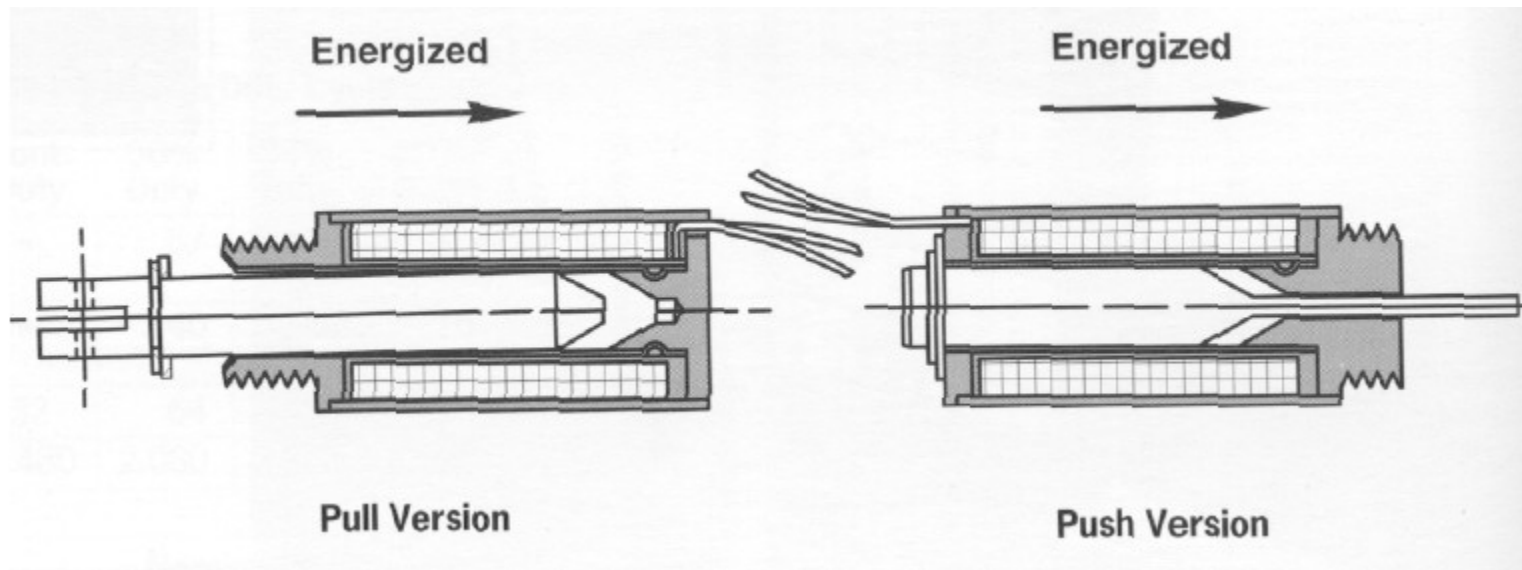
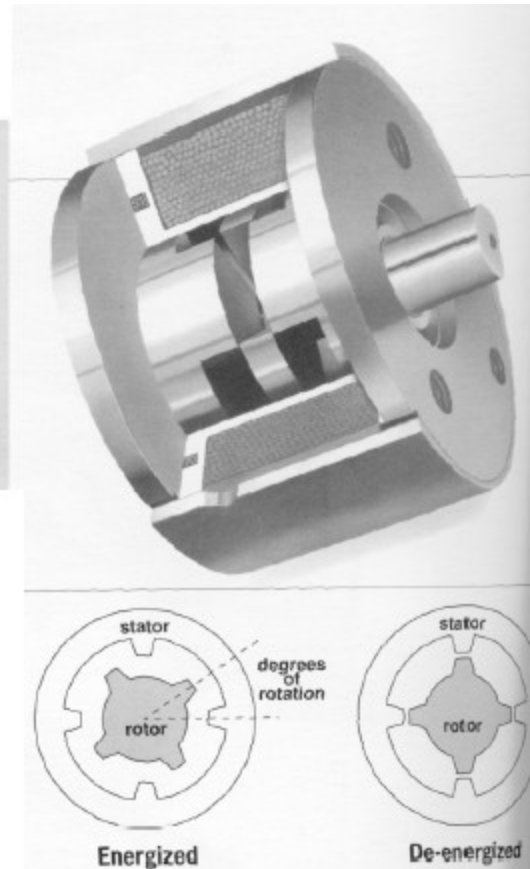


