PMR2450 - Projeto de Máquinas

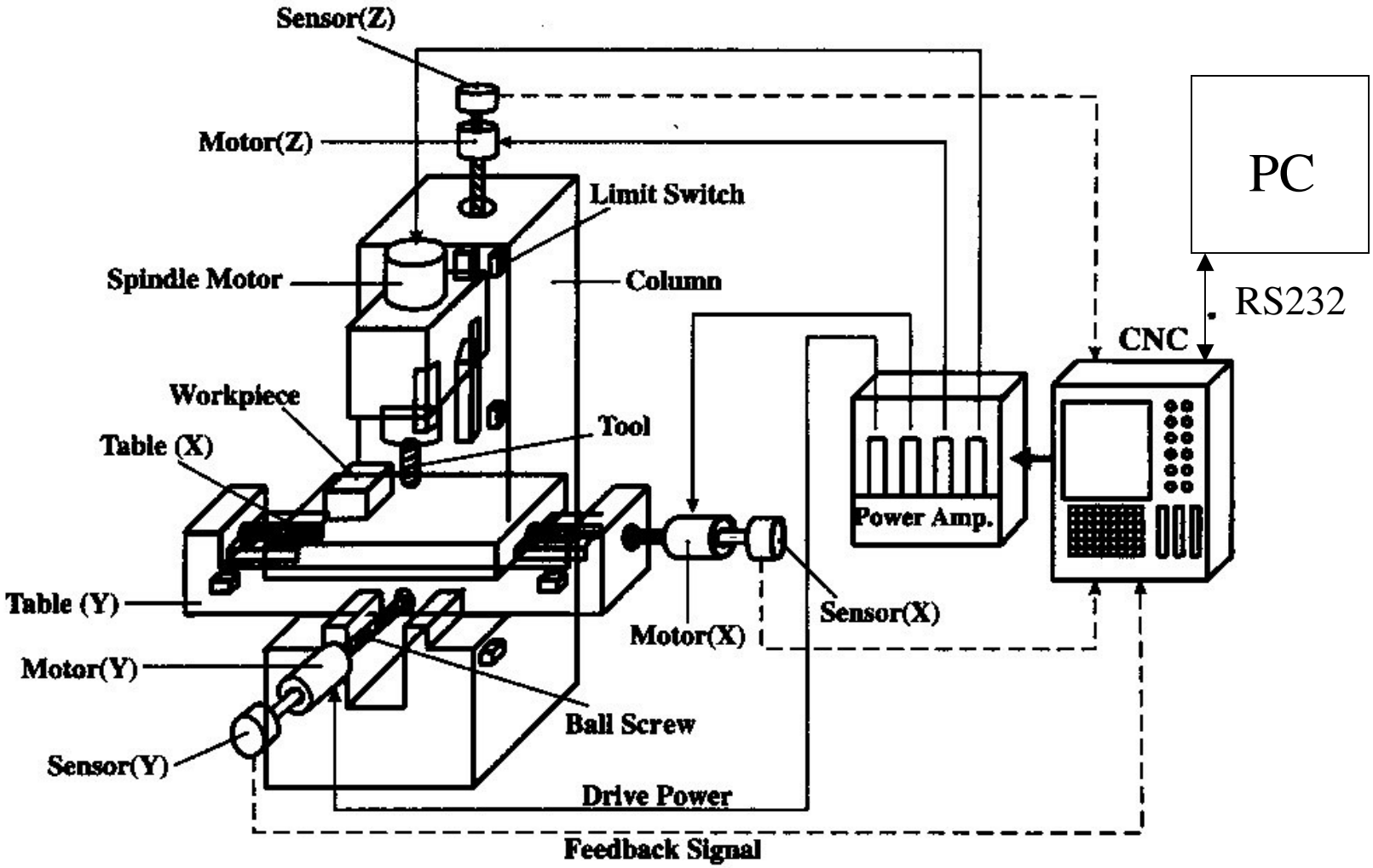
Mecatrônica - EPUSP

Subsistemas básicos