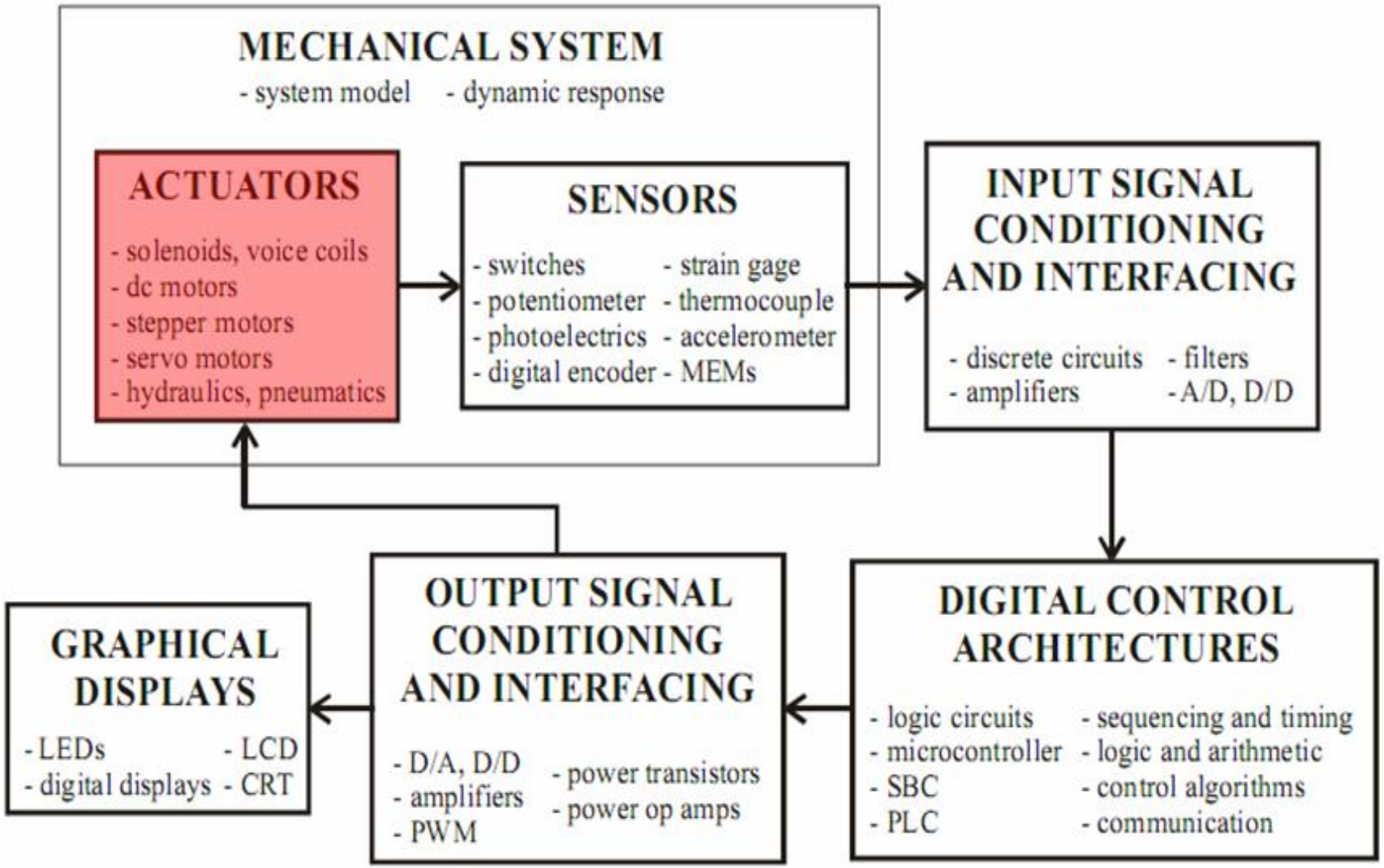
CONTROL ACTUATORS and SENSOR IN ROBOT

Actuators


MECHANICAL SYSTEM
- system model
- dynamic response
ACTUATORS
- solenoids, voice coils
- dc motors
- stepper motors
- servo motors
- hydraulics, pneumatics
SENSORS
- switches
- potentiometer
- photoelectrics
- digital encoder
- strain gage
- thermocouple
- accelerometer
- MEMs
INPUT SIGNAL CONDITIONING AND INTERFACING
- discrete circuits
- amplifiers
- filters
- A/D, D/D
DIGITAL CONTROL ARCHITECTURES
- logic circuits
- microcontroller
- SBC
- PLC
- sequencing and timing
- logic and arithmetic
- control algorithms
- communication
OUTPUT SIGNAL CONDITIONING AND INTERFACING
- D/A, D/D
- amplifiers
- PWM
- power transistors
- power op amps
GRAPHICAL DISPLAYS
- LEDs
- digital displays
- LCD
- CRT

Electric Motor

Các Nguyên Tắc Chọn Lựa Động Cơ Thích Hợp:

- Power required: năng lương tiêu tốn.
- Available voltage: điện áp thích hợp
- Output speed required: tốc độ yêu cầu.
- Operating temperature : nhiệt độ làm việc.

Electric-motor

Stepper Motor : động cơ bước.

DC Motor:động cơ điện 1 chiều.

DC servo Motor:động cơ servo.

RC servo motor: động cơ RC servo

Brusless Motor: động cơ không chổi than.

AC motor: động cơ xoay chiều.

AC sevo motor: động cơ xoay chiềuservo.

Stepper Motor

- Động cơ bước: là động cơ điện đồng bộ có thể cung cấp chuyển động quay thông qua một số lớn bước(xung) .

- Vị trí chính xác của động cơ có thể được điều khiển chính xác mà không cần tín hiệu phản hồi.

Stepper Motor

Classification :

- Cấu trúc :
  - Permanent Stepper.
  - Hybrid Synchronous Stepper.
  - Variable Reluctance Stepper.
- Cách đấu dây :
  - Đơn cực.
  - Song cực
- Pha : số cuộn dây của stator.
  - 2-phase: 6 dây, 4 dây tín hiệu ra: uniolar, bipolar.
  - 3-phase.
  - 5-phase.

Stepper Motor

* **Vận tốc :**

Tốc độ đáp ứng của động cơ bước phụ thuộc vào thế của xung điện kích ,muốn động cơ đáp ứng nhanh ta phải cấp xung điện thế cao hơn.Tuy nhiện để bảo vệ động cơ chúng ta nên cấp thế đúng như nhà sản xuất quy định.

Momen :

$$T_i = I(\omega/t)\pi\ \theta\ K$$

I = **quán tính của tải** g-cm2

ω = **tốc độ bước bước/S**

t = thời gian được tính bằng giây

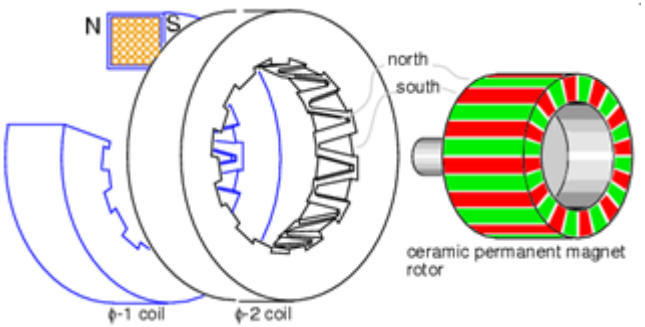
θ = **góc bước được tính bằng độ**

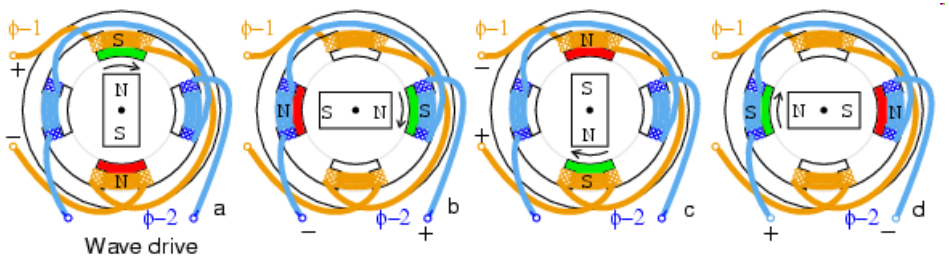
K = 97.73

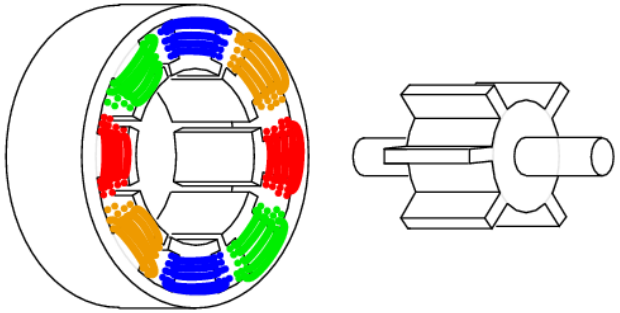
Tốc độ bước : ω**=1/(delay)**

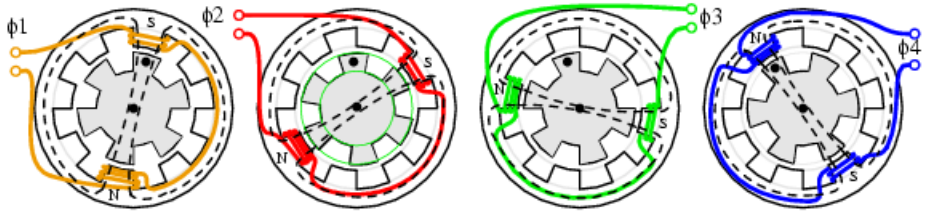
Với **delay** là thời gian trì hoãn giữa hai xung tính bằng giây