ELECTRIC SOLENOIDS



$$\text{Force} \propto \text{stroke}^{-1}$$

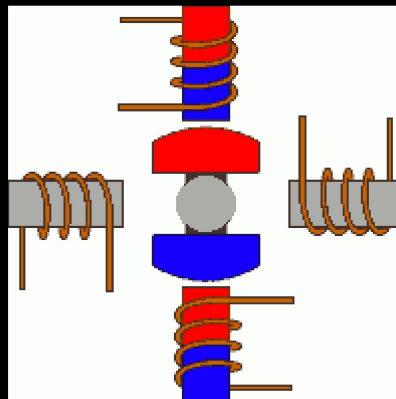
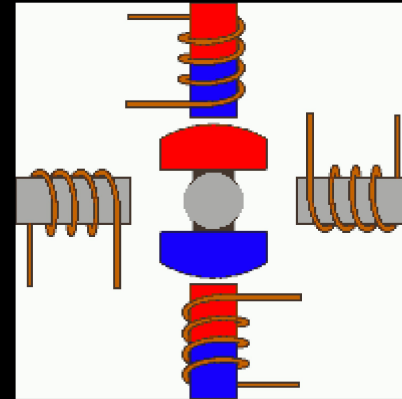
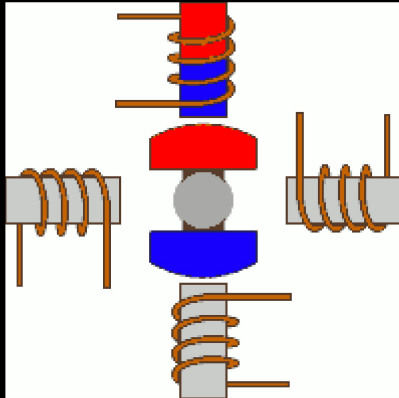
ELECTRIC ROTARY ACTUATOR (SOLENOID)



ELECTRIC ROTARY ACTUATORS (MOTORS)

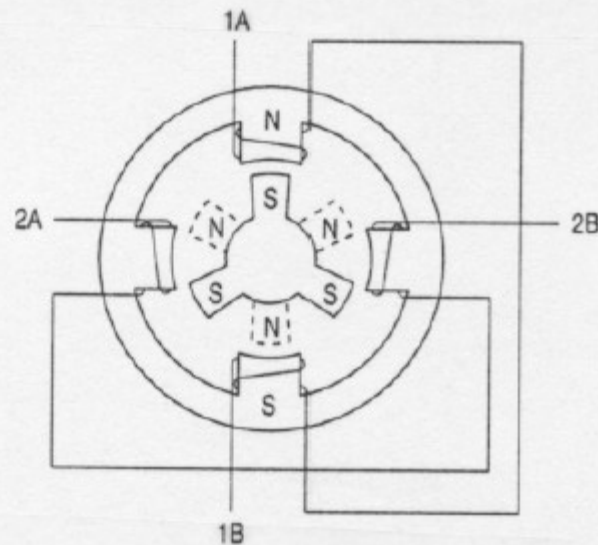
- DC motors
- AC motors
 - stepper (2-phase synchronous)
 - brushless (3-phase synchronous)
 - induction