de uma máquina CNC

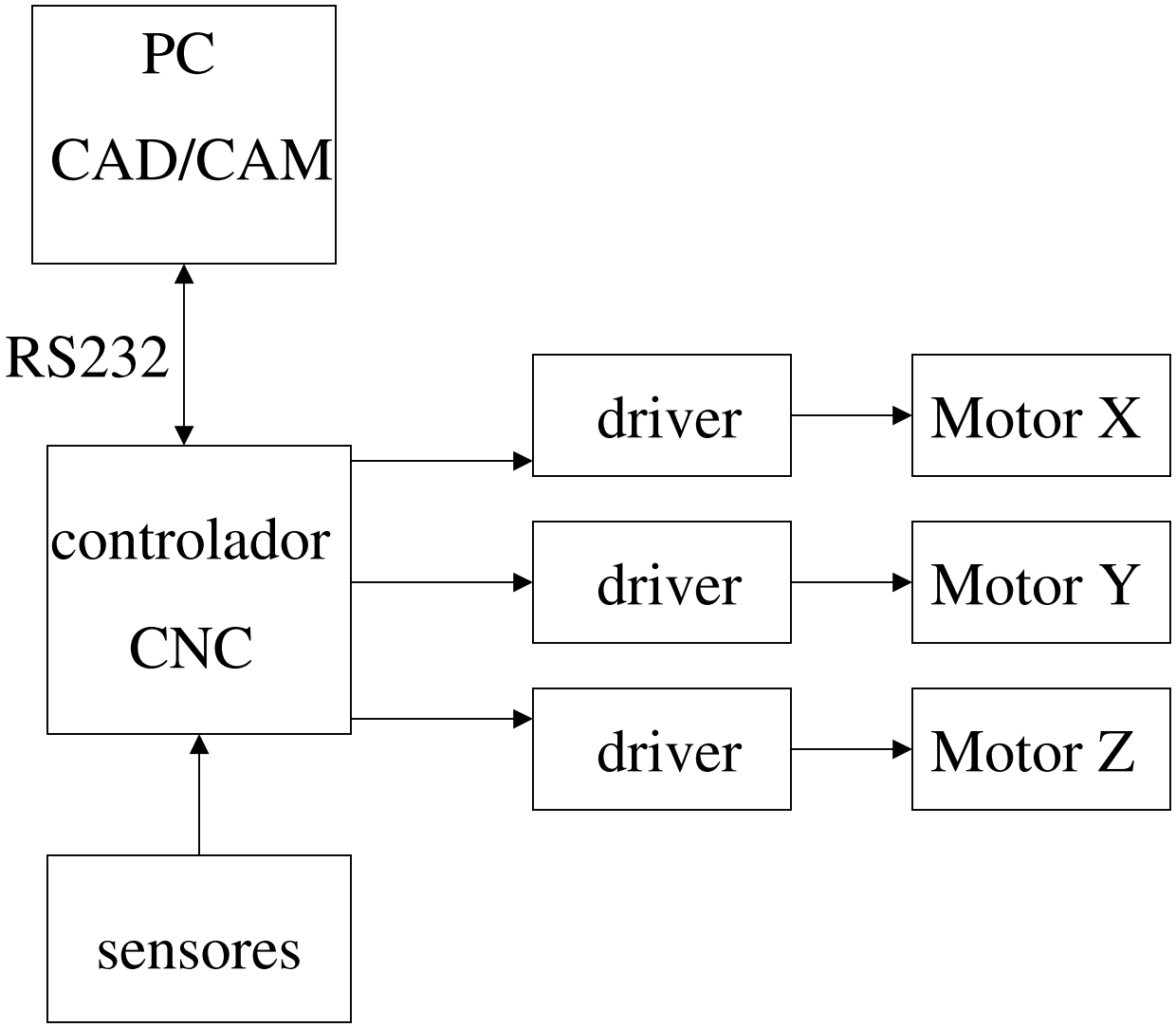
Julio Cezar Adamowski

agosto/2005

