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BANGALORE

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GATE ECE Coaching By IITians GATE CLASSES

Power Electronics Study Material



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Ideal switches:

- 1) Have zero conduction and blocking losses
- 2) Can change from ON state to OFF and vice-versa immediately
- 3) Does not require an external energy to change its state from ON to OFF and vice-versa
- 4) Does not require an external source to maintain the given state
- 5) Thermally stable under all operating conditions

Real Switches:

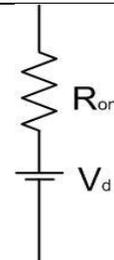
- 1) Have finite conduction and blocking losses
- 2) Takes finite time to change from ON to OFF state and vice-versa
- 3) Requires external energy to change the state as well as to maintain the given state.
- 4) Thermally not stable under all operating conditions (has thermal constraints for stable operation)

Switch circuit models:

Device	Circuit model
Diode $R_{on} = on - state\ resistance$ $V_d = on - state\ voltage\ drop$	
MOSFET $R_{on} = on - state\ resistance$ $V_d = on - state\ voltage\ drop$	
BJT $R_{on} = on - state\ resistance$ $V_d = on - state\ voltage\ drop$	



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<p>SCR $R_{on} = \text{on - state resistance}$ $V_d = \text{on - state voltage drop}$</p>	
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Switch types:

Classification-1 (based on control properties)

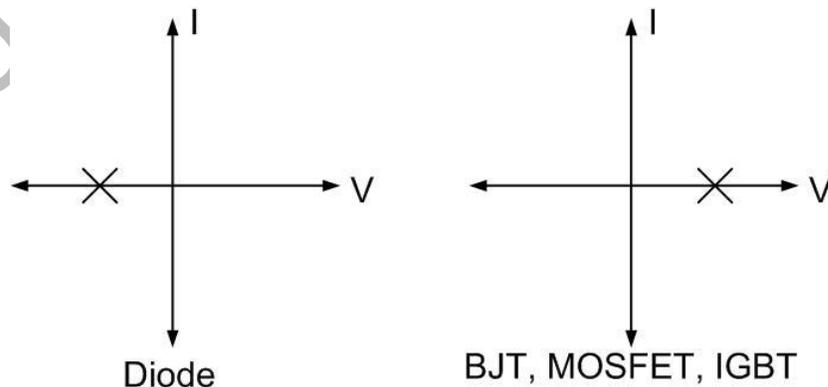
- 1) Uncontrolled switches: Switching states cannot be controlled with control signal
Eg- Diode
- 2) Semi-controlled (or) Half-controlled switches: only one switching state (either ON or OFF) can be controlled using control signal

Eg- SCR

- 3) Fully-controlled switches: Both the switching states can be controlled by control signal
Eg- BJT, MOSFET, IGBT

Classification -2 (based on operating point characteristics)

- 1) Unipolar switches: Blocks only one polarity of voltage (either positive or negative) during blocking state
Eg- diode, BJT, IGBT, and MOSFET



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- 2) Bipolar switches: Blocks both polarity of voltage during blocking state.
Eg- SCR, TRIAC
- 3) Unidirectional switches: Allows current to flow in only one direction during conduction mode.
Eg – BJT, MOSFET, IGBT, SCR, and GTO
- 4) Bidirectional switches: Allows current to flow in both directions during conduction mode.
Eg - TRIAC

For high frequency and low power applications like UPS MOSFET is used.

For low frequency and high power applications like high voltage DC transmission SCR is used.

Silicon Controlled Rectifier (SCR):

It is a semi controlled, bipolar, and unidirectional switch which can be operated in 1st and 2nd quadrant.

Rating – up to 3 KV and 10 KVA

It is a 4 layer 3 junction device.

N_2 is heavily doped and thin layer, P_2 is moderately doped and thick layer, N_1 is lightly doped and thickest of all layers, and P_1 is similar to P_2