STEP MOTORS



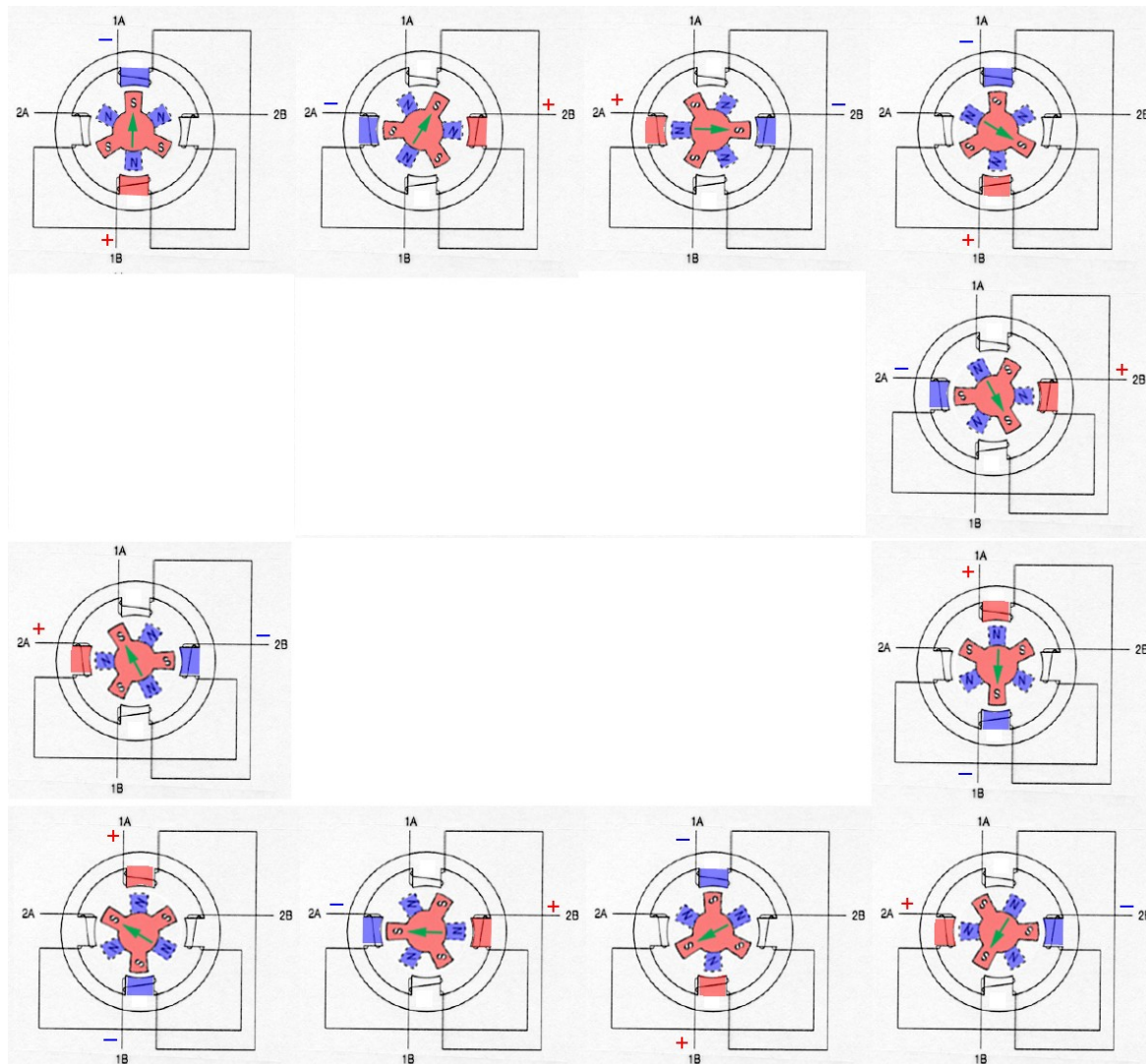
STEP MOTORS

Fig. 1.4 Simple 12 step/rev hybrid motor



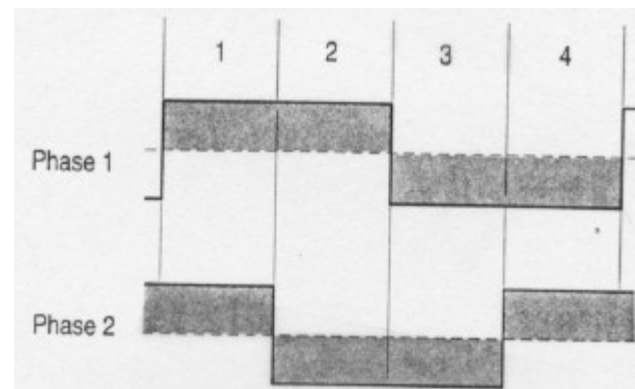
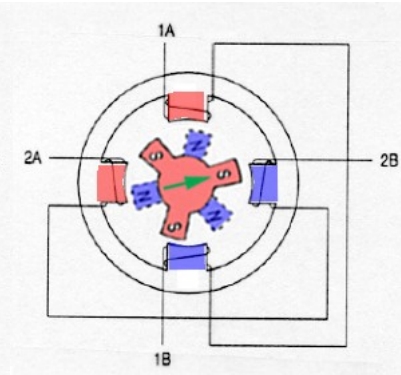
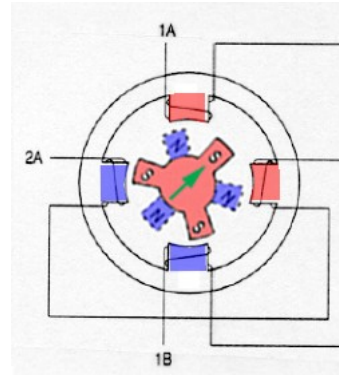
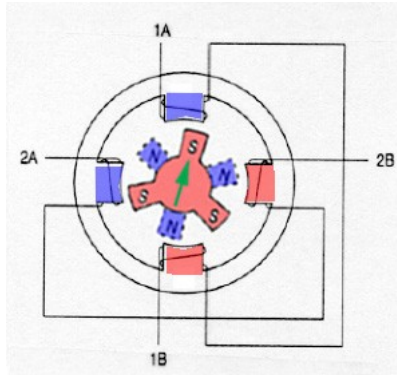