Diagrama básico de uma máquina CNC



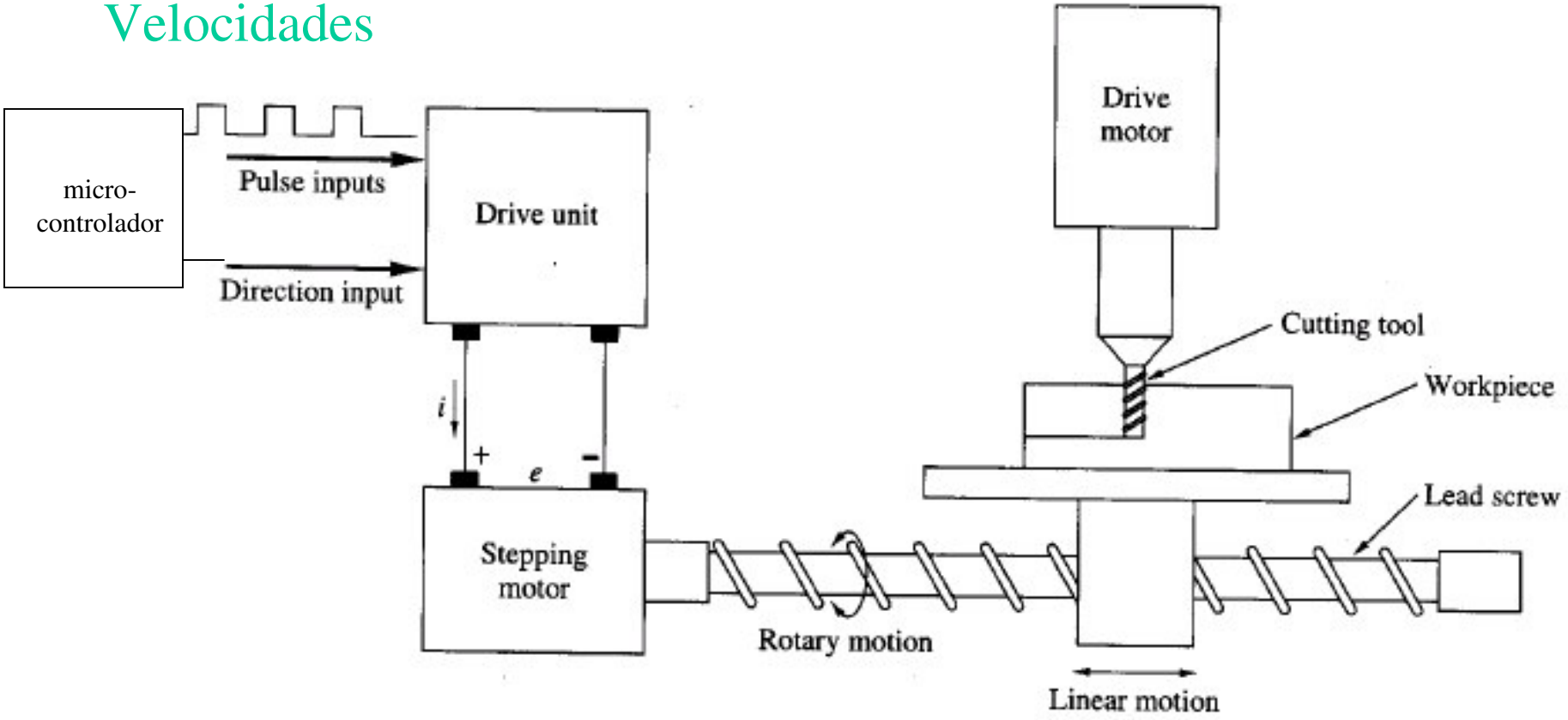
Exemplo de diagrama da nossa Máquina CNC