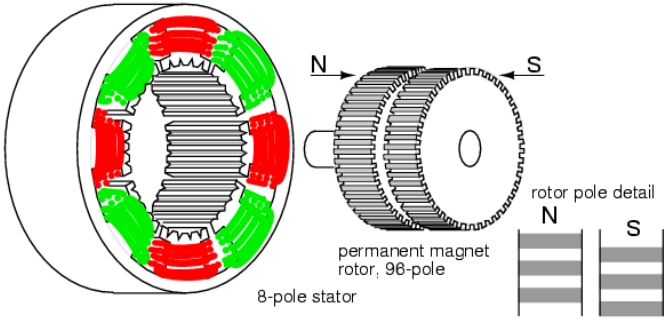
Stepper Motor

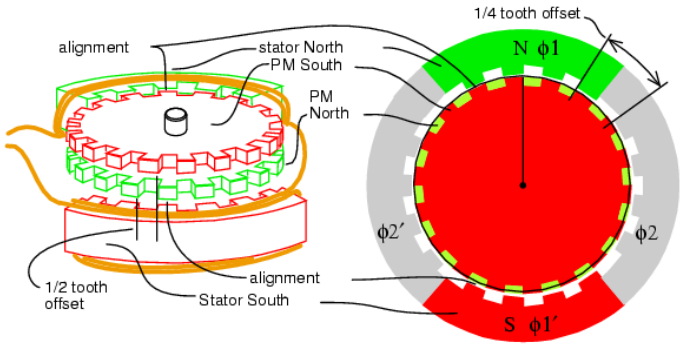




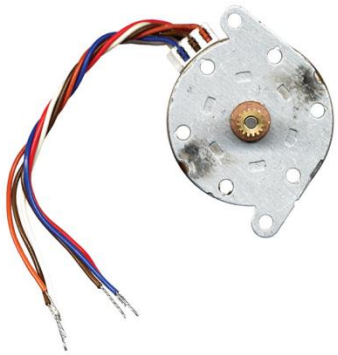


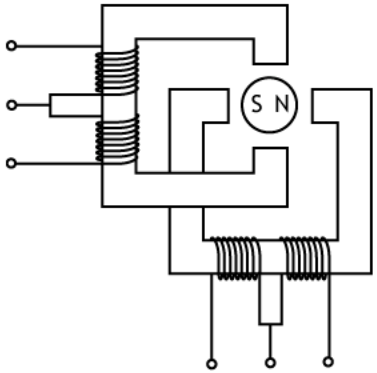


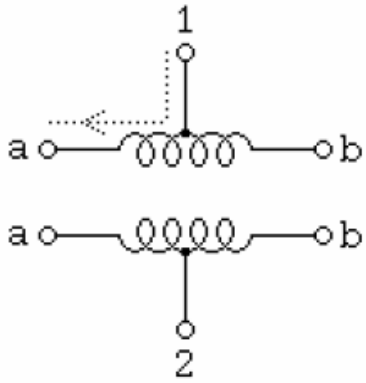


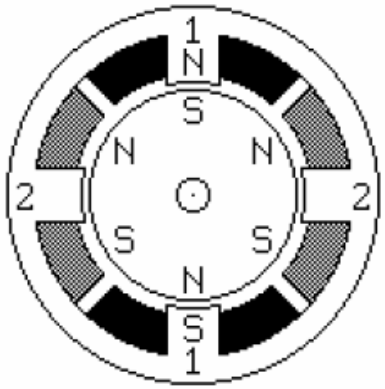


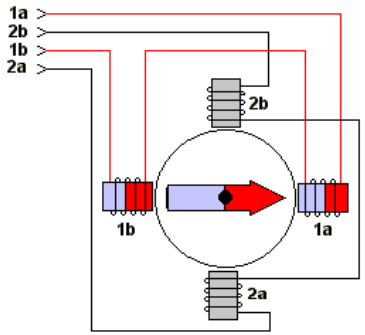
Stepper Motor



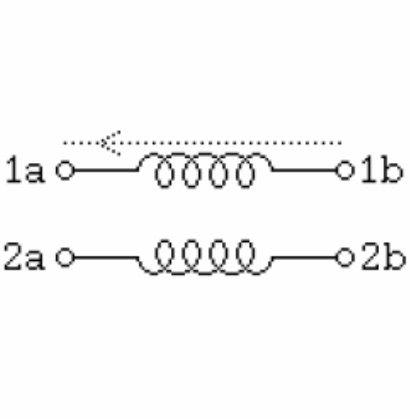


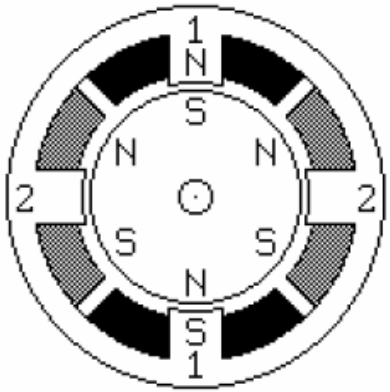




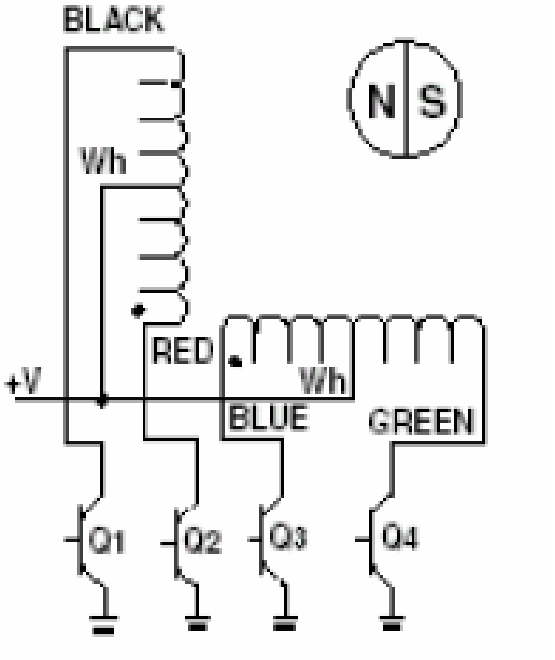


Conceptual Model of Bipolar Stepper Motor

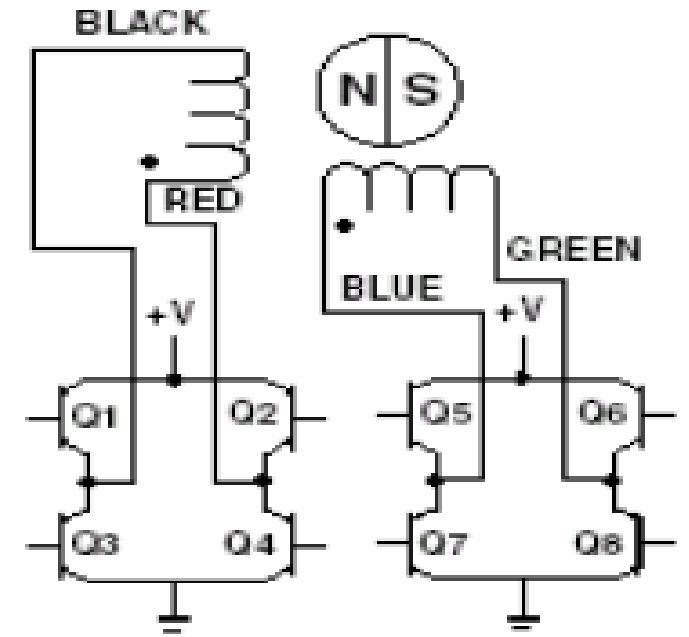




Stepper Motor

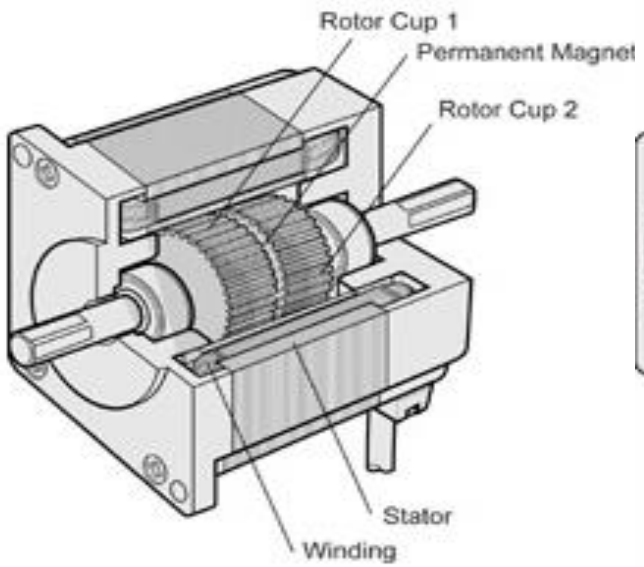


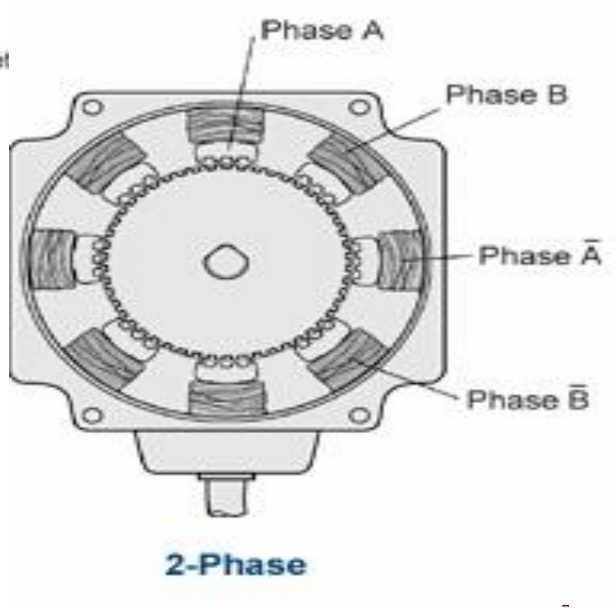
Unipolar Winding



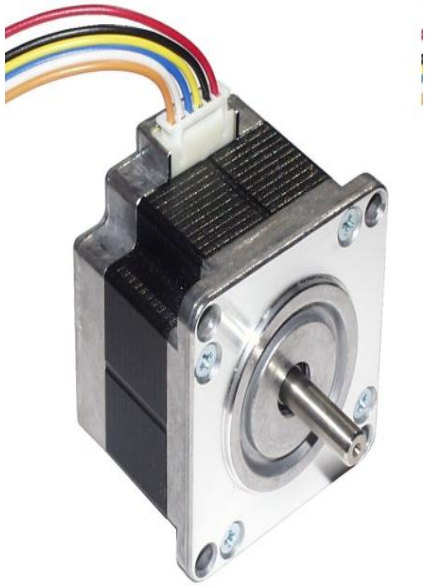
Bipolar Winding

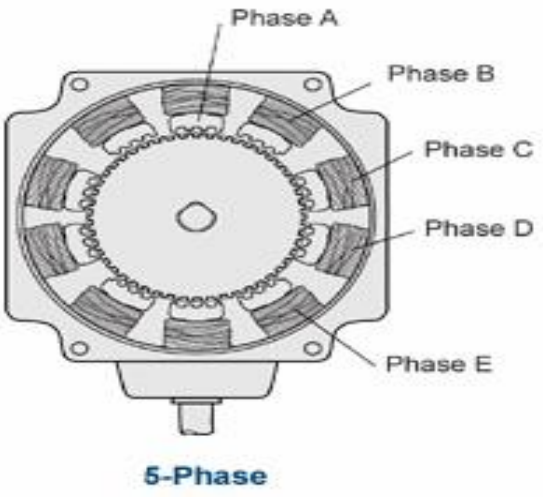
Stepper Motor



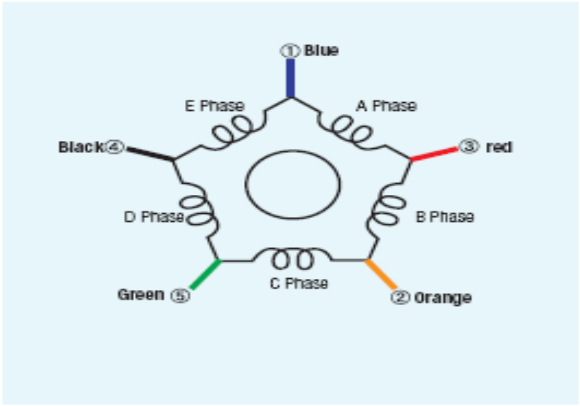


2-Phase





5-Phase

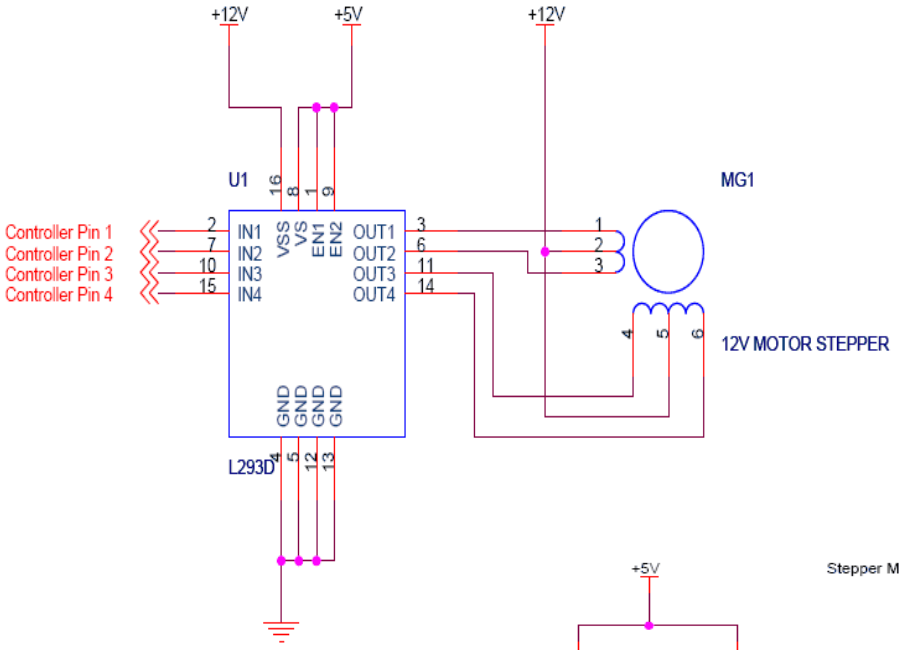


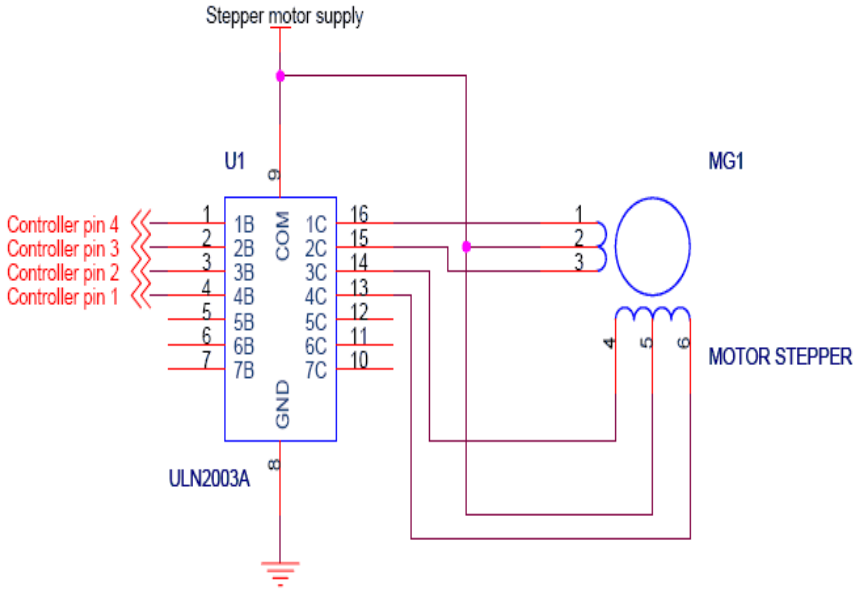
5 Leads (PMM, TS3664N17E4 Series)

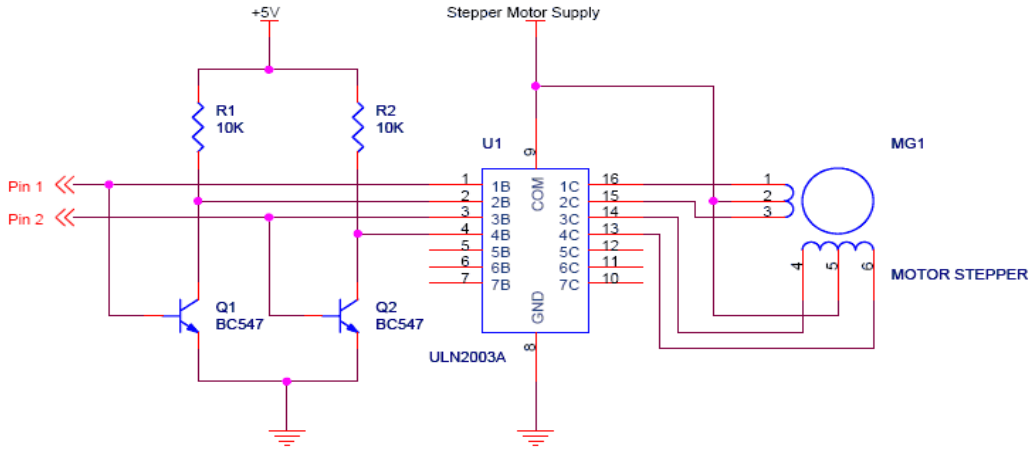
Stepper Motor

Kết nối :

- Đơn cực :



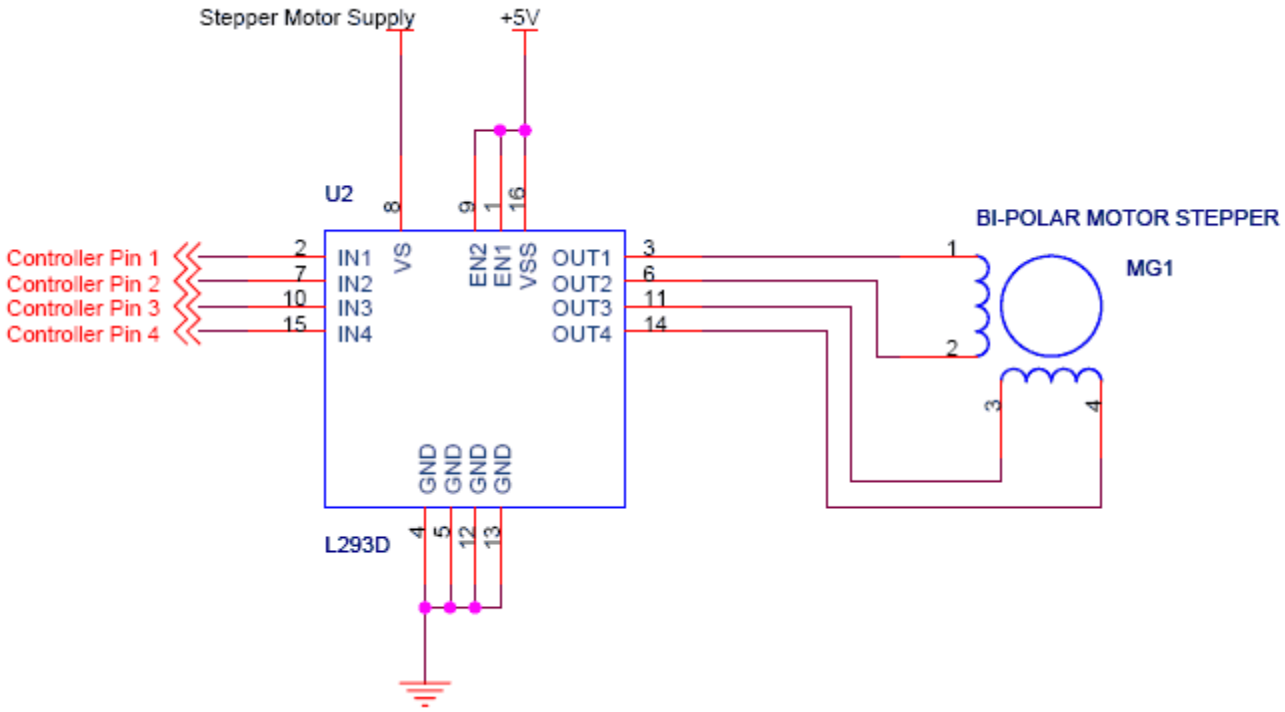




Stepper Motor

Kết nối :

- Lưỡng cực :

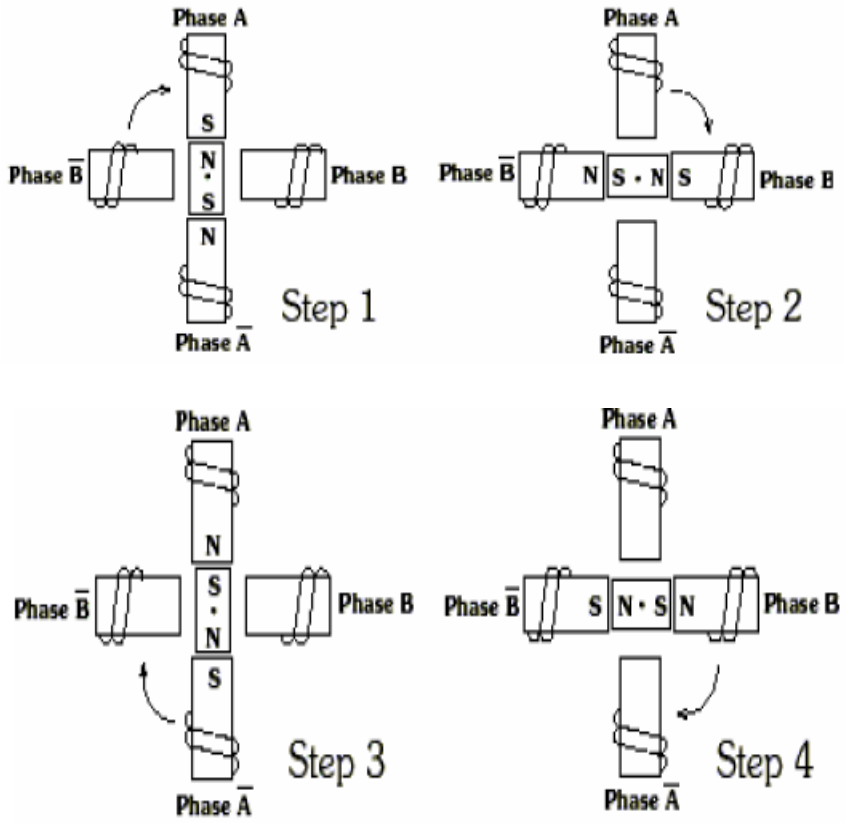


Phương pháp điều khiển :

- Điều khiển đủ bước.(Full Step).
- Điều khiển nửa bước (semi-step.)

Điều Khiển Đủ Bước- Full Step

Trong một thời điểm chỉ có một phase được kích dựa trên nguyên tắc từ trường quay.

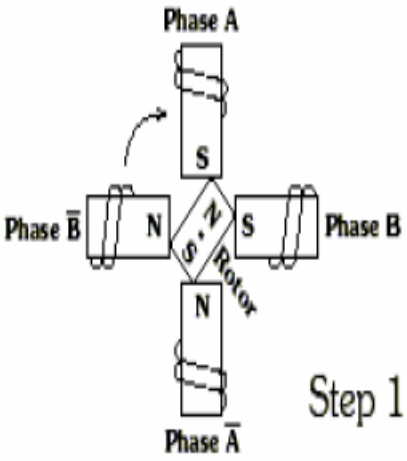


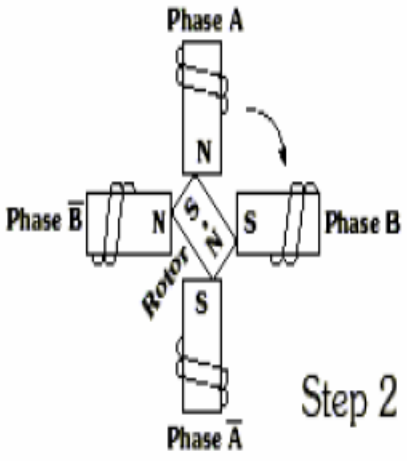
Kích một pha

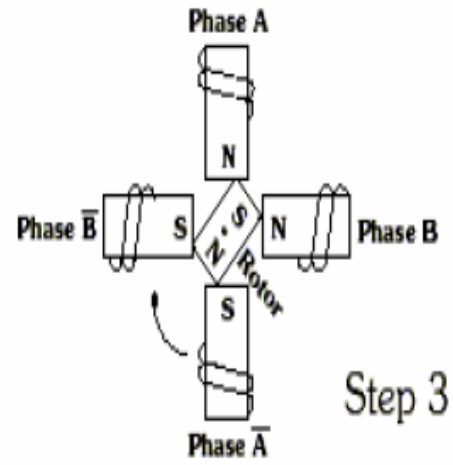
Unipolar Step	A	$\overline{A}$	B	$\overline{B}$
1	ON	OFF	OFF	OFF
2	OFF	OFF	ON	OFF
3	OFF	ON	OFF	OFF
4	OFF	OFF	OFF	ON
1	ON	OFF	OFF	OFF

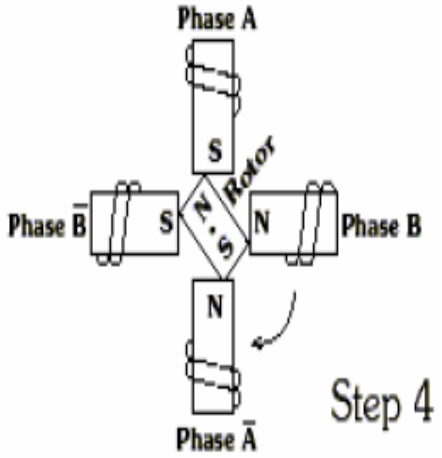
Điều Khiển Đủ Bước- Full Step

Kích 2 phase:





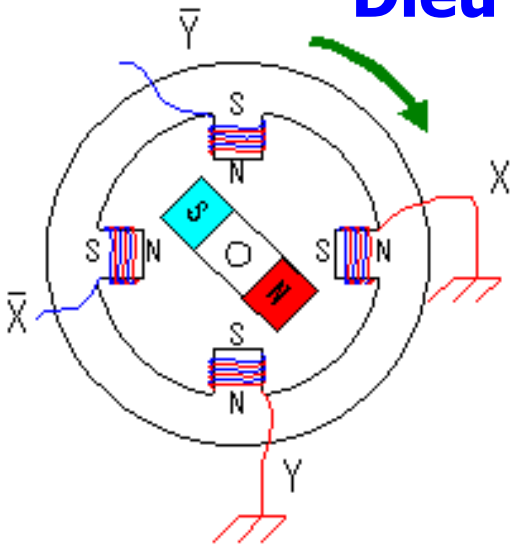




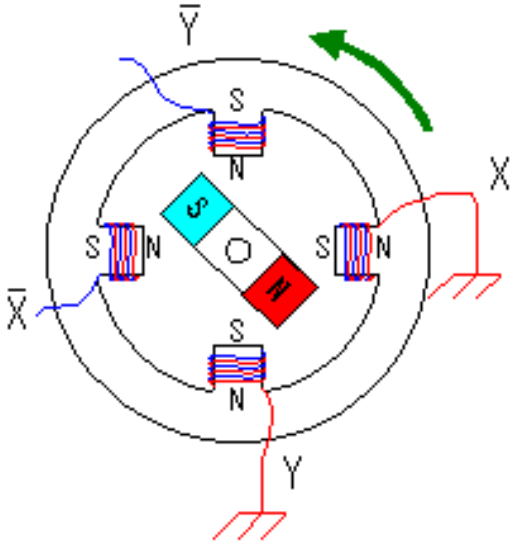
Công suất tăng gấp đôi, ngẫu lực tăng theo.

