, leading to increased reverse current.

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