Sistema de Movimentação

Mecânica, eletrônica, motores, sensores

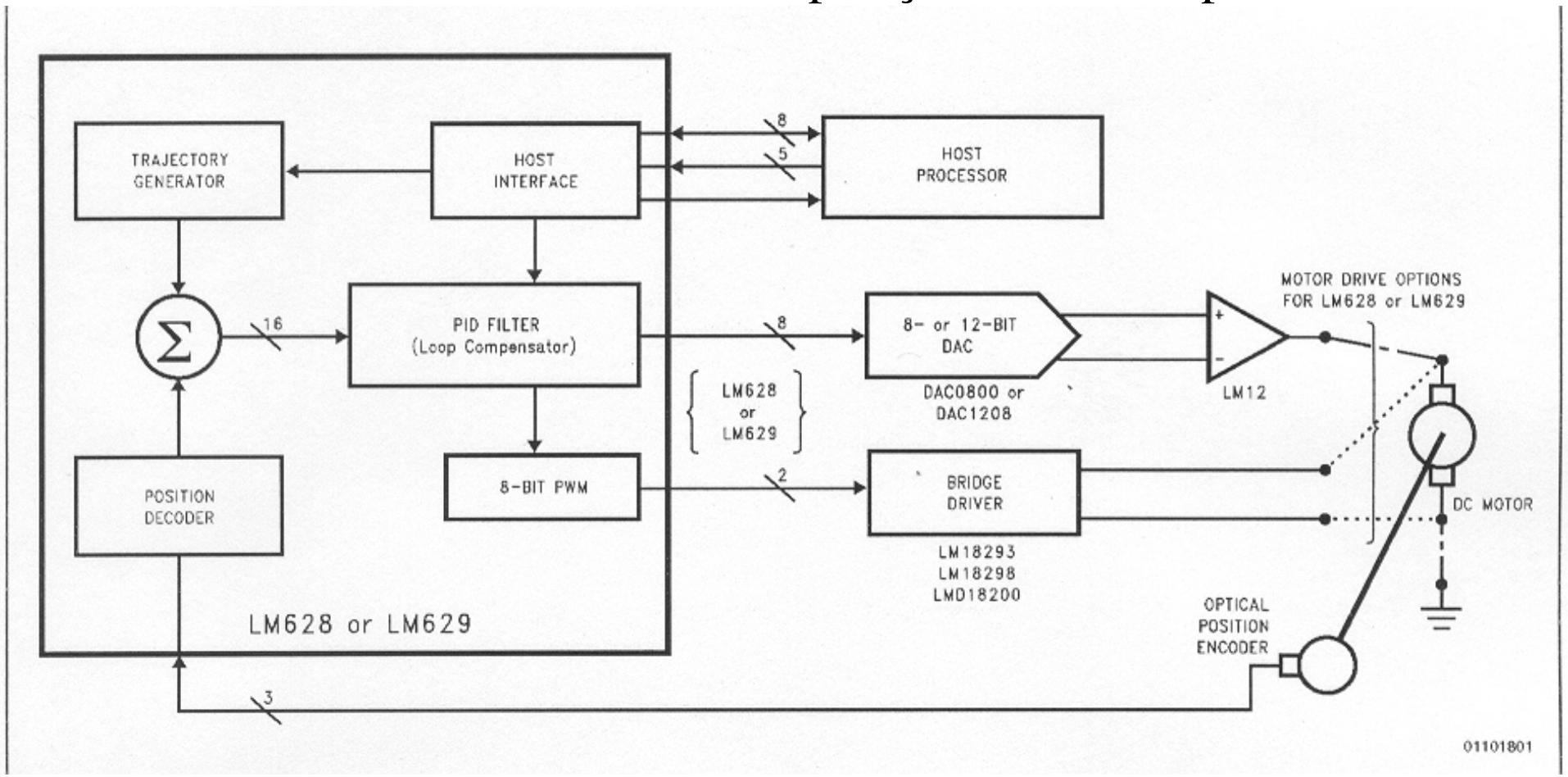
Forças inerciais
Forças de usinagem
Velocidades



