Module – 2

CONTROL SYSTEM COMPONENTS

Lecture - 6

STATIC SWITCHES

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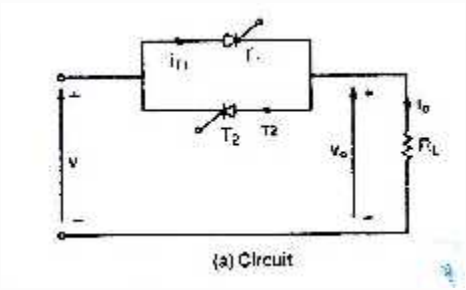
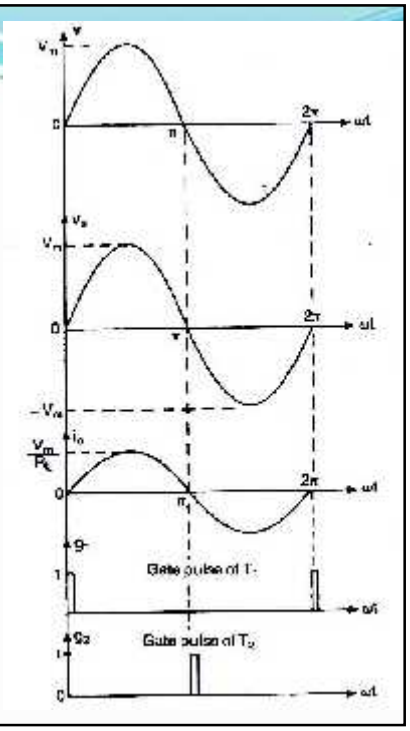
Introduction

- Thyristor can be turned on and off within a few microseconds
- operated as fast-acting switches to replace mechanical and electromechanical circuit breakers.
- power transistors - For low-power dc applications
- Advantages :
  - very high switching speeds,
  - no moving parts,
  - no contact bounce upon closing
- Other uses
  - can be designed to provide time-delay, latching, over- and under current, and voltage detections.

SINGLE-PHASE AC SWITCHES

- two thyristors are connected in inverse parallel.
- Thyristor *T1 is fired at ωt = o*
- thyristor *T2 is fired at ωt = π.*
- *The output voltage is the same as the input voltage.*
- *The* thyristors act like switches and are line commutated

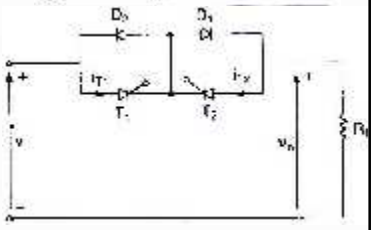




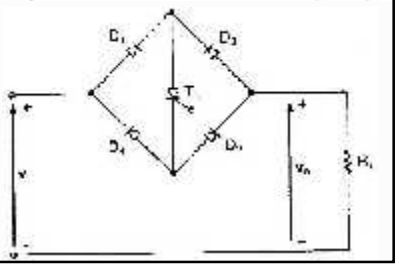
Other Switches

- A TRIAC may be used instead of two thyristors

- Two thyristors have a common cathode and the gating signals have a common terminal. (with freewheeling diode)

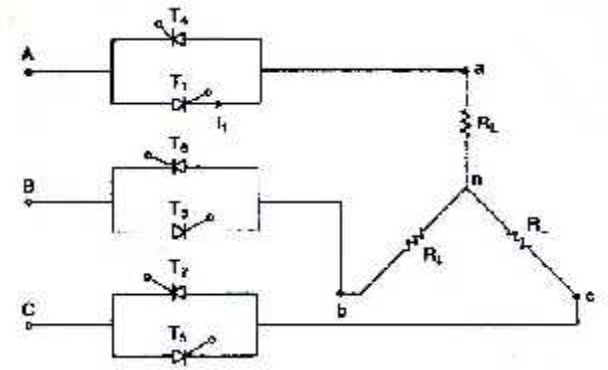


- A diode bridge rectifier and a thyristor *T1* as cross arm



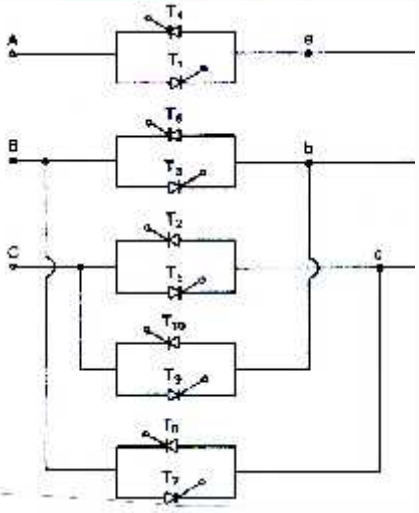
THREE-PHASE AC SWITCHES

- Three single-phase switches connected to form a three-phase switch
- The load could be connected in either wye or delta.
- Instead of connecting two thyristors, one thyristor and a diode can be used. (i.e. T4 replace with D1)