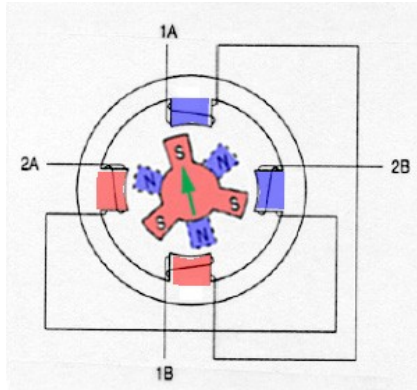
STEP MOTOR

1 2 STEP/REV, 1 PHASE ON



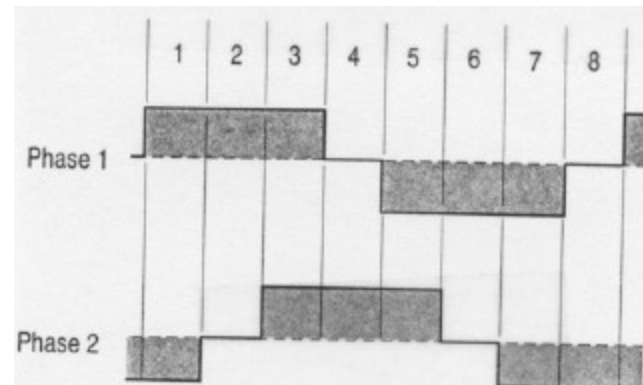
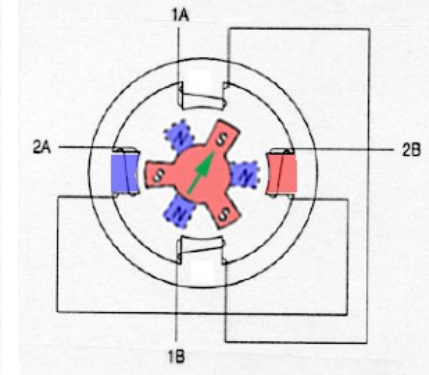
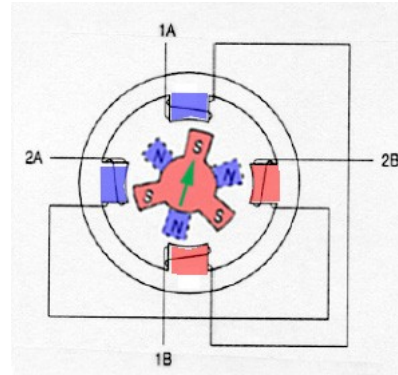
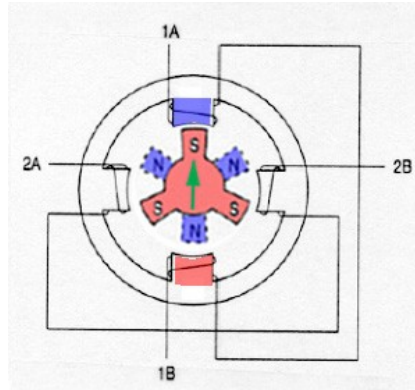
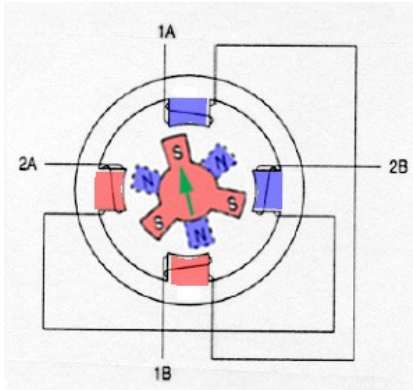
STEP MOTOR