Motor de passo: malha aberta

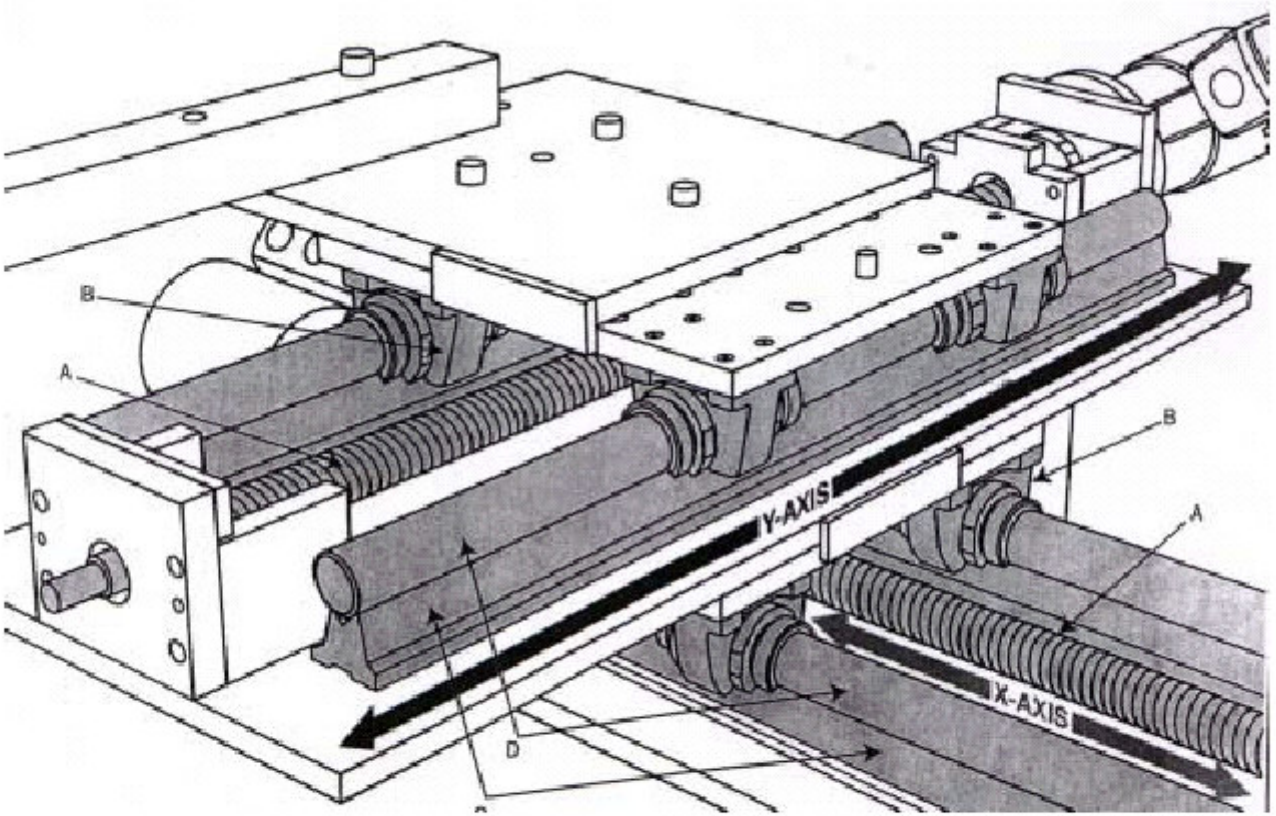
Acionamento com motor CC

Sensor de posição: encoder óptico



Motor CC: malha fechada

Exemplo de mesa XY

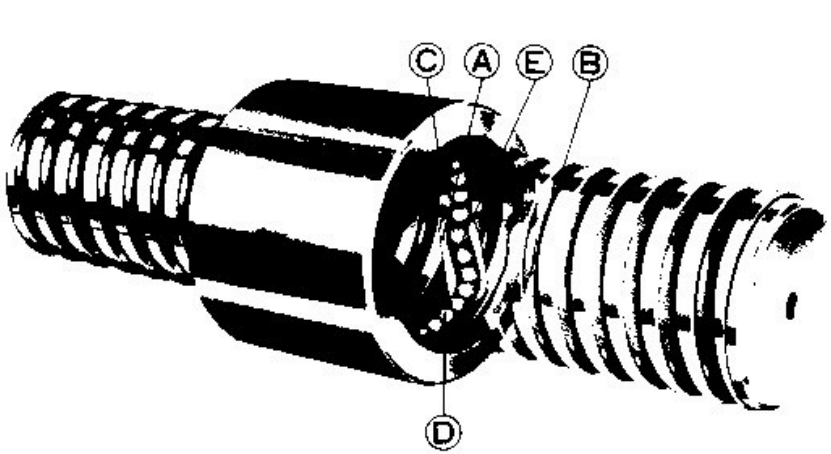


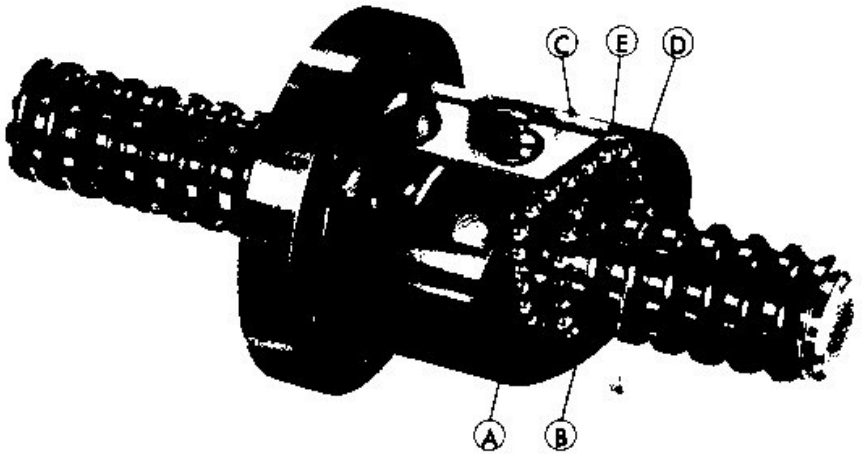
A - Ball Screw
B – Linear Bearings

