6 degrees of freedom
stepper motors

NEMA 17 - 5mm diameter shaft, bolt hole spacing 31 mm square
NEMA 23 – 0.25” diameter shaft, bolt hole spacing 1.856”
typically 1.8 deg per step or 200 steps/rev +/- 5%
2000 steps per revolution max = 10 microstep
low rpm = high torque & high rpm = low torque
Screws

- Lead
- Pitch
- One start
- Two starts

Ball Screw

Anti-backlash leadscrew nut
Timing Belts

Trapezoidal Pitch (XL, MXL)
HTD
GT2
Gears

Rack and Pinion

Anti Backlash Gears

Harmonic Drive
Bearings

- Linear ball
- Roller
- Sleeve
- thrust
Shafts

Rotary
Linear
Shaft Coupling
Stepper Motor Drivers

A4985
Up to 35v 1A
full, half, 4, 8 microstepping

I_{tripMAX} = \frac{V_{ref}}{8*R_s}
Power Supplies

linear
stable against ripple but expensive

switching
switched-mode power supply
more efficient and cheaper

Powersupplyone.com

ATX power supply
always include at least a 0.1uf bypass cap (smaller cap closest to the IC)
too much capacitance results in larger boards and additional cost
too little capacitance results in noise causing ICs to reset or unwanted motor stepping
G-code

G92 ; zero axis G92xyz
G00 ; seek rate
F ; feed rate
G01 ; feed rate G01X1F100
S1: spindle speed
M3; turn on spindle
M2; turn off spindle
M30; end of file
GRBL

Gcode interpreter for the Arduino

http://mtm.cba.mit.edu/machines/mtm_snap-lock/build/software.html

Arduino + stepper driver shield

Arduino + Quad Easy Driver
LINUX CNC

free machine control software
Computer + Parallel port + Ubuntu

Linuxcnc.org