Unipolar Step	A	$\bar{A}$	B	$\bar{B}$
1	ON	OFF	ON	OFF
2	OFF	ON	ON	OFF
3	OFF	ON	OFF	ON
4	ON	OFF	OFF	ON
1	ON	OFF	ON	OFF

Điều Khiển Đủ Bước- Full Step

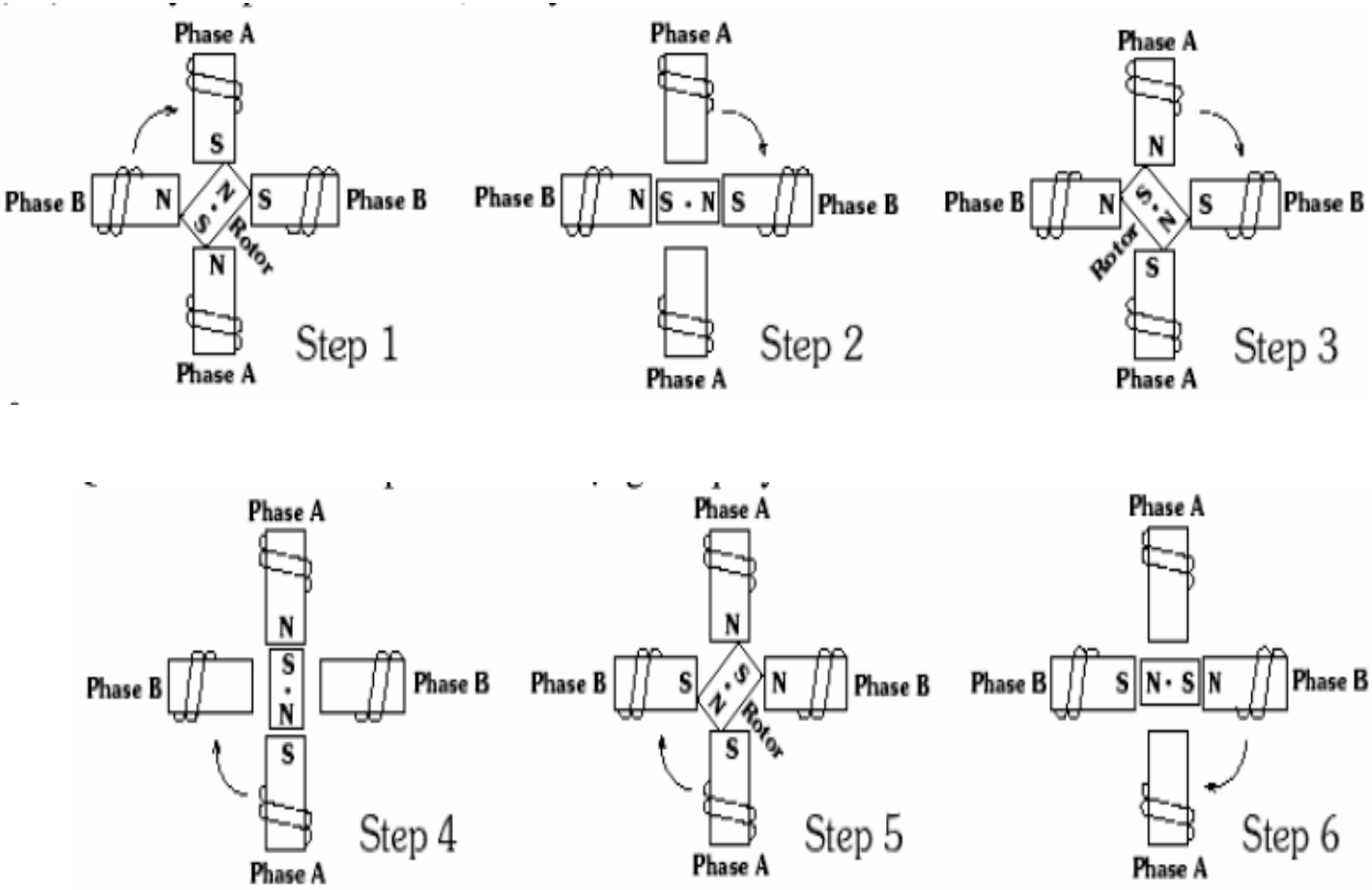


X	$\bar{X}$	Y	$\bar{Y}$
0	1	0	1
1	0	0	1
1	0	1	0
0	1	1	0



X	$\bar{X}$	Y	$\bar{Y}$
0	1	0	1
0	1	1	0
1	0	1	0
1	0	0	1

Haft-Step control.

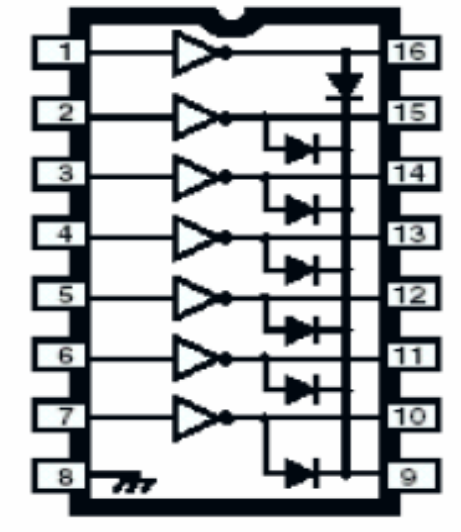


Haft Step Control

Unipolar Step	A	$\overline{A}$	B	$\overline{B}$
1	ON	OFF	ON	OFF
2	OFF	OFF	ON	OFF
3	OFF	ON	ON	OFF
4	OFF	ON	OFF	OFF
5	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON
7	ON	OFF	OFF	ON
8	ON	OFF	OFF	OFF

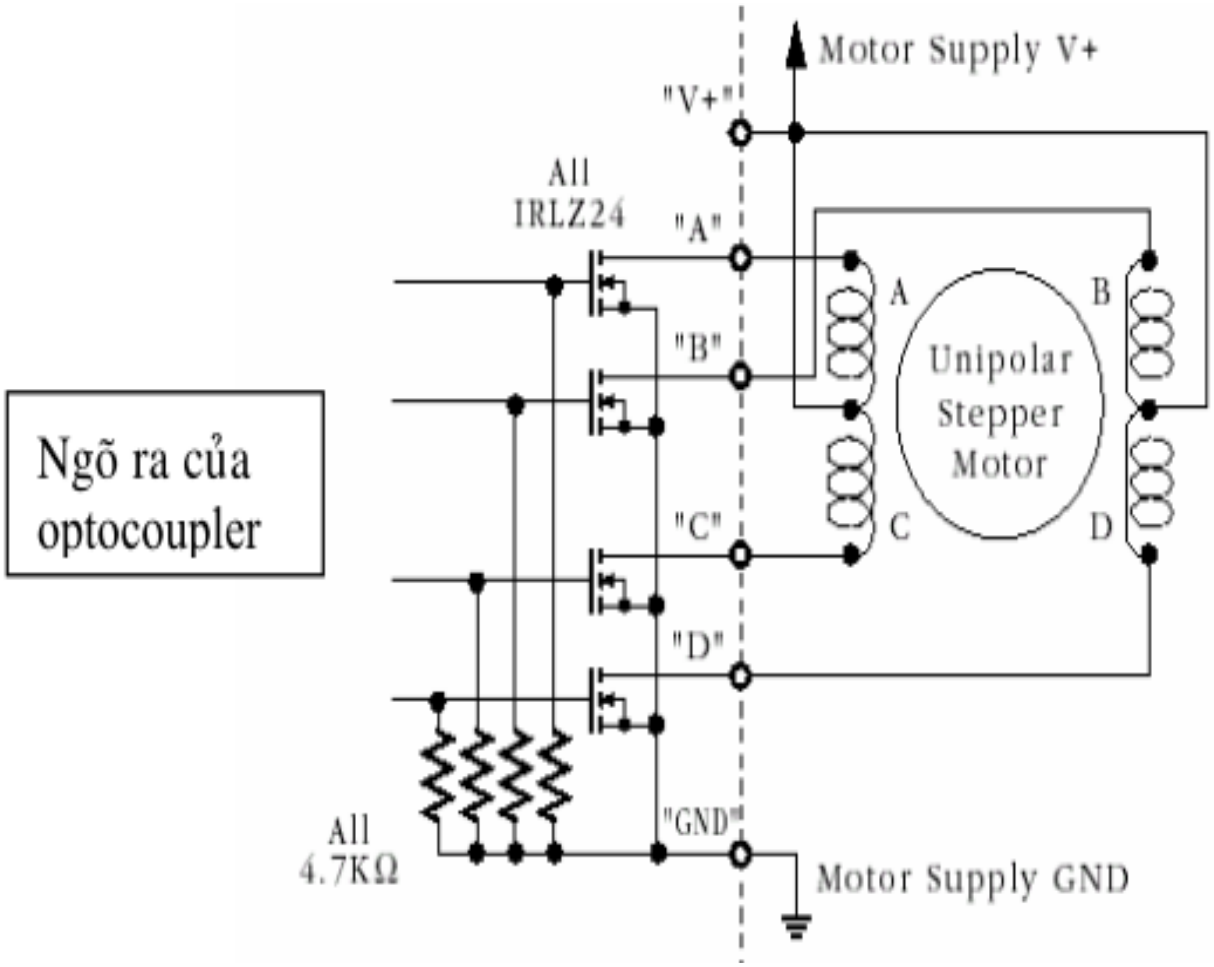
Mạch Công Suất

Công suất nhỏ : (<5W) : dùng IC ULN-2003, ULN-2004



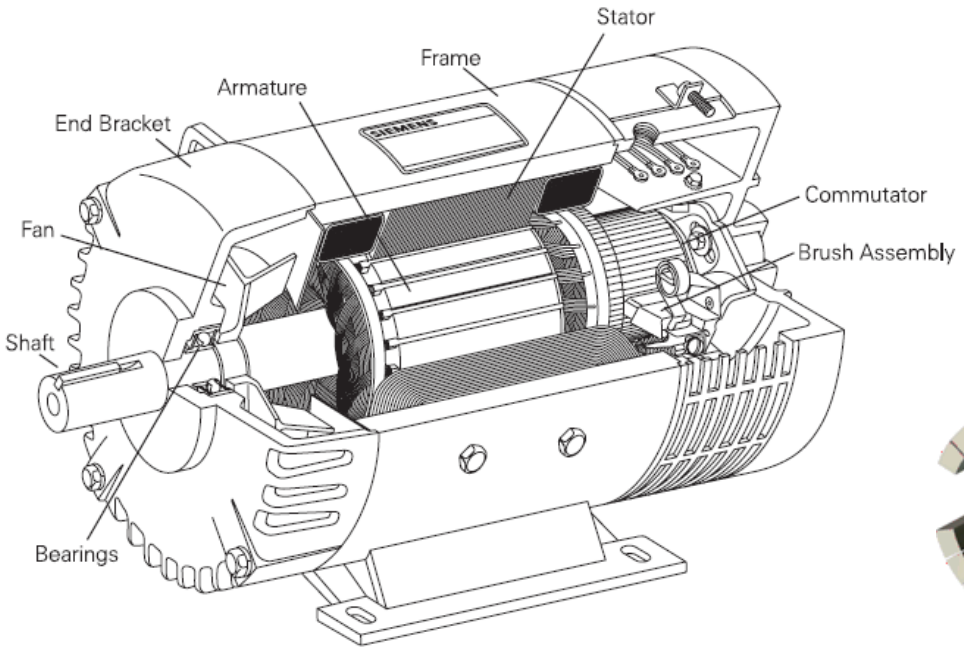
Có dòng kích là **25 mA**,dòng ra cực đại là **500mA**,điện thế ngõ ra có thể lên đến 50V.

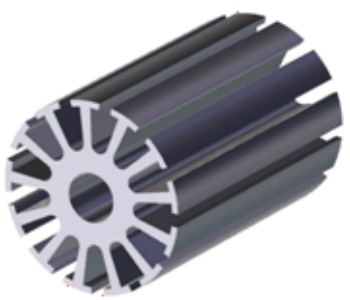
Công suất lớn : Dùng FET IRF840 + opto coupler

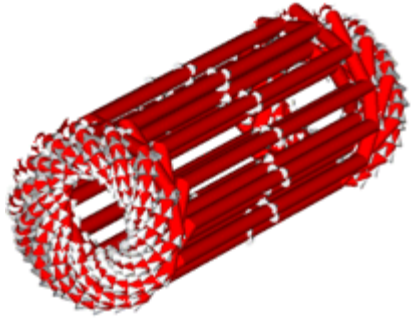


DC Motor

- Động cơ điện 1 chiều : hoạt động trên nguồn điện một chiều .
- Nguyên lý : dựa trên nguyên lý từ trường quay.

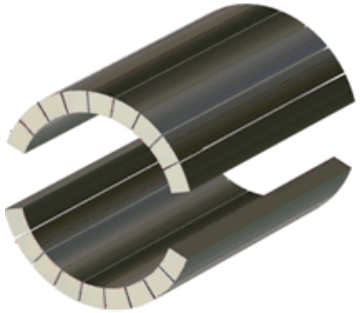


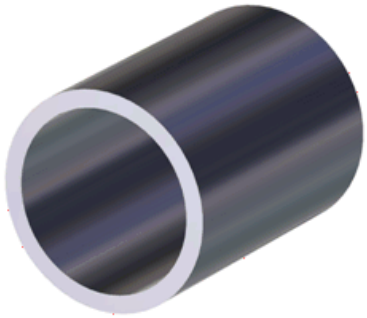




Rotor

Windings





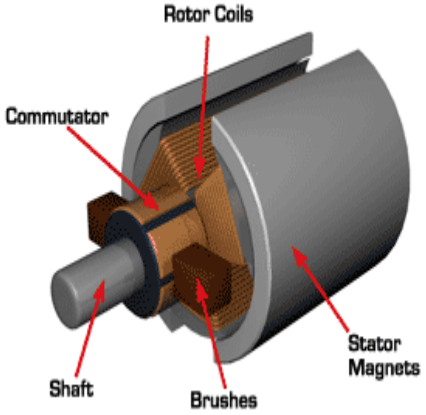
Permanent Magnets

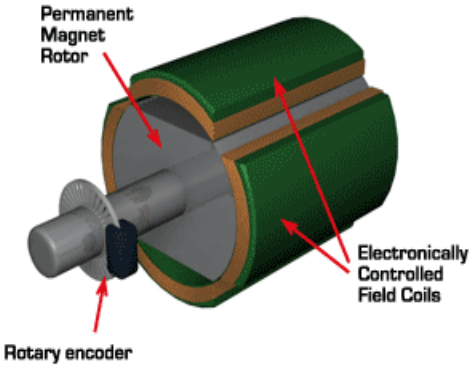
Stator

DC Motor

Phân Loại :

- Từ trường vĩnh cửu.
- Nối tiếp (cách mắc cuộn cảm ứng)
- song song
- Kết hợp .
- Không có chổi than.





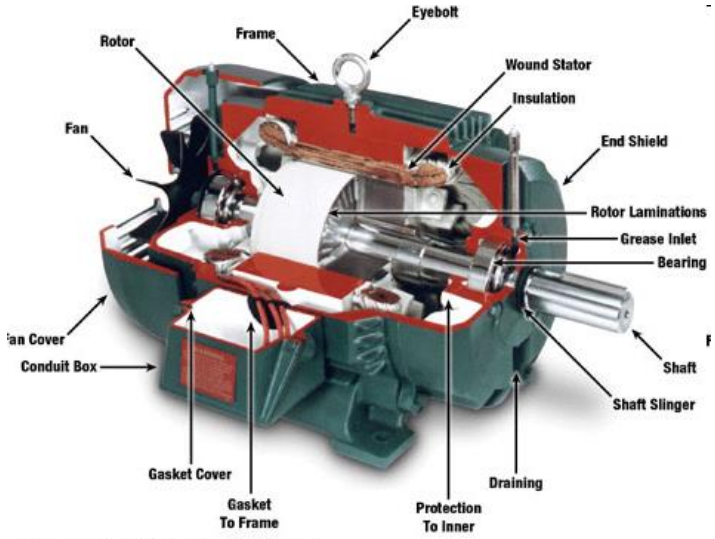
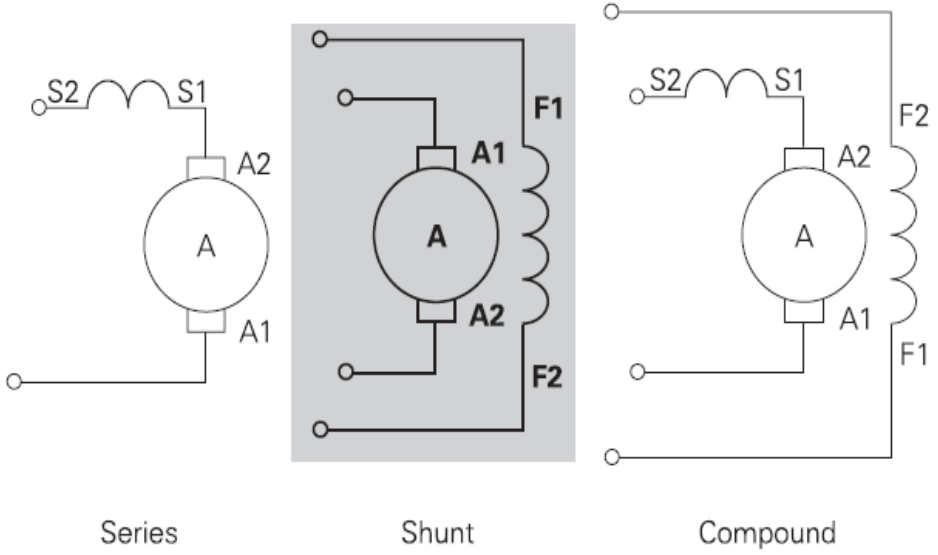
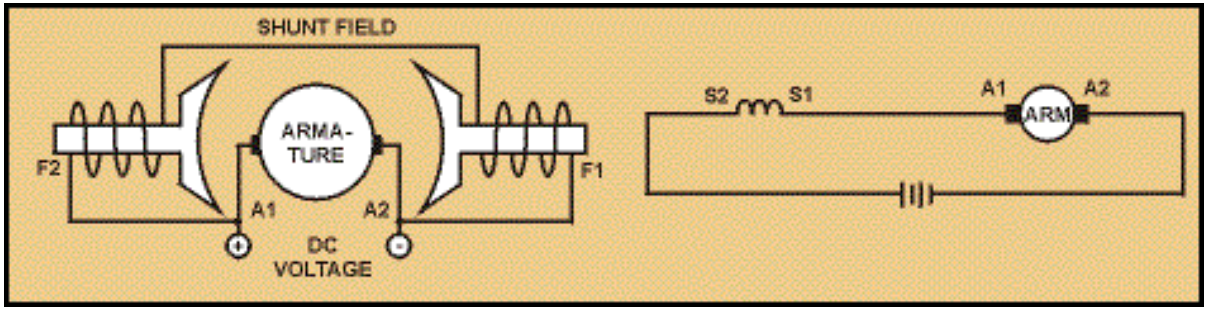