Microcomputer Controlled X-Y Table

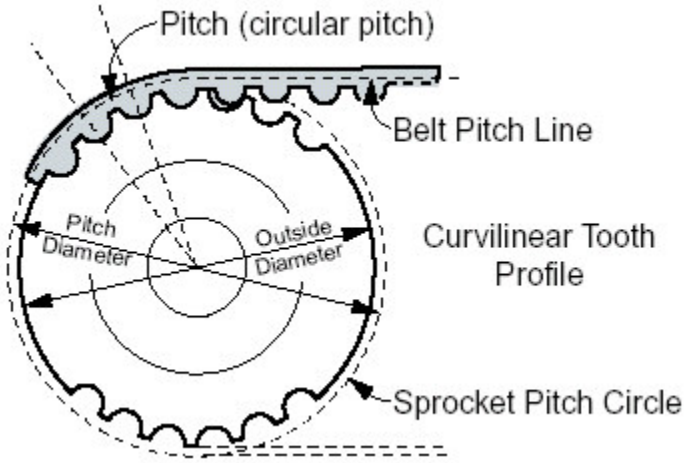
C – Apoio da Guia Linear
D – Guia Linear

fuso com castalha de esferas recirculantes

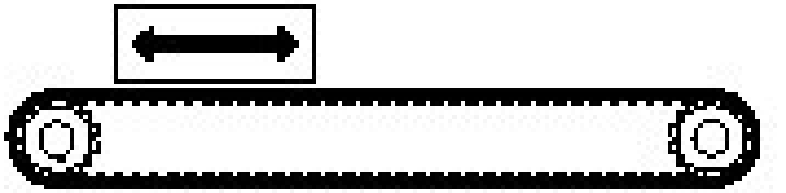


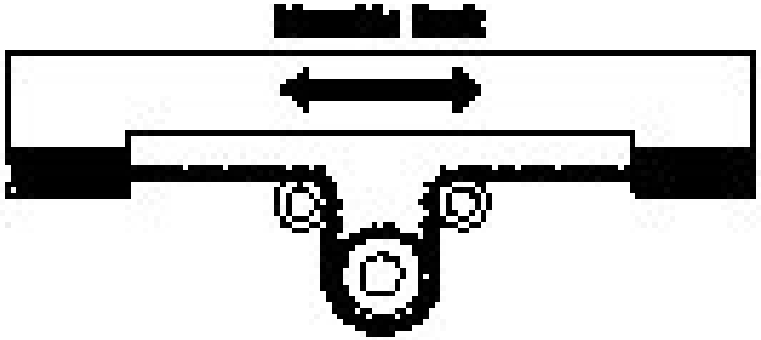


Transmissão por correias sincronizadoras



Exemplos de configurações