1 2 STEP/REV, 2 PHASE ON



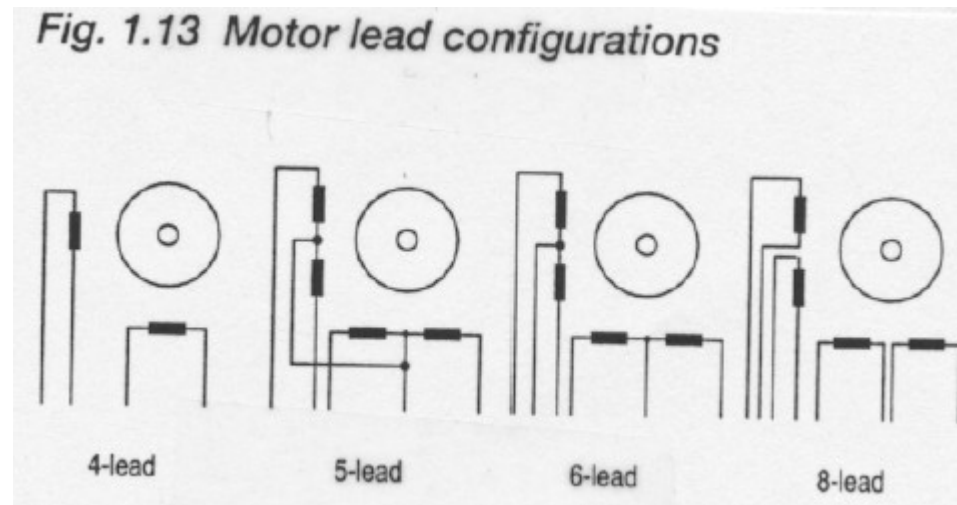
STEP MOTOR

1 2 STEP/REV, HALF-STEPPING



STEP MOTORS

Fig. 1.13 Motor lead configurations

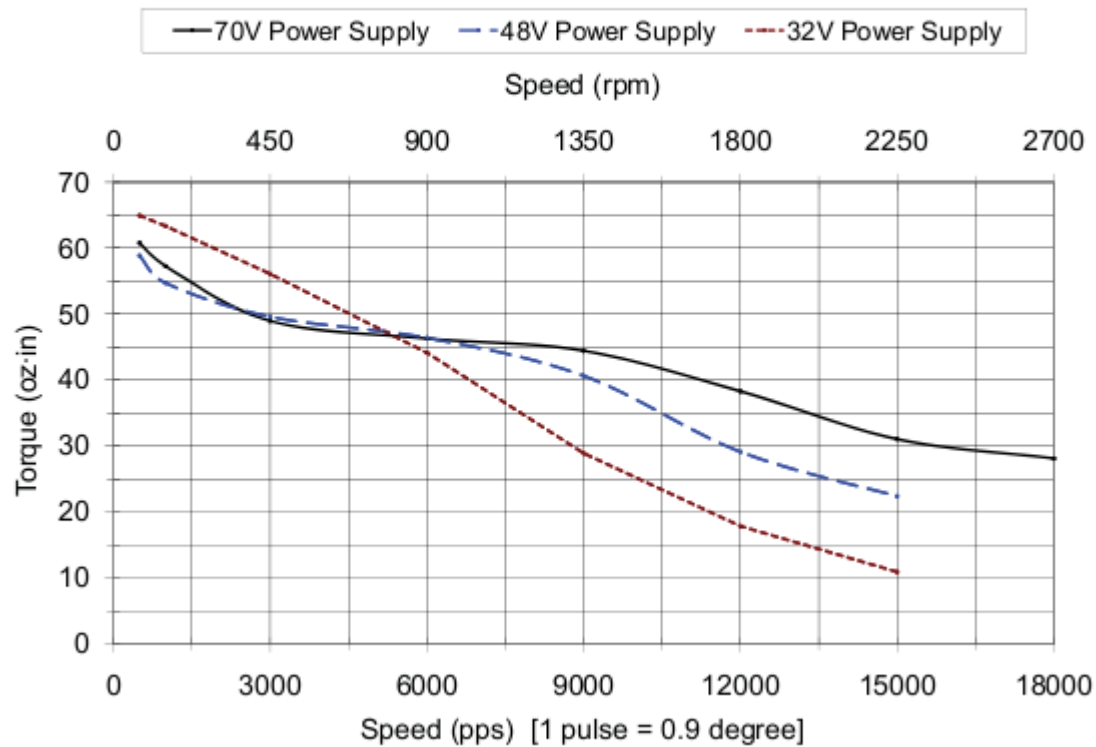


SELECTING STEP MOTORS

- Torque
- Speed
- Size, shaft configuration

TORQUE/SPEED

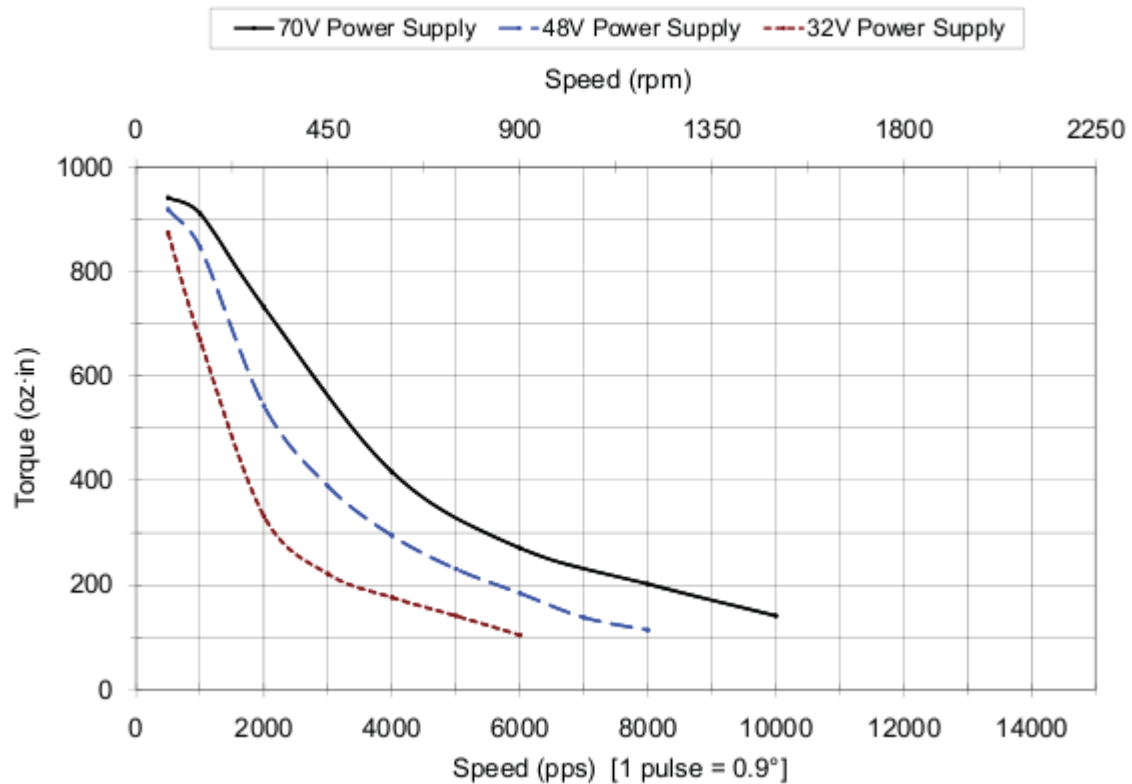
STP-MTR-17048 Torque vs Speed (1.8° step motor; 1/2 stepping)



\$20 motor

TORQUE/SPEED

STP-MTRH-34127 Torque vs Speed (1.8° step motor; 1/2 stepping)



\$160 motor

STEP MOTOR DRIVES

- Resolution (full, half, microstepping)
- Current Limit (resistor or digital)
- AC powered or DC powered
- Pulse/Direction or Indexing

RESOLUTION

- Full step/Half step
- Microstepping
 - x2,x4,x5,x8,x10,x16,x25,x32,x50,x64,x125,x128,x250,x256 common choices
- Max step frequency
 - PLC: 7kHz pulse rate => 2100 RPM at x1, 8.2RPM at x256 (1.8deg motor)
 - Compumotor 6104: 2MHz pulse rate => 2300RPM at x256
- Resonance problems