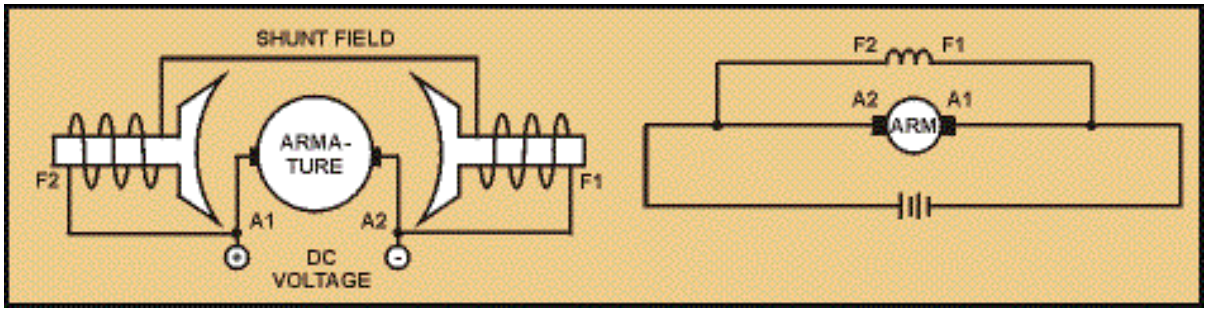
Figure 8 - Motor Construction



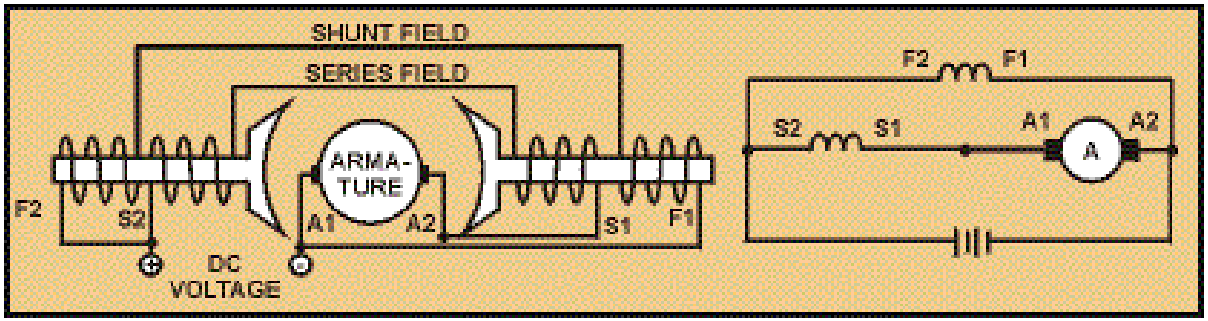
DC Motor



Series motor



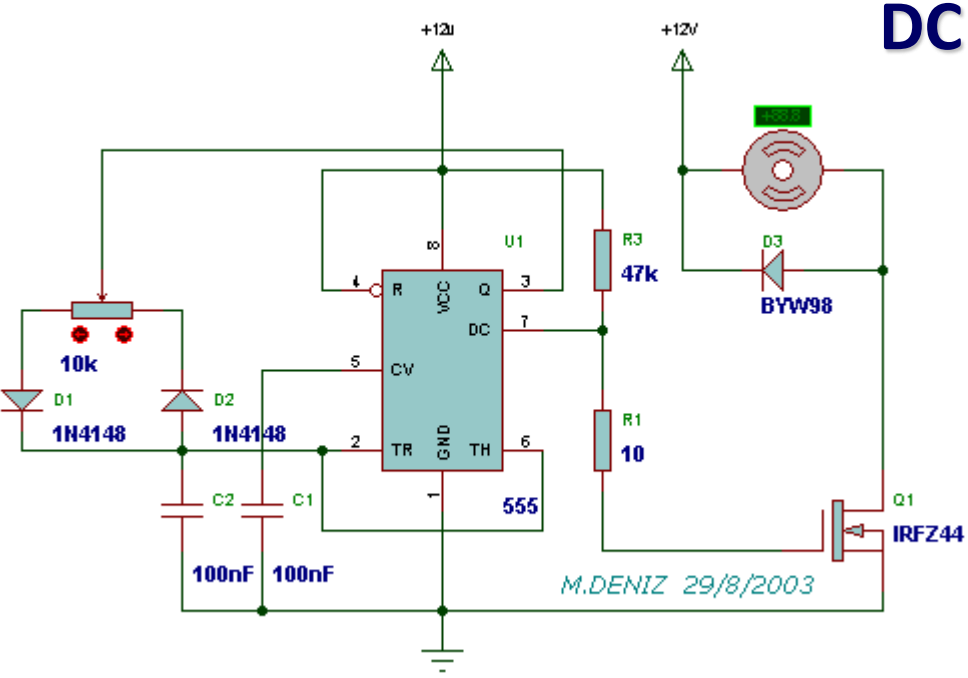
Shunt motor

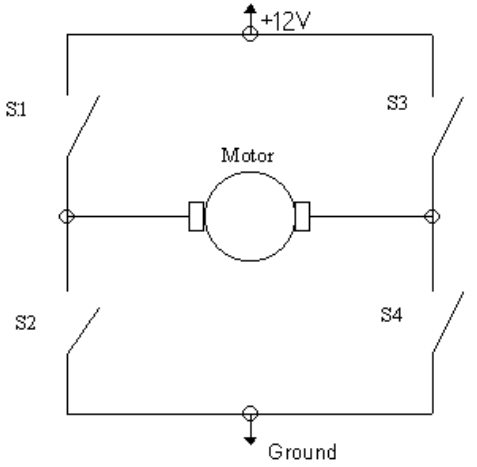


Compound motor

DC Motor

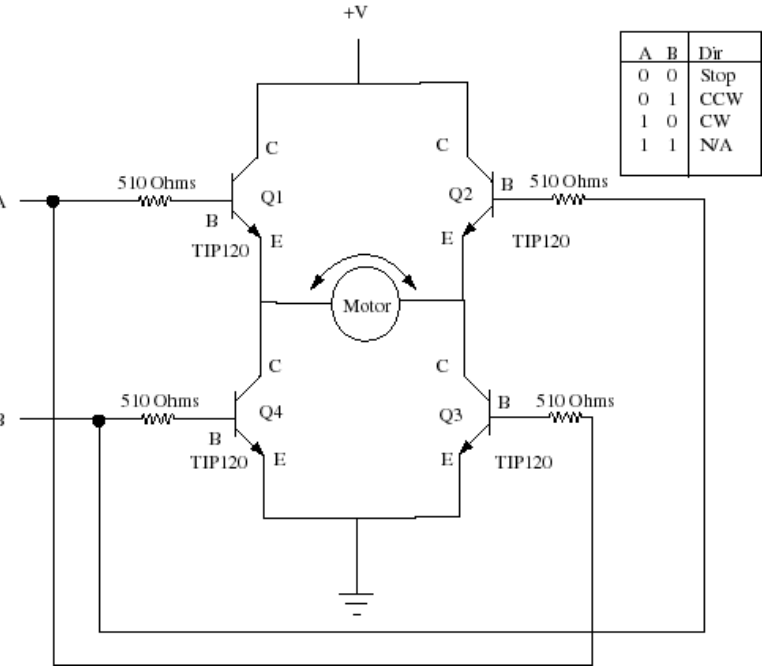
DC Motor



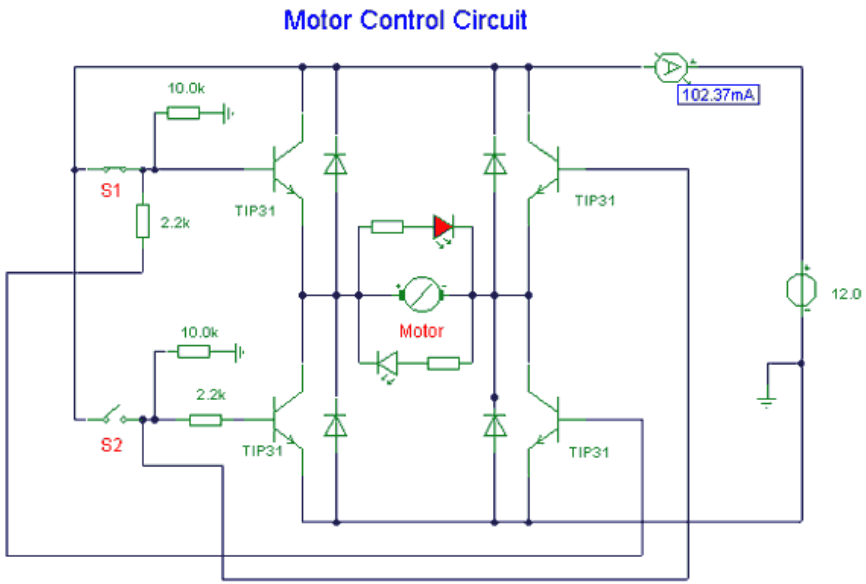


H-Bridge Switch

Switches Closed	Motor
S1 S3	Off
S2 S4	Off
S1 S4	Forward
S3 S2	Reverse



A	B	Dir
0	0	Stop
0	1	CCW
1	0	CW
1	1	N/A

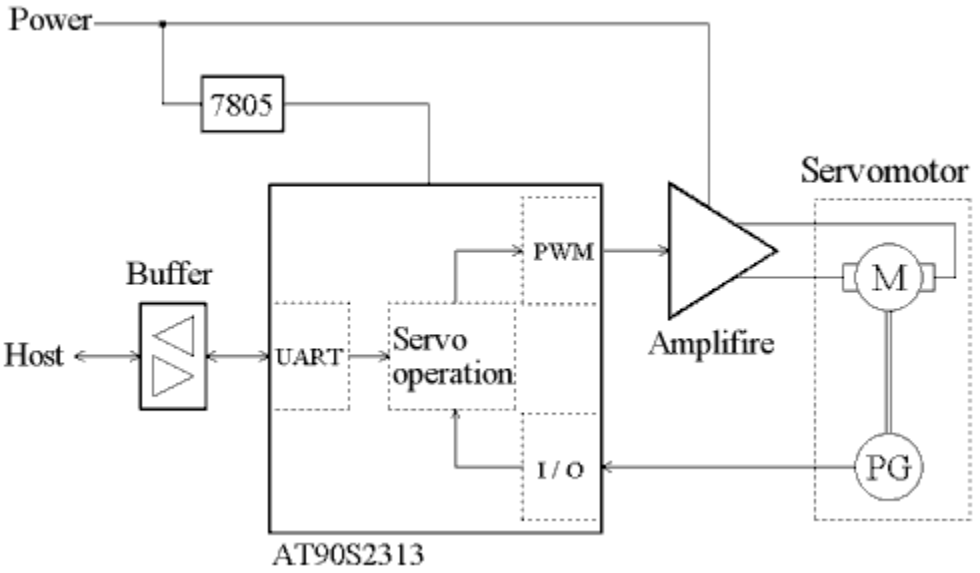


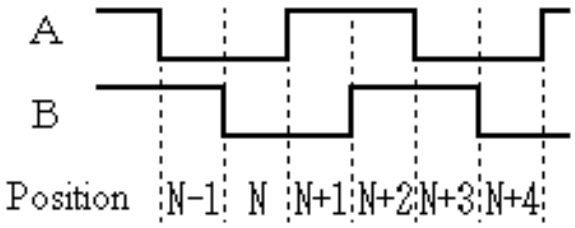
DC servo

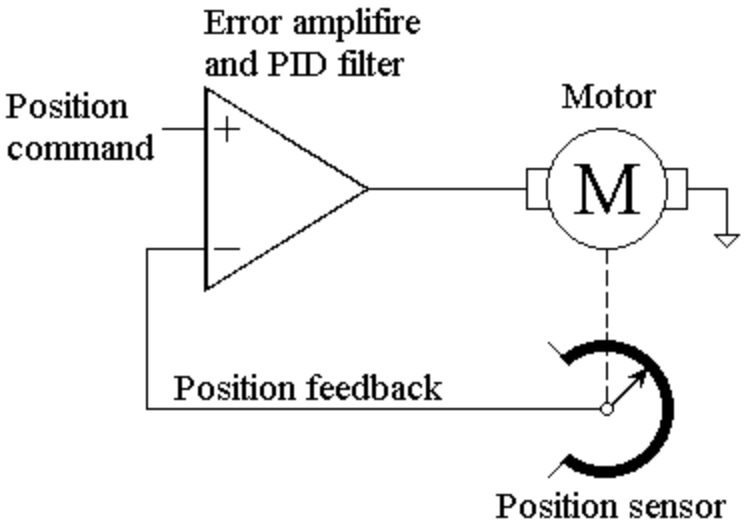

IN / OUT
SETUP


M1 V+
M1 +
GND
M1 −
M2 V+
M2 +
GND
M2 −
Made in USA
CH1
+5V
CH A
CH B
INDEX
GND
CH2
+5V
CH A
CH B
INDEX
GND
rtd
RTD Embedded Technologies, Inc.
©2004
www.rtd.com


DC servo

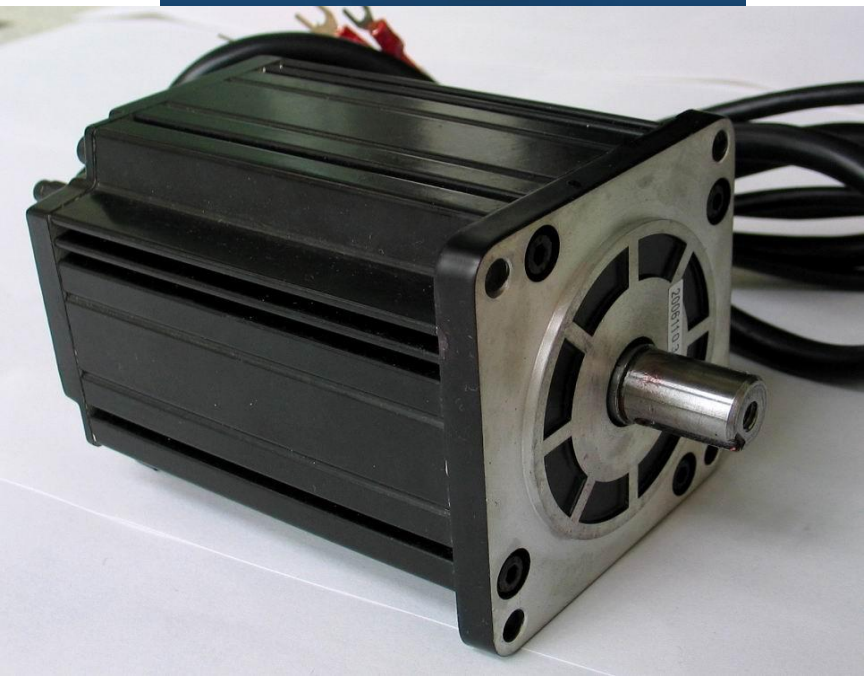

Power
7805
Servomotor
Buffer
PWM
M
Host
UART
Servo operation
Amplifire
I / O
PG
AT90S2313

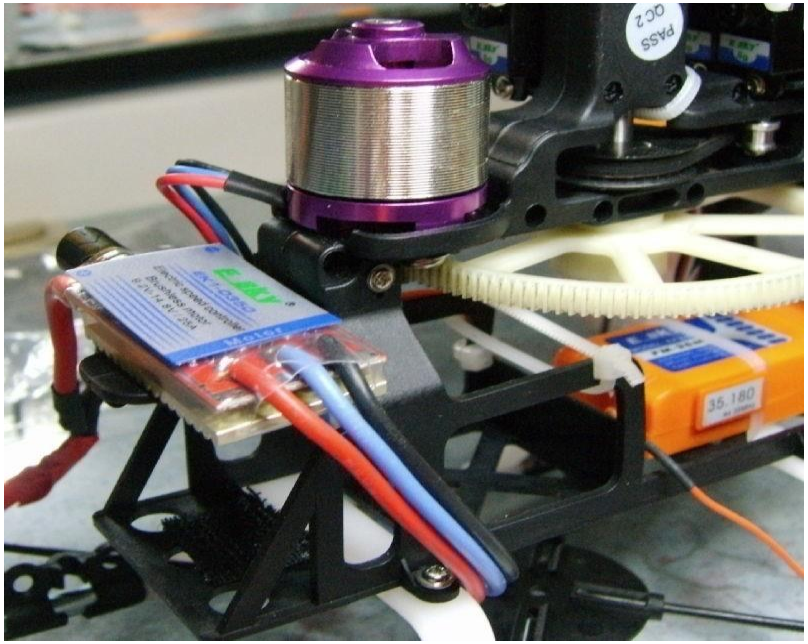

A
B
Position
N-1
N
N+1
N+2
N+3
N+4


Error amplifire
and PID filter
Position
command
Motor
M
Position feedback
Position sensor