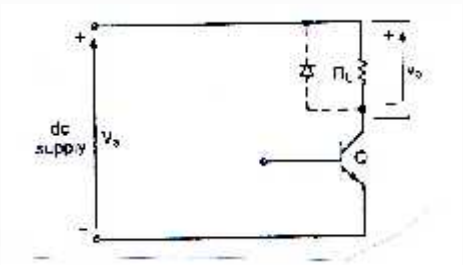
THREE-PHASE REVERSING SWITCHES

- The reversal of three-phase power supplied to a load can be achieved by extending the three-phase switch with two more single-phase switches.
- Under normal operation, thyristors *T7 to T10* are turned off and thyristors *T1* through *T6* are turned on.
- Line A feeds terminal a, line B feeds terminal b, line C feeds terminal c.
- Under phase-reversing operation, thyristors *T2, T3, T5, and T6 are turned off* and thyristors *T7 to T10 are operative*
- Line B feeds terminal c and line C feeds terminal b, resulting in a phase reversal of the voltage applied to the load.

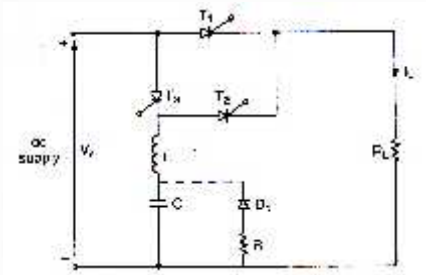


DC SWITCHES

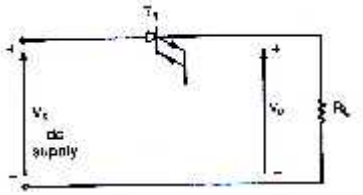
- input voltage is dc and power transistors fast switching thyristors or GTO can be used.
- turned off by forced commutation.



Single pole transistor



Single pole thyristor

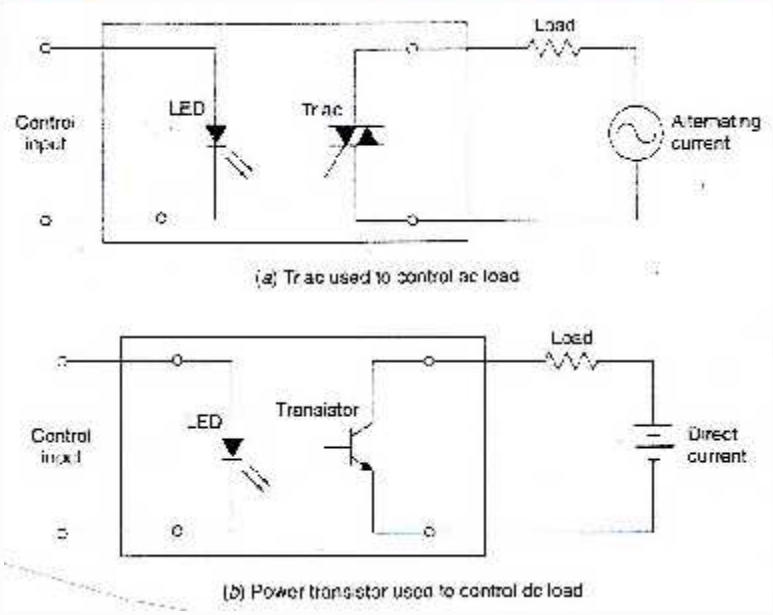


Single pole GTO

SOLID-STATE RELAYS

- SSRs do not have actual coils and contacts
- they use semiconductor switching devices such as bipolar transistors, MOSFETs, silicon-controlled rectifiers (SCRs), or triacs
- Used in isolating a low-voltage control circuit from a high-power load circuit.
- can be used to control ac or dc loads
  - For AC load, a triac is used
  - For DC load, power transistor
- The control voltage - can be DC or AC - usually ranges from 3 to 32 V for the dc and 80 to 280 V for the ac.
- Maximum load circuit amps of up to 50 A

Optically coupled SSR



- Advantages:
  - more reliable
  - has a longer life because it has no moving parts.
  - compatible with transistor and IC circuitry
  - does not generate as much electromagnetic interference.
  - more resistant to shock and vibration,
  - has a much faster response time,
  - does not exhibit contact bounce.
- Disadvantages:
  - Contains semiconductors that are susceptible to damage from voltage and current spikes.
  - Unlike the EMR contacts, the SSR switching semiconductor has a significant ON-state resistance and OFF-state leakage current.

Thank You