Power Electronics in Electrical Motors Controls

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# Motor Types

- ## AC motor

  driven by single-phase or three-phase commercial AC

- ## DC motor

  driven by DC (batteries or AC/DC converters)

- ## Precision motor

  electronically controlled stepping motors (hybrid or variable-reluctance or permanent-magnet)
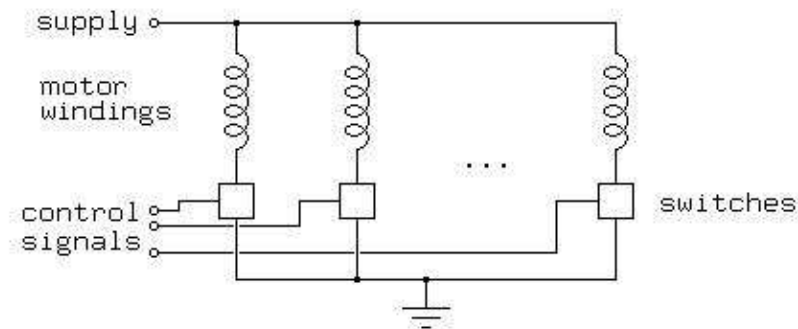
Comparison of Motors

- AC/DC motors ---- analog rotation
- Stepping motors ---- digital rotation
  1. <u>Hybrid</u>: small step length, high torque, position preserved during power failure
  2. <u>Variable-reluctance</u>: longer revolution (due to large step), faster acceleration (low inertial load due to no permanent-magnet in rotor)
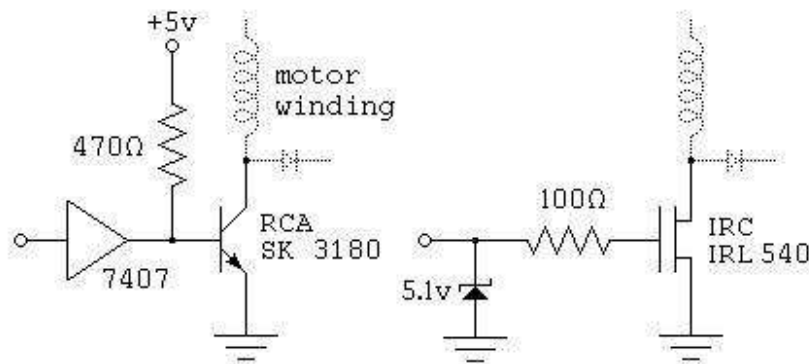
Motor Control
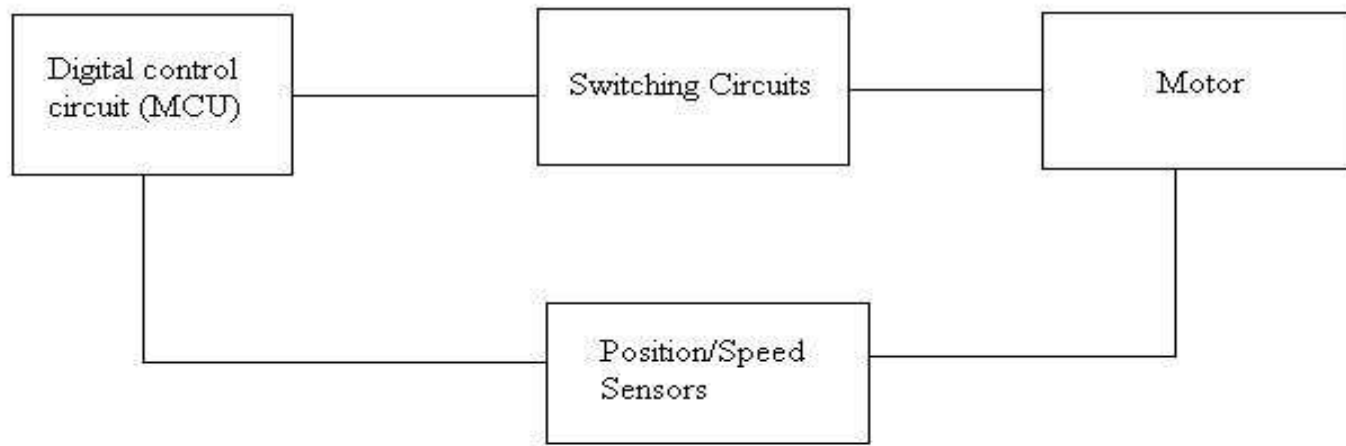
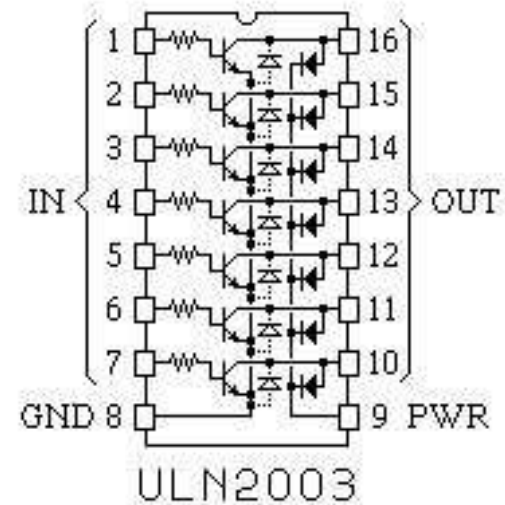# Switching Circuits
I. Unipolar motor control

Unipolar DC VR stepping
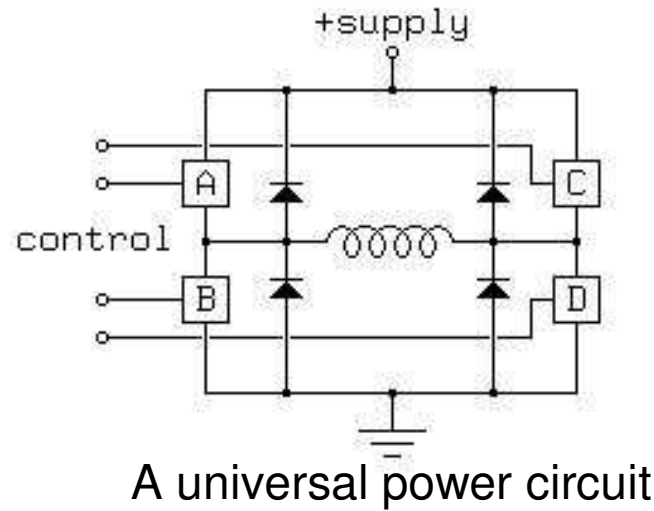
General control block

Switching circuits

Commercial chips

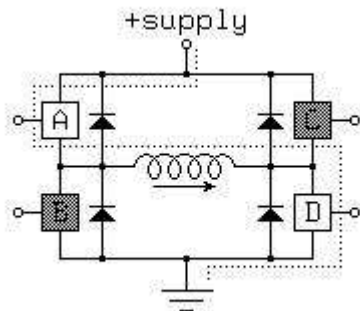# Switching Circuits
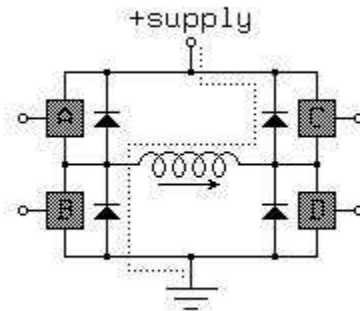# II. Bipolar motor control

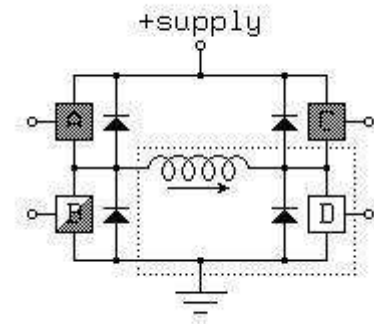
A universal power circuit

**Bipolar DC
Permanent-magnet
Hybrid Stepping**

XY ABCD Mode
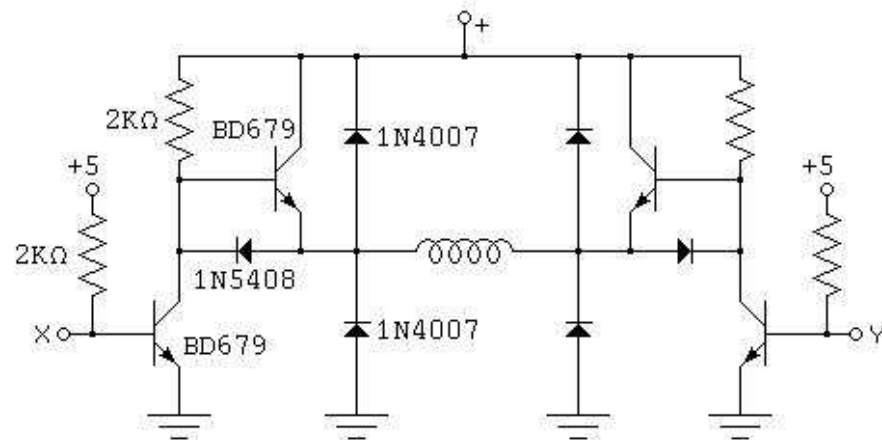01   1001 **forward**

XY ABCD   Mode
00   0000 fast decay

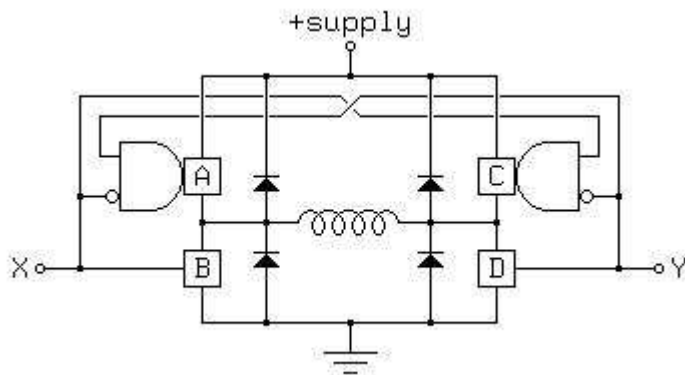**XY ABCD   Mode**
11   0101   slow decay

Switching Circuits
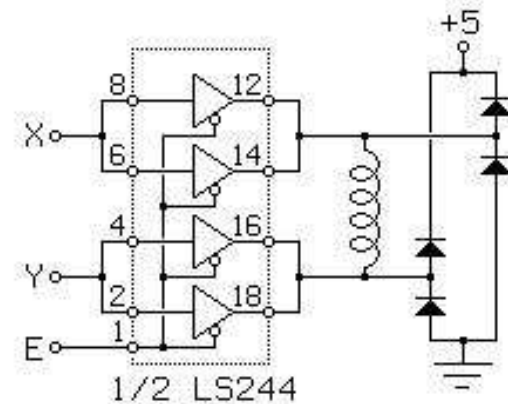# II. Bipolar motor control

74LS125A/ 74LS244
TC4467 18V/250mA
L293 36V/1A
LMD18200 3A
IR2104 high V, I
TC4467 CMOS

A practical bipolar switching circuit
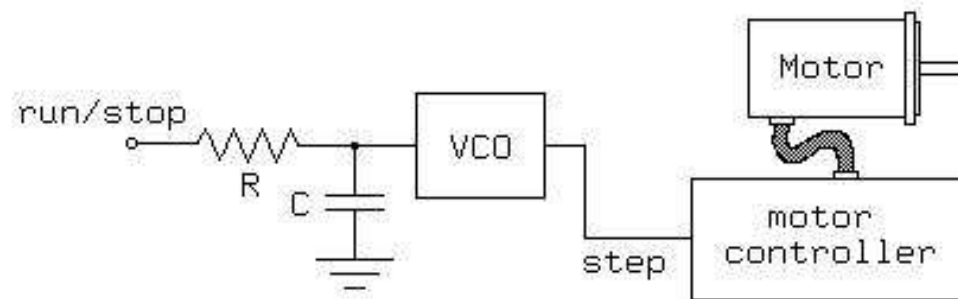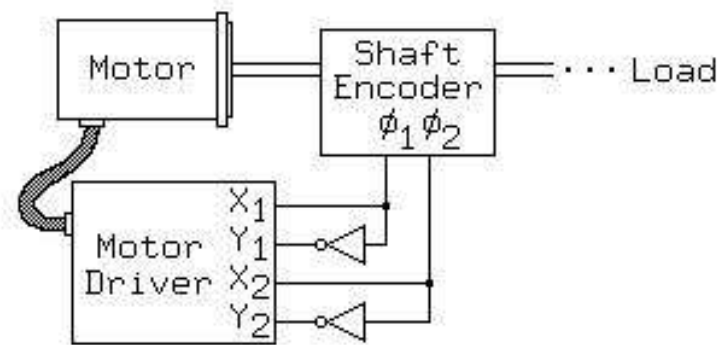
A simple circuit with digital coding gate

Commercial chips

Device Selection

- ## BJT
  require high base drive power

- ## Darlington

  high current gain

- ## MOSFET

  negligible drive power

- ## IGBT

  high voltage high current case

Digital Control
Open loop or close loop?

Reference

- Control of Stepping Motors

  http://www.cs.uiowa.edu/~jones/step/

- Electric Motors and their Controls

  by Tak Kenjo, Oxford Science Publications

- Stepping Motors a guide to theory and practice

  by Paul Acarnley, 4th edition, IEE

- Foundations of Electric Power

  by J.R.Cogdell, Prentice Hall