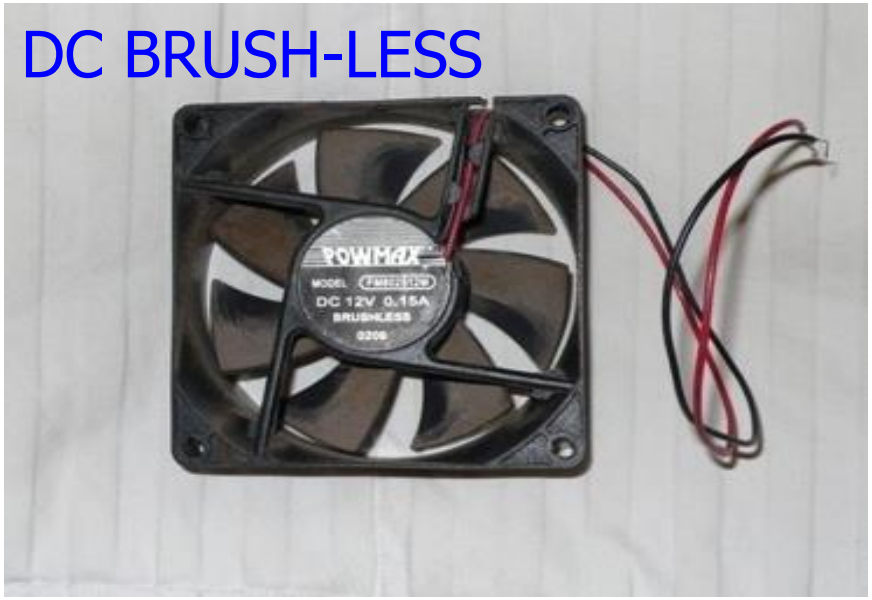

-432000

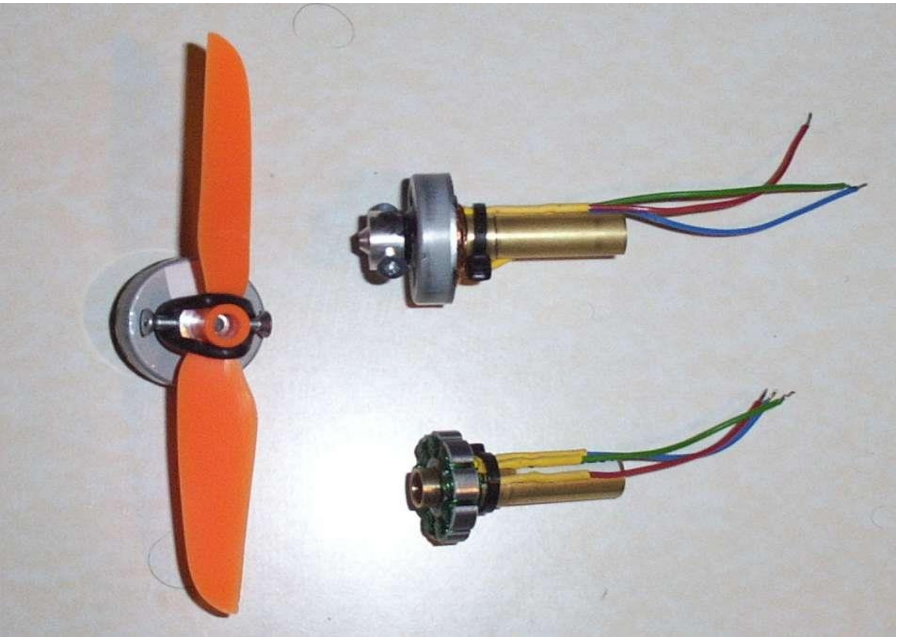
DC BRUSH-LESS

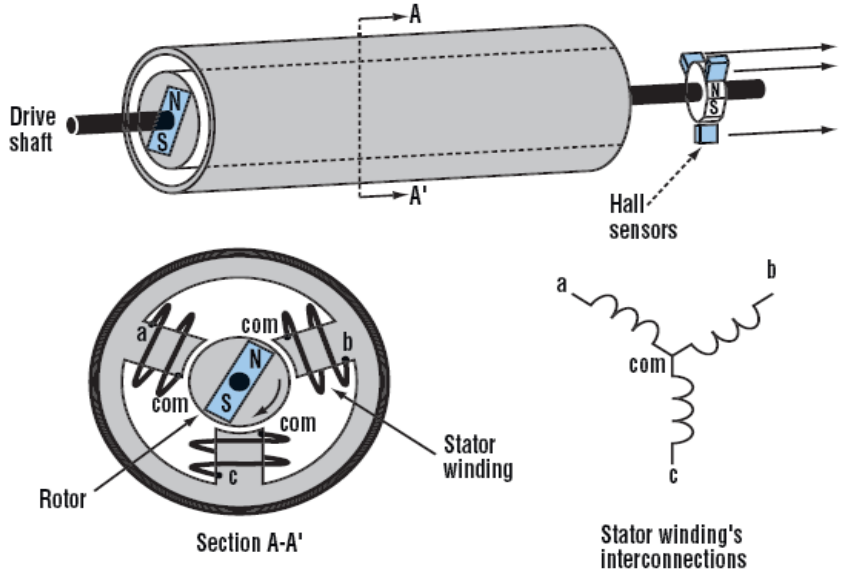




DC BRUSH-LESS

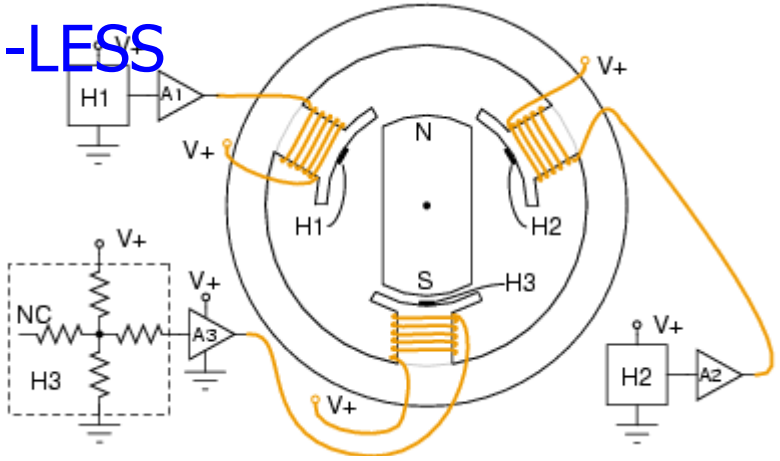


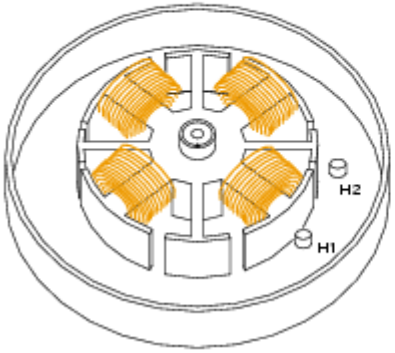


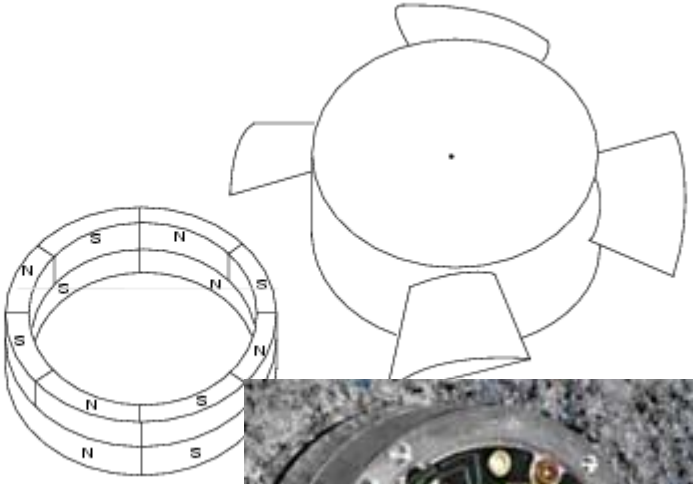


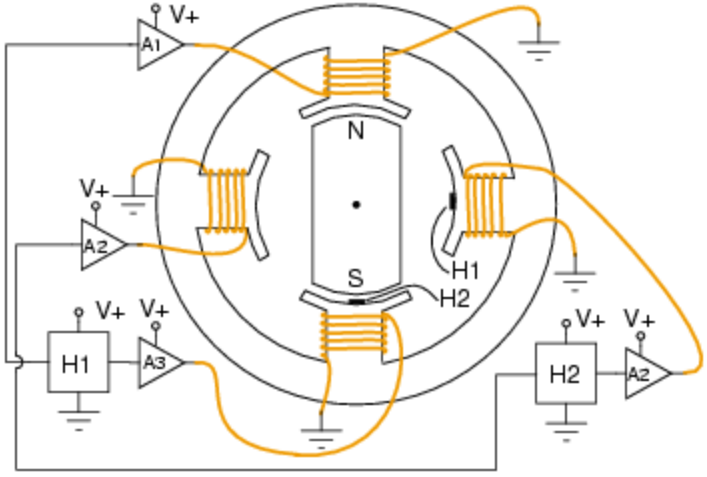
1. A brushless dc motor employs Hall sensors rather than the familiar brush-commutator configuration of a conventional dc motor with brushes.

DC BRUSH-LESS

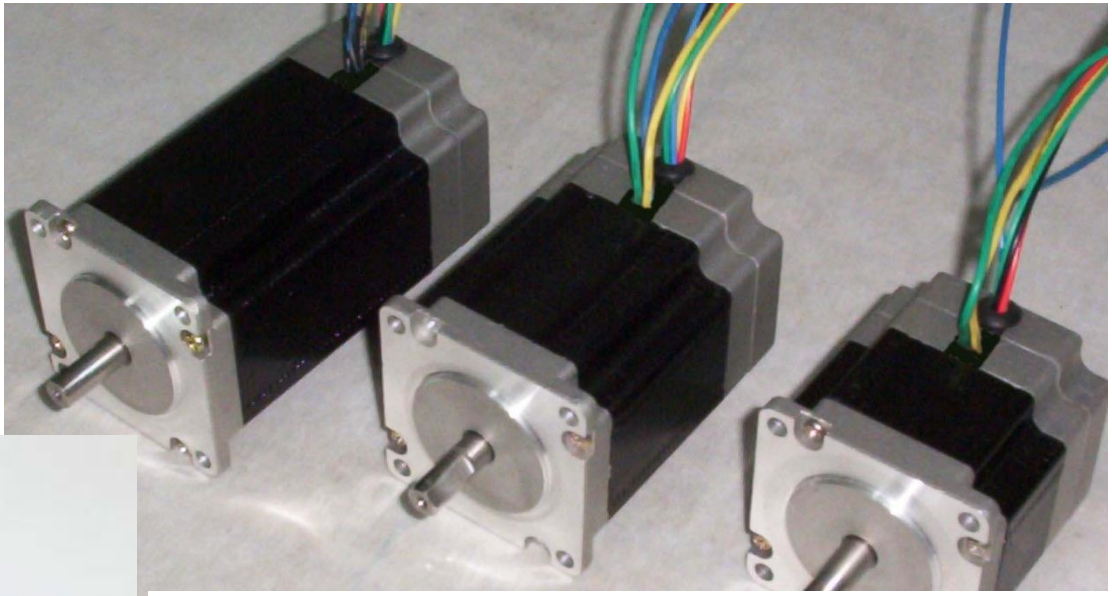




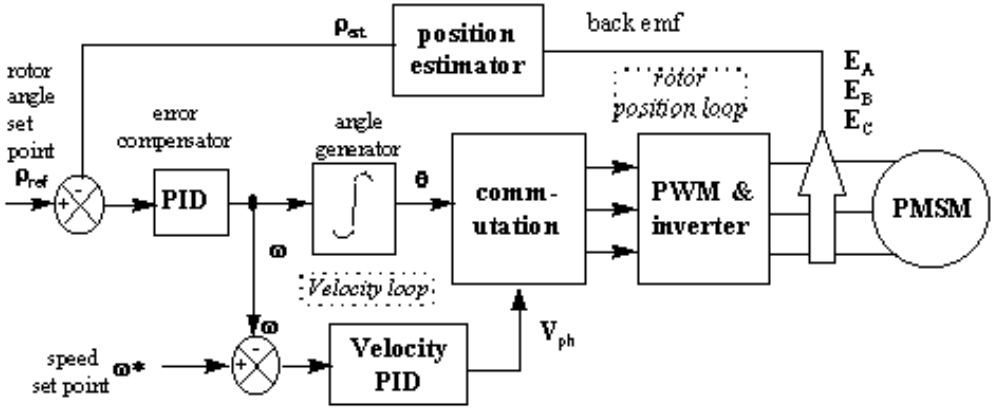




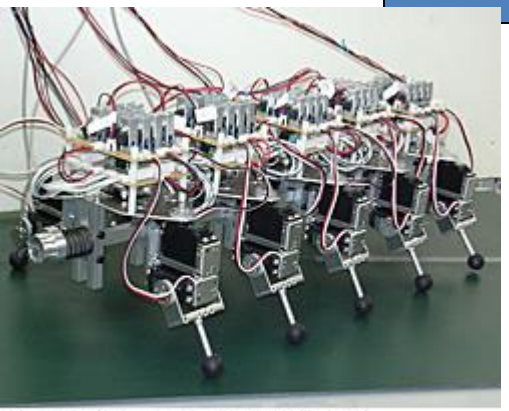
DC BRUSH-LESS



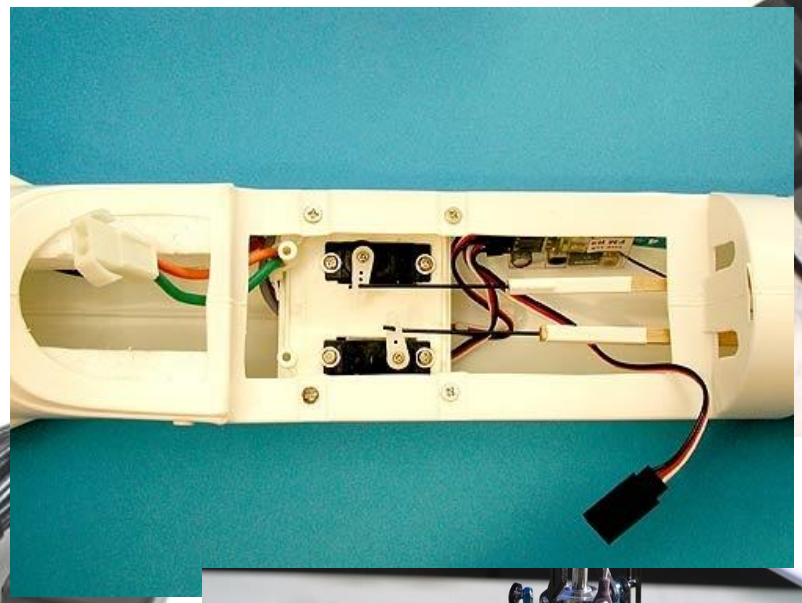
Atmel's ATAVRMC100 BLDC Motor Control kit includes a power module with an 8-bit AVR processor (AT90PWM3) suitable for deployment.

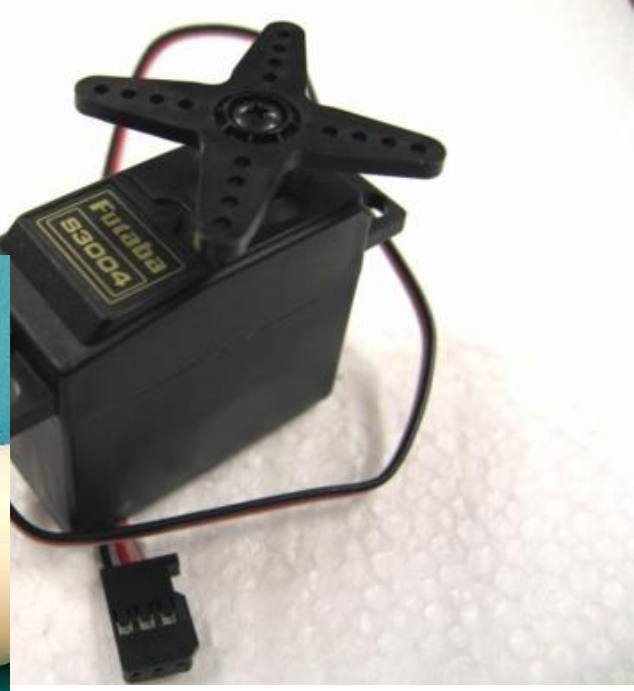


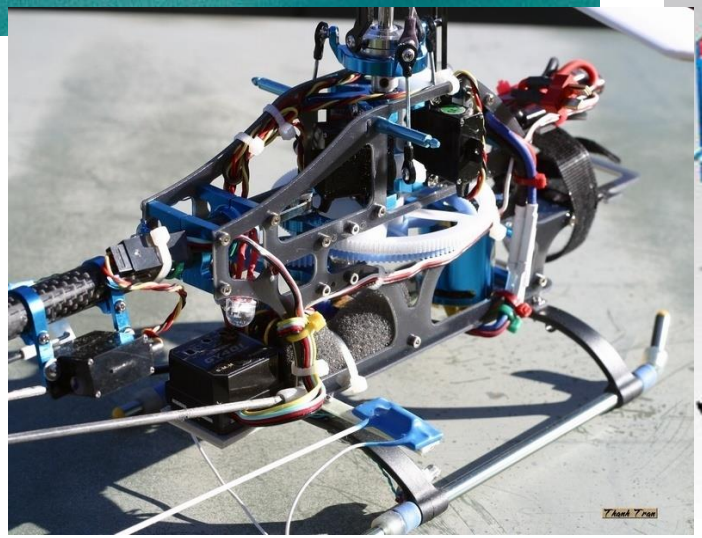
RC servo motor

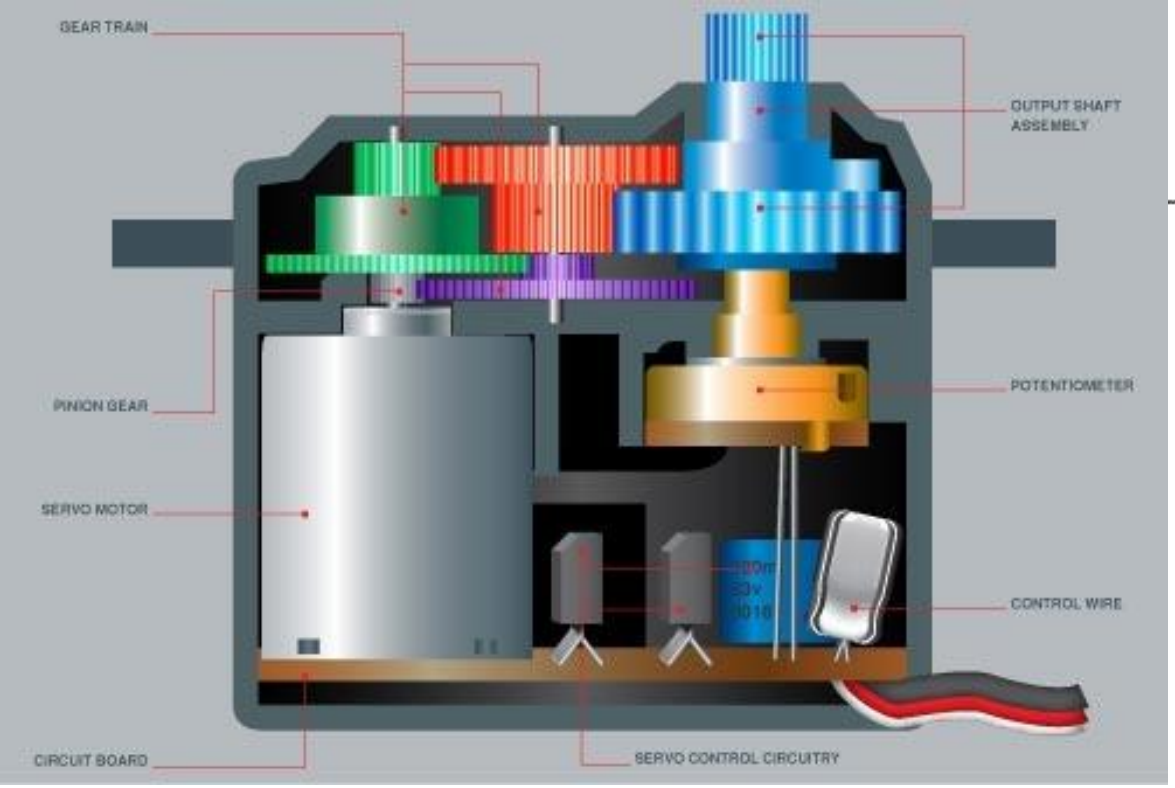


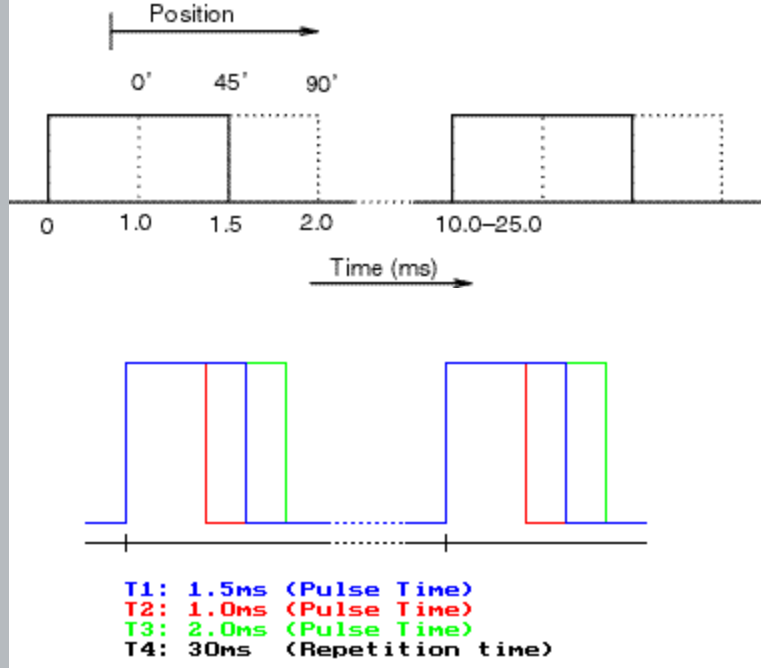
【写真】名古屋大学 石黒章夫助教授提供

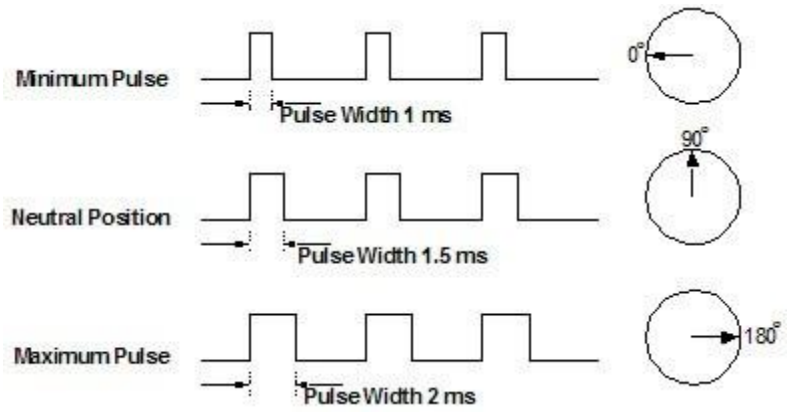


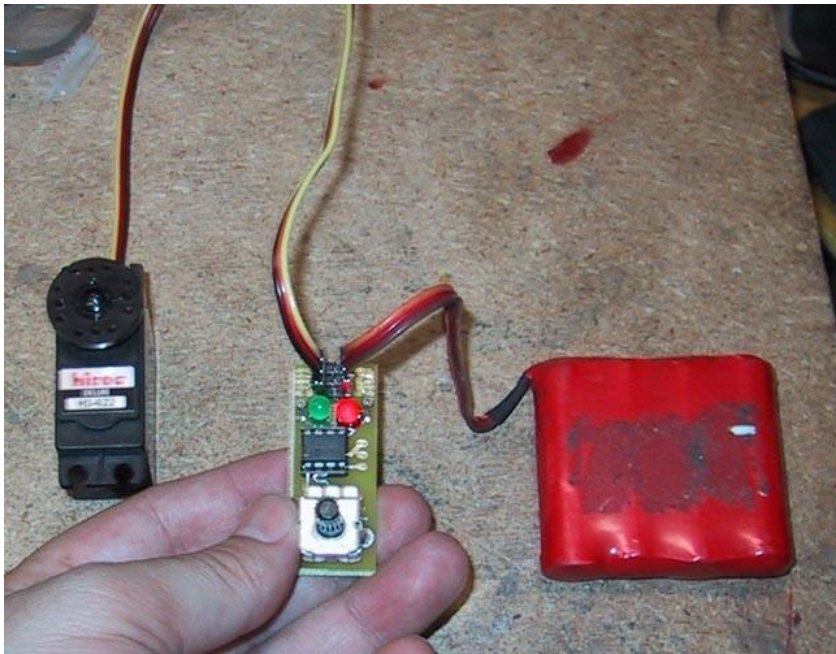




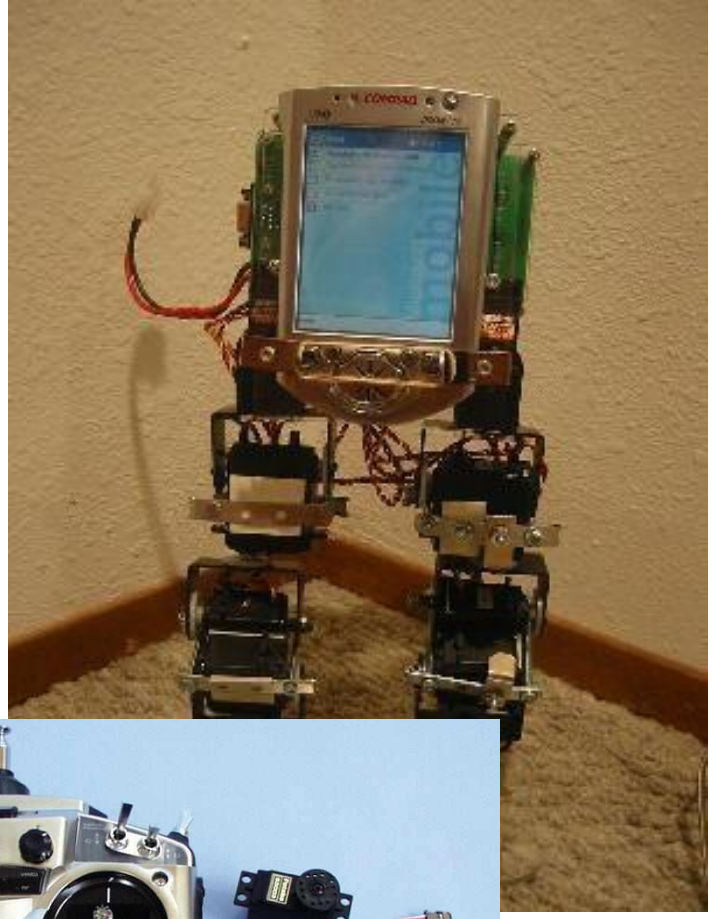

GEAR TRAIN
OUTPUT SHAFT ASSEMBLY
POTENTIOMETER
PINION GEAR
SERVO MOTOR
CONTROL WIRE
CIRCUIT BOARD
SERVO CONTROL CIRCUITRY

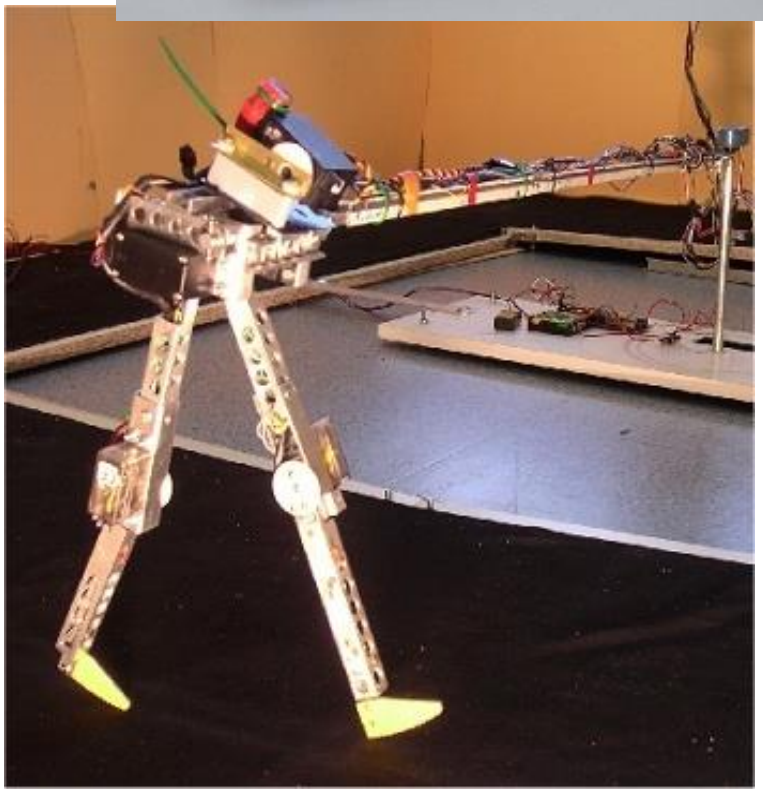

Position
0'
45'
90'
0
1.0
1.5
2.0
10.0–25.0
Time (ms)
T1: 1.5ms (Pulse Time)
T2: 1.0ms (Pulse Time)
T3: 2.0ms (Pulse Time)
T4: 30ms (Repetition time)


Minimum Pulse
Pulse Width 1 ms
0°
Neutral Position
Pulse Width 1.5 ms
90°
Maximum Pulse
Pulse Width 2 ms
180°




LTG-6100T
LOGICTECH
MENU
DATA

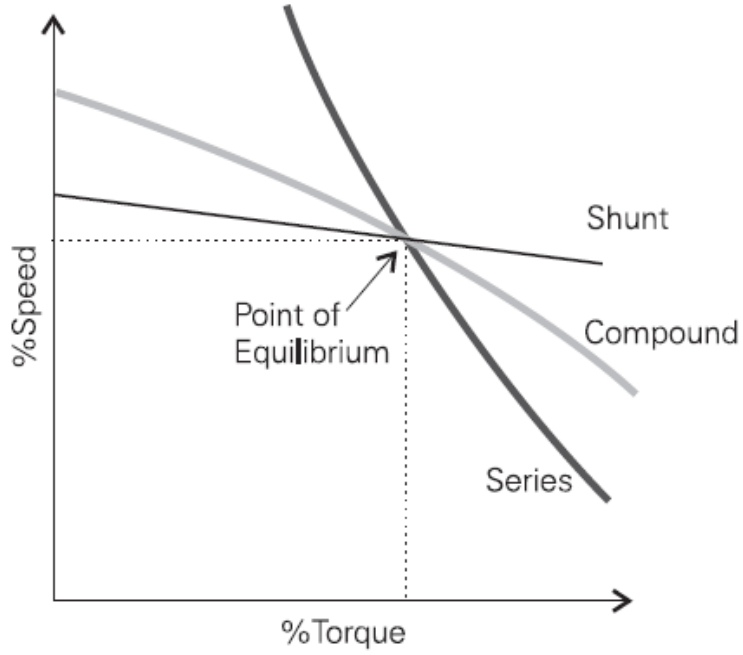


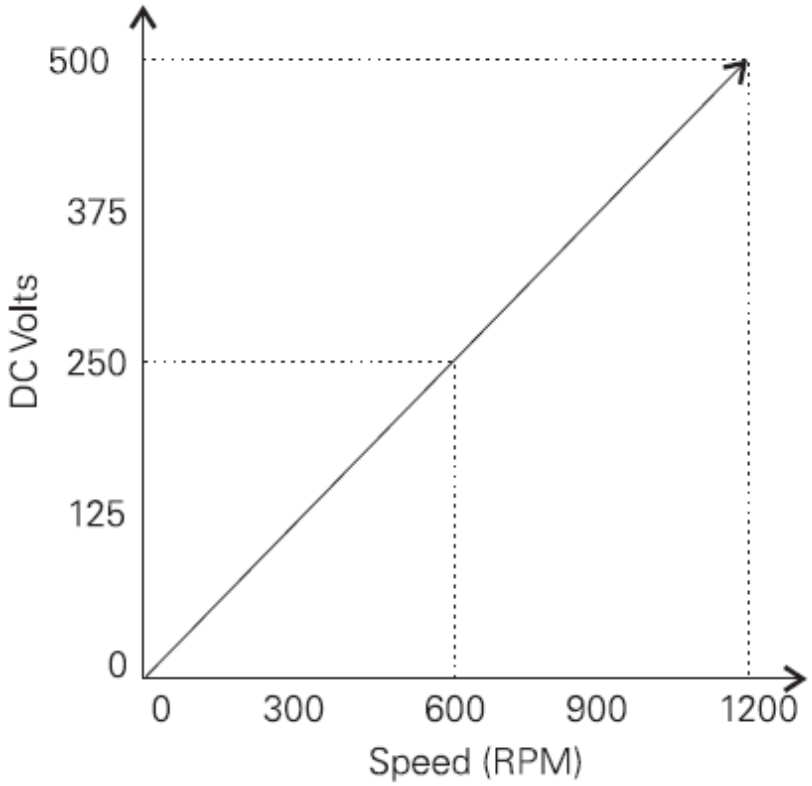



T9CP
Futaba
R149DP

DC Motor

Đặc tính làm việc động cơ điện một chiều

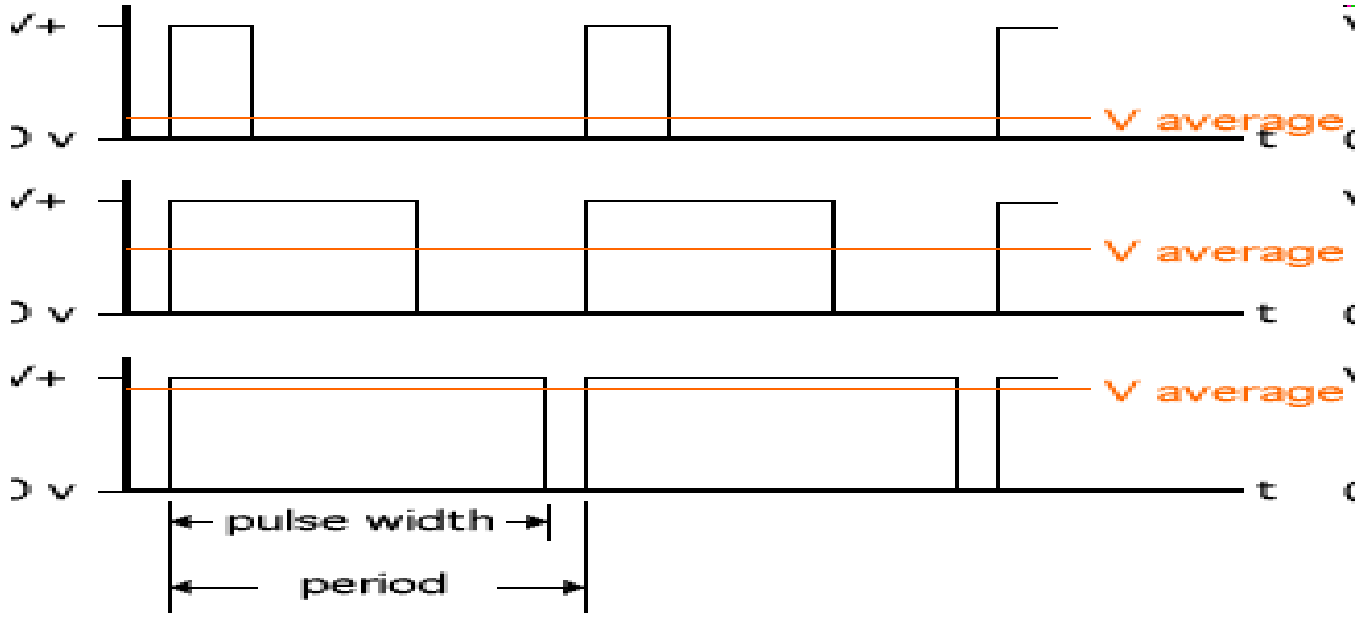




DC Motor

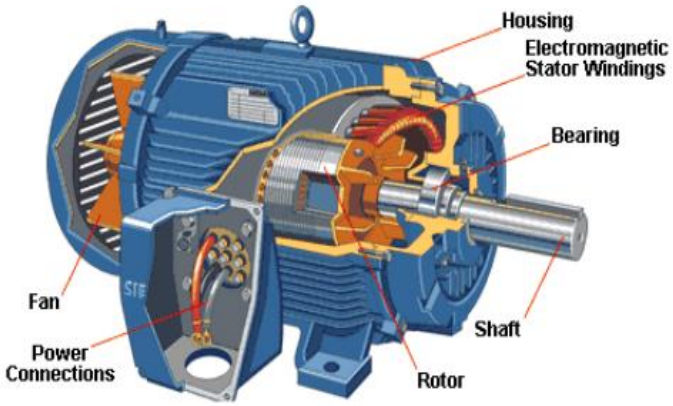
Điều Khiển tốc độ :

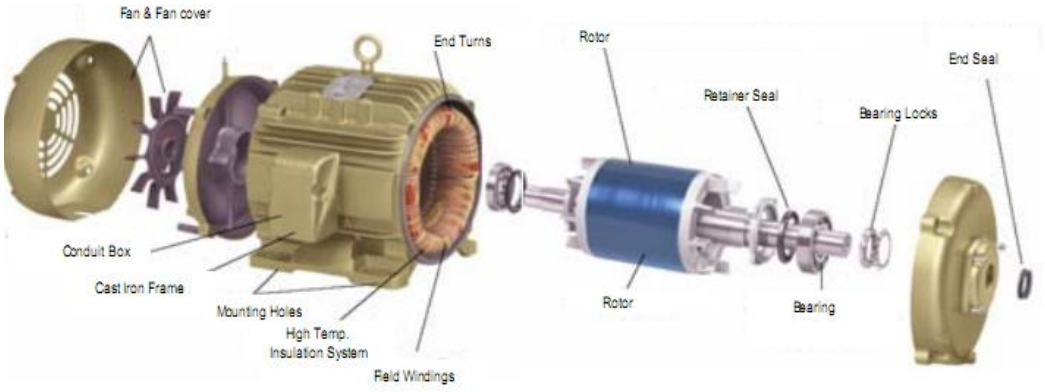
- Biến trở : thay đổi điện trở phần cảm.
- Thay đổi điện áp phần ứng.
- Điều chế độ rộng xung: Pulse Width Modulation .



AC Motor

- **Động cơ xoay chiều : hoạt động dựa trên nguồn điện xoay chiều.**

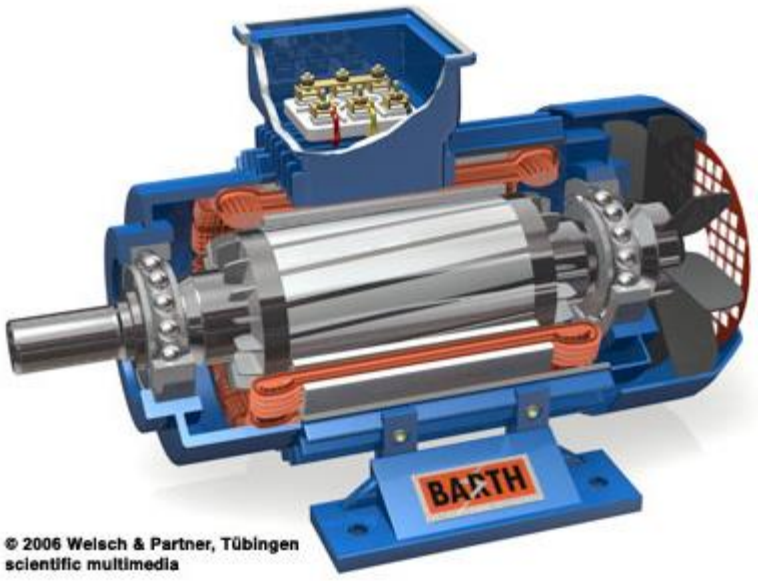


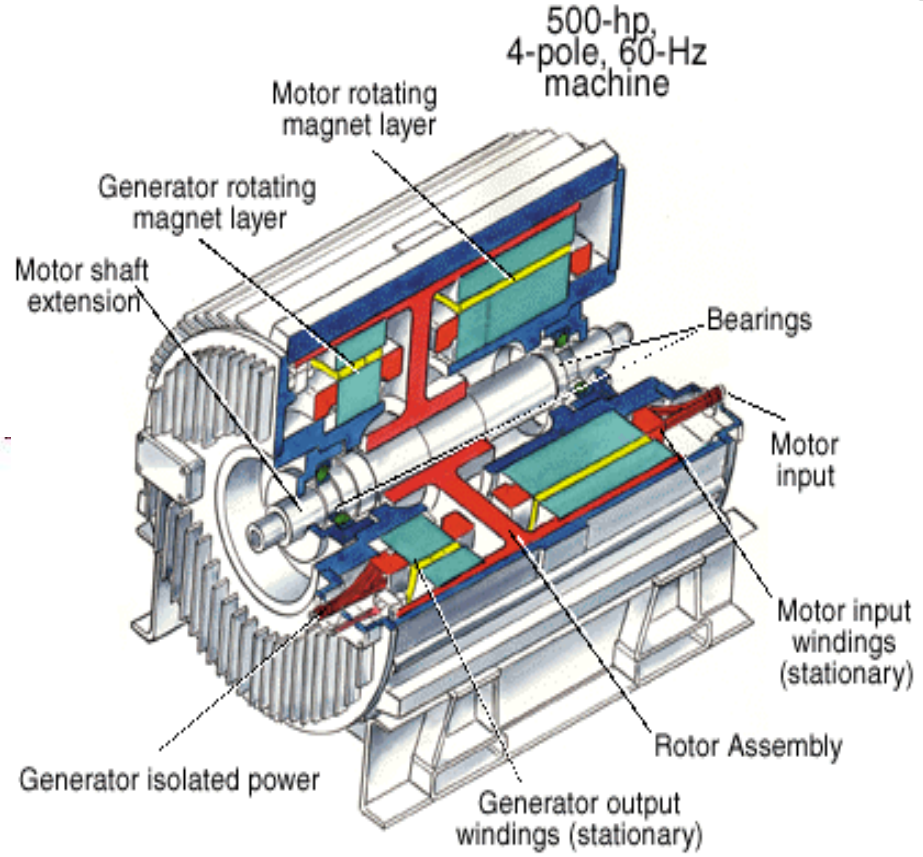


AC Motor

Phân loại :

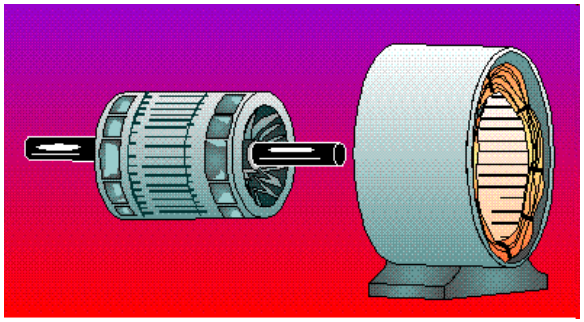
- Đồng Bộ.
- Không đồng bộ.
  - 1-phase.
  - 3-phase.

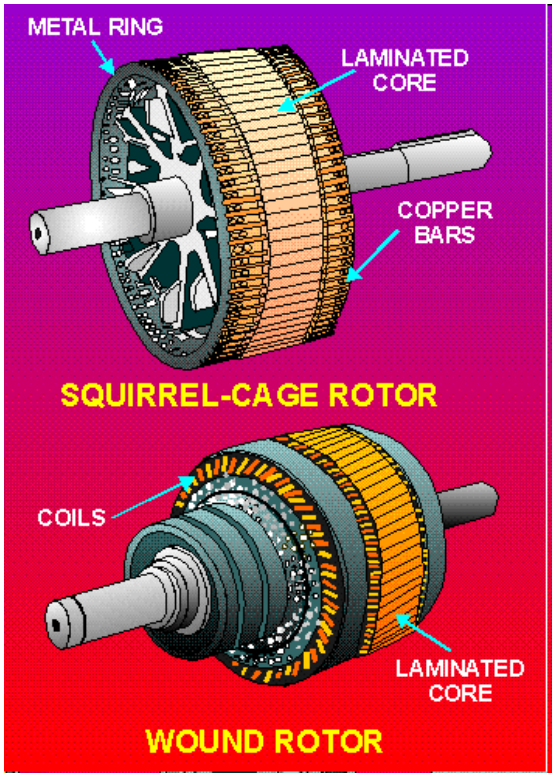


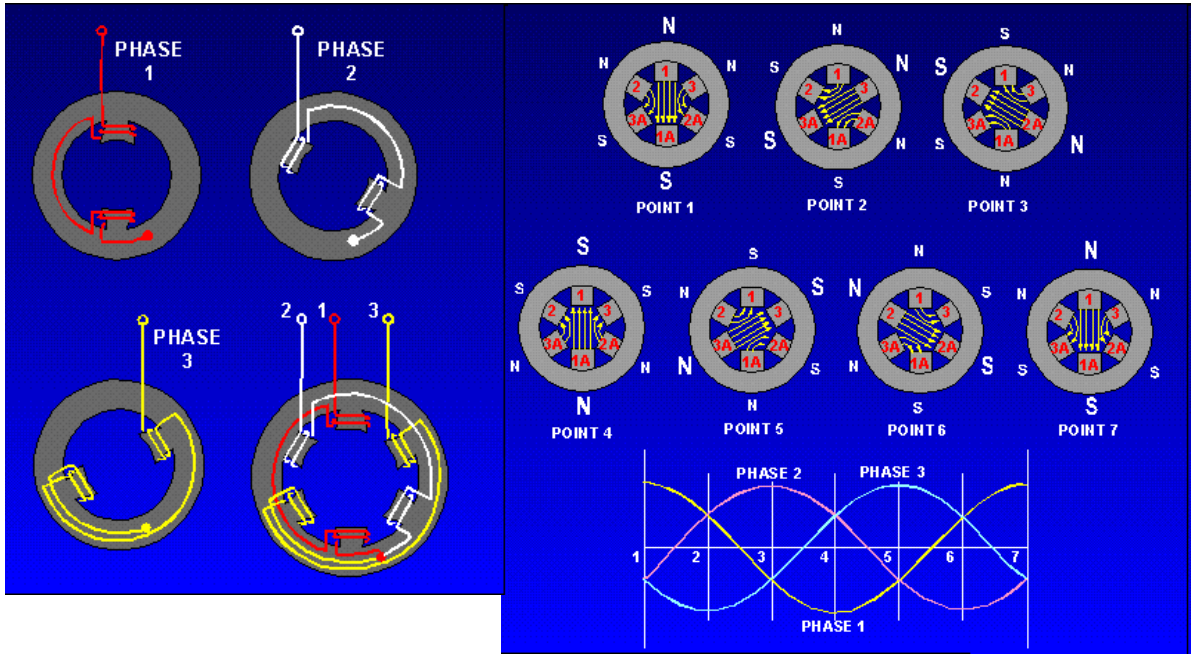


AC Motor

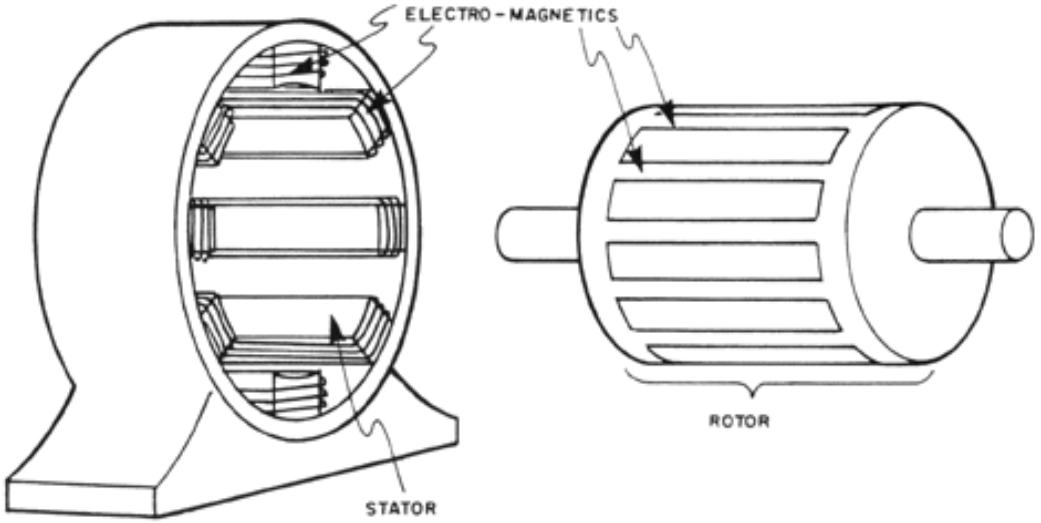
3-phase asynchronous AC motor :







AC Motor



One-quarter scale 5,000 hp motor under construction

AC servo


DATATURKDRI

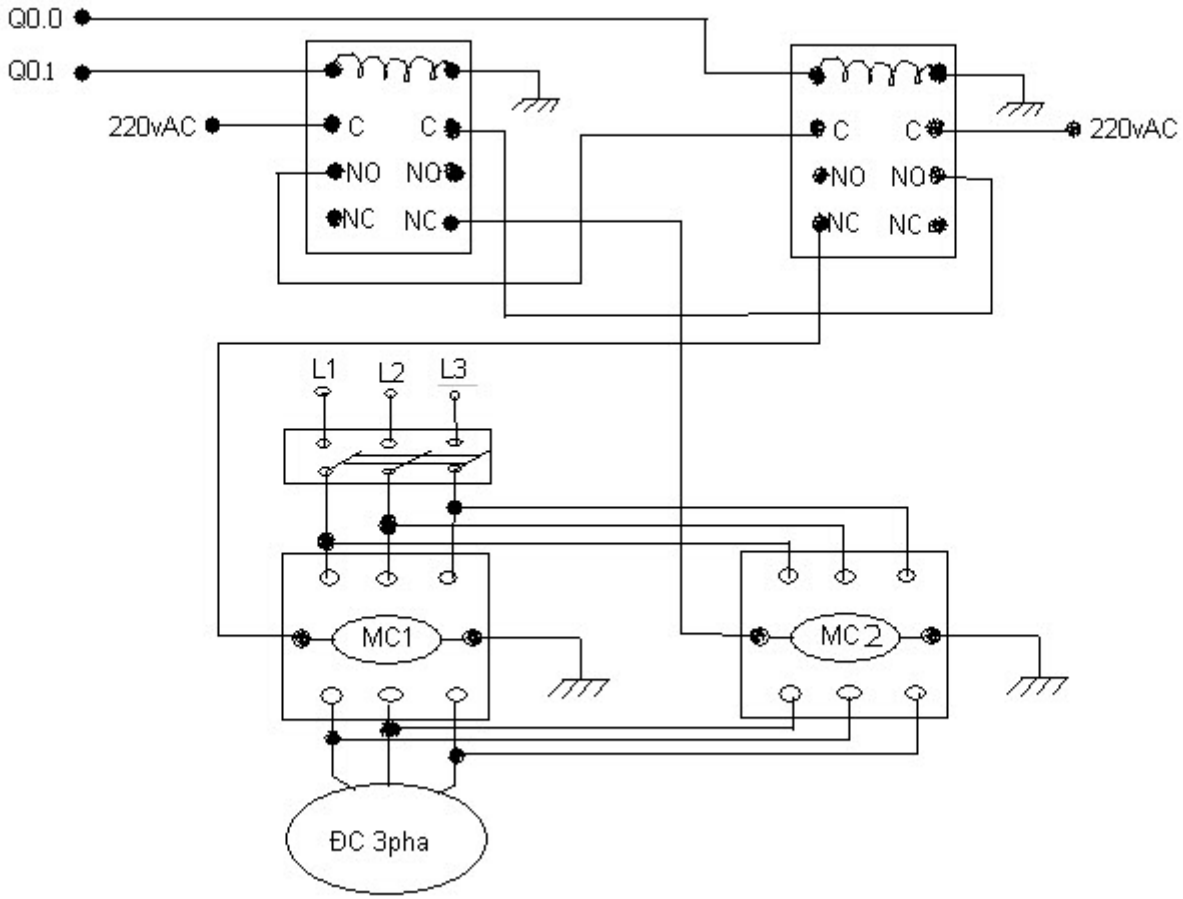

YASKAWA
Varispeed
V7-4X
230V - 1.6A
WARNING


BALDOR
BALDOR


FANUC

AC Motor

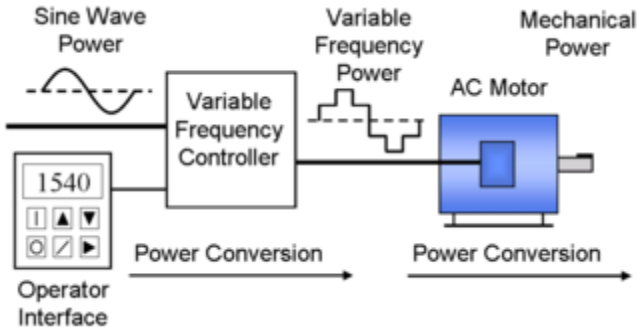
Connection :



AC Motor

Điều khiển vận tốc

- Biến tần (inverter - Variable frequency drive – VFD).



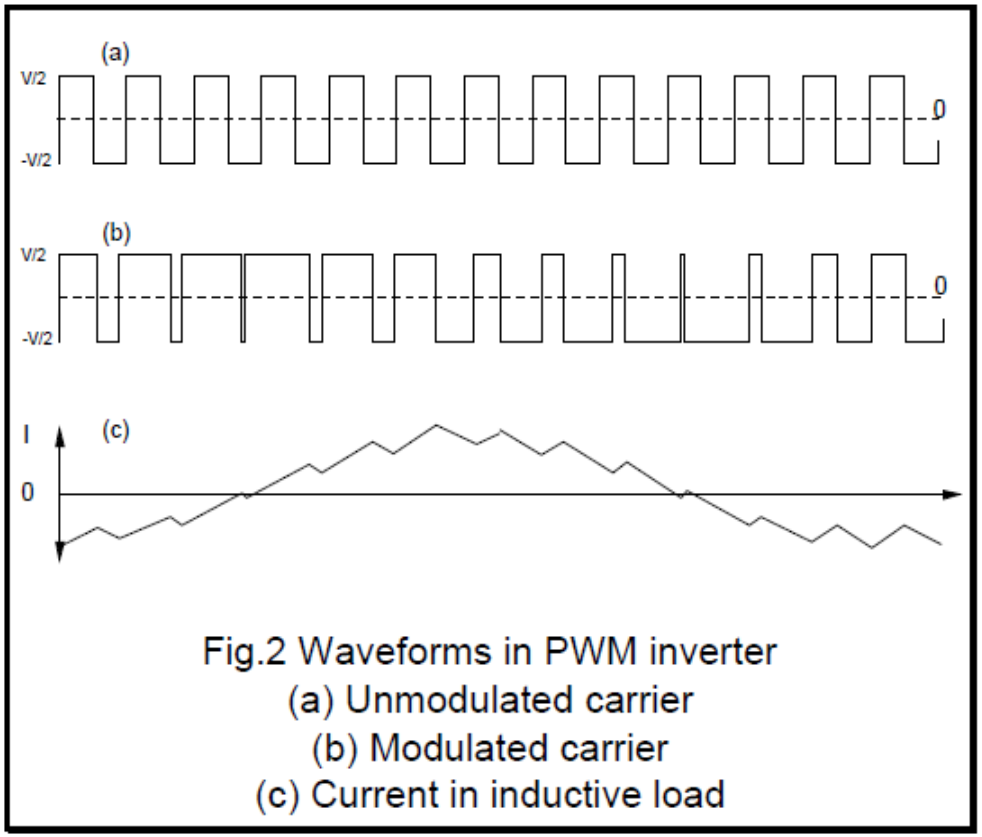


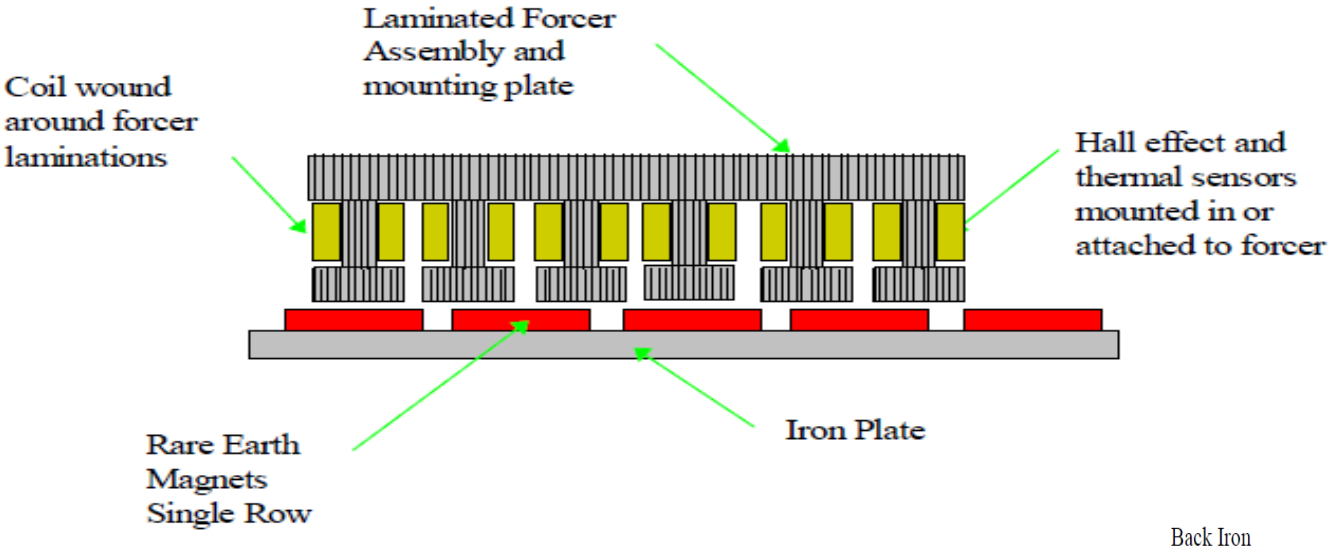
Fig.2 Waveforms in PWM inverter
(a) Unmodulated carrier
(b) Modulated carrier
(c) Current in inductive load

Linear motor – Piezoelectric actuator

- Động cơ tuyến tính : nguyên lý từ trường , tạo chuyển động thẳng.
- Ứng dụng : tàu điện siêu tốc…

- Cơ cấu tinh thể thạch anh : chuyển tín hiệu điện thành dịch chuyển dạng cơ dựa trên sự biên dạng vật liệu thạch anh.

Linear motor – Piezoelectric actuator



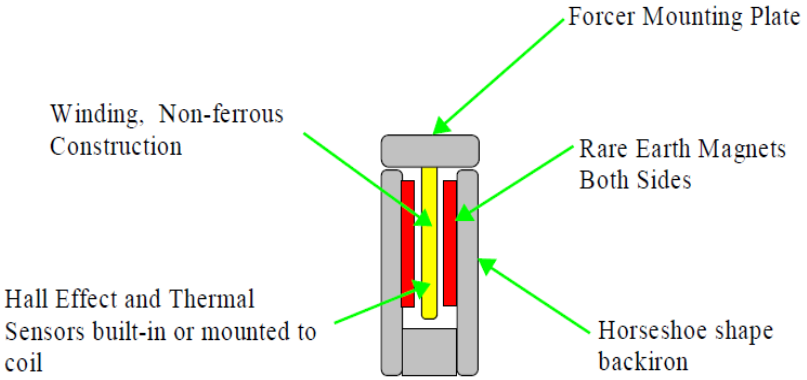
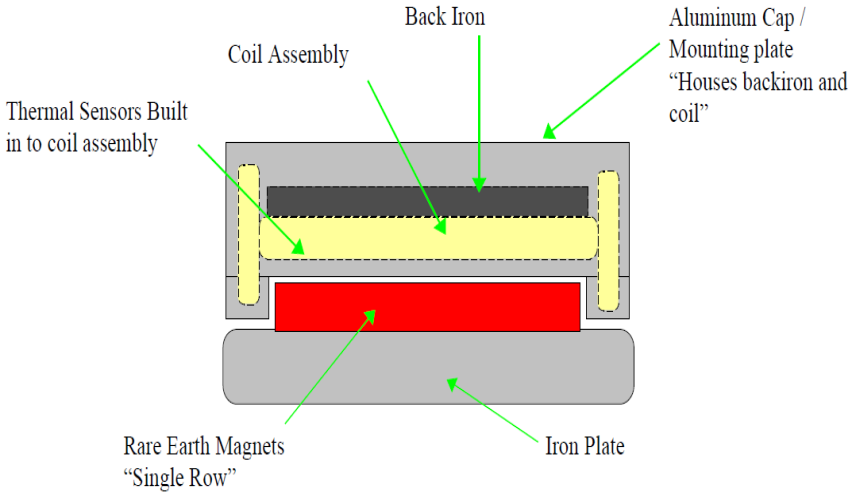
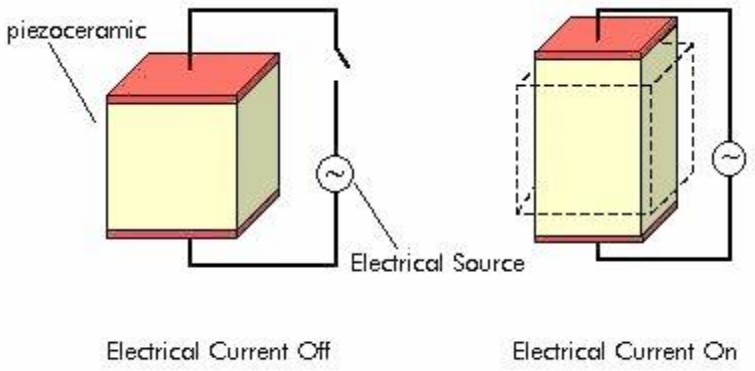


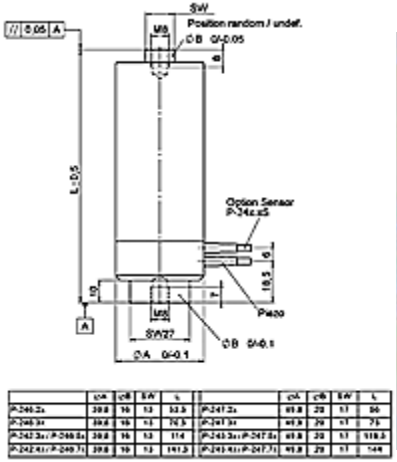
Figure 2: AirCore Linear Motor



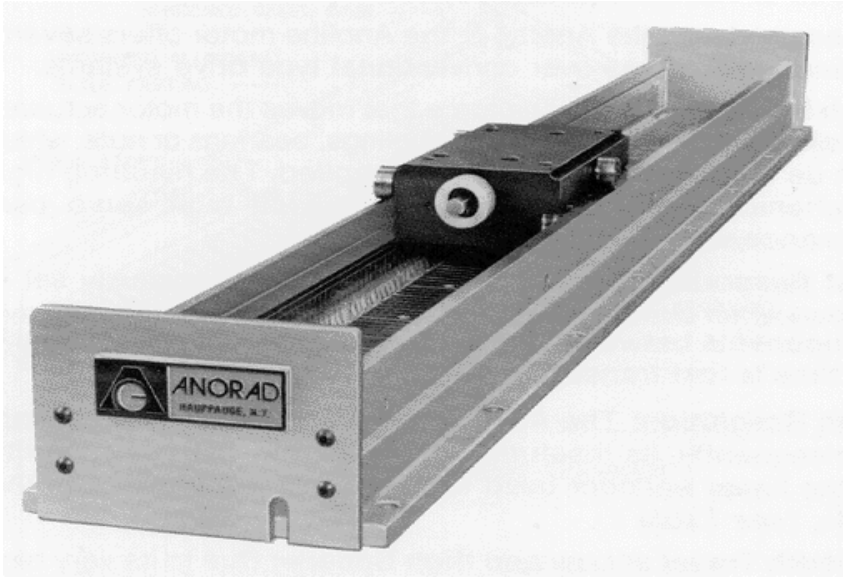
Linear motor – Piezoelectric actuator

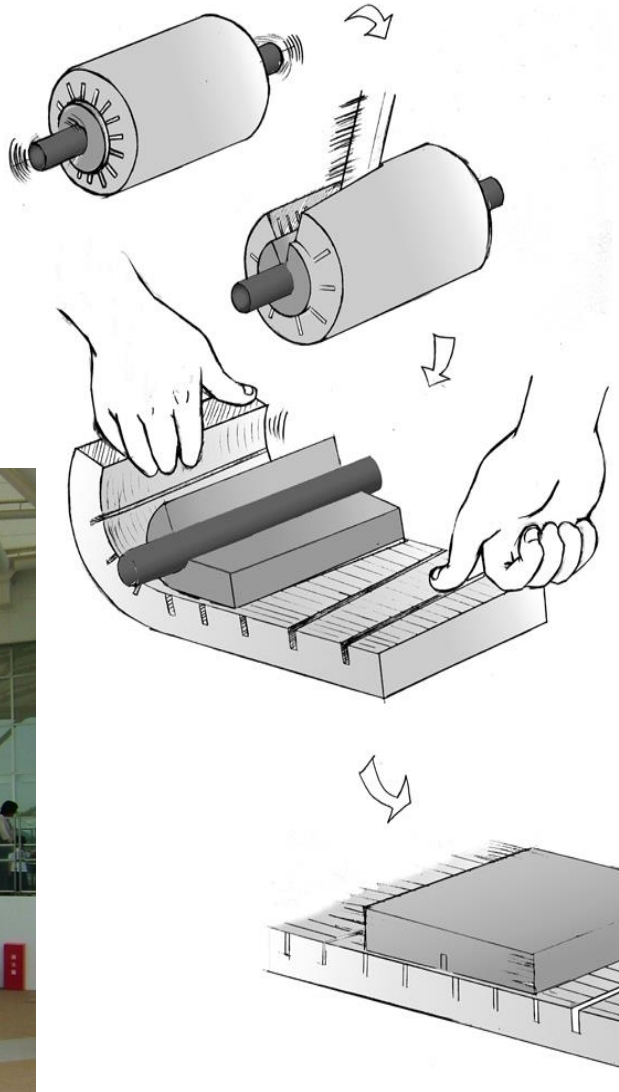
Piezoelectric motor:



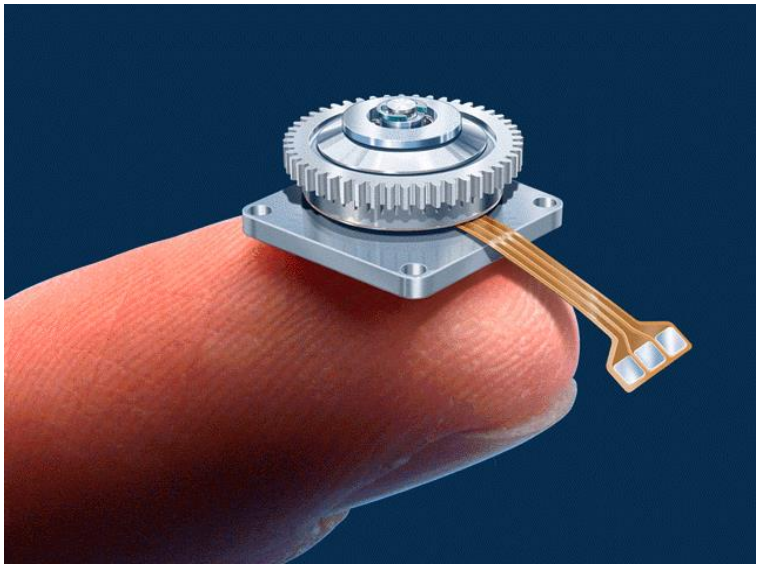


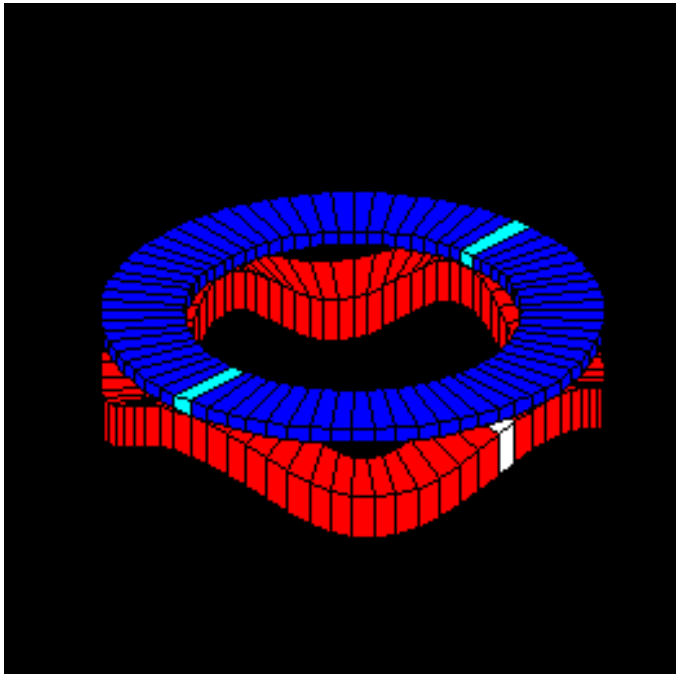
Linear motor – Piezoelectric actuator

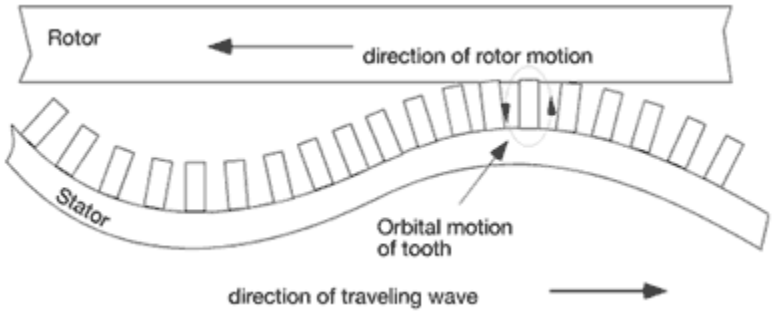




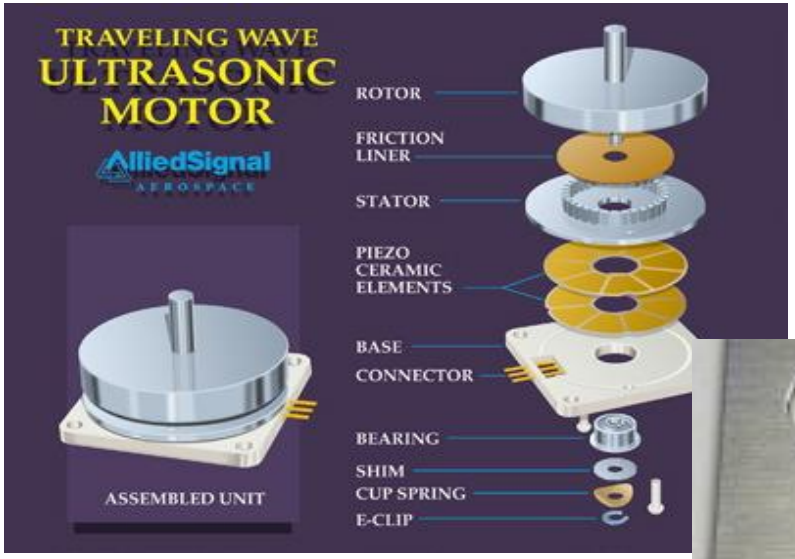
Linear motor – Piezoelectric actuator

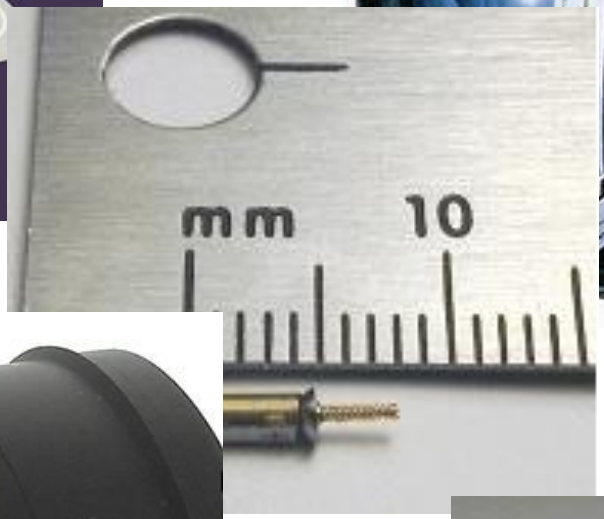


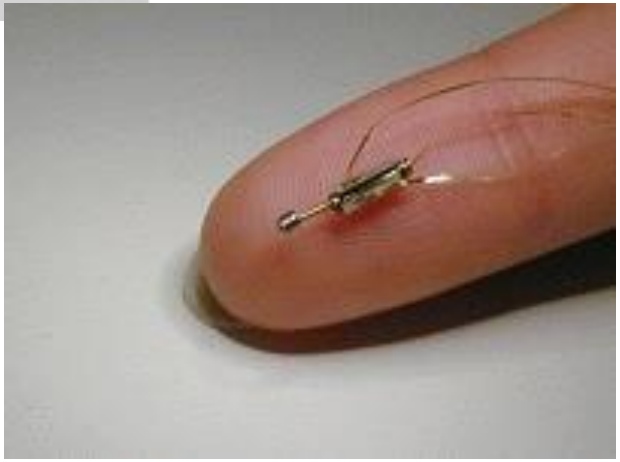




Linear motor – Piezoelectric actuator







The end of motor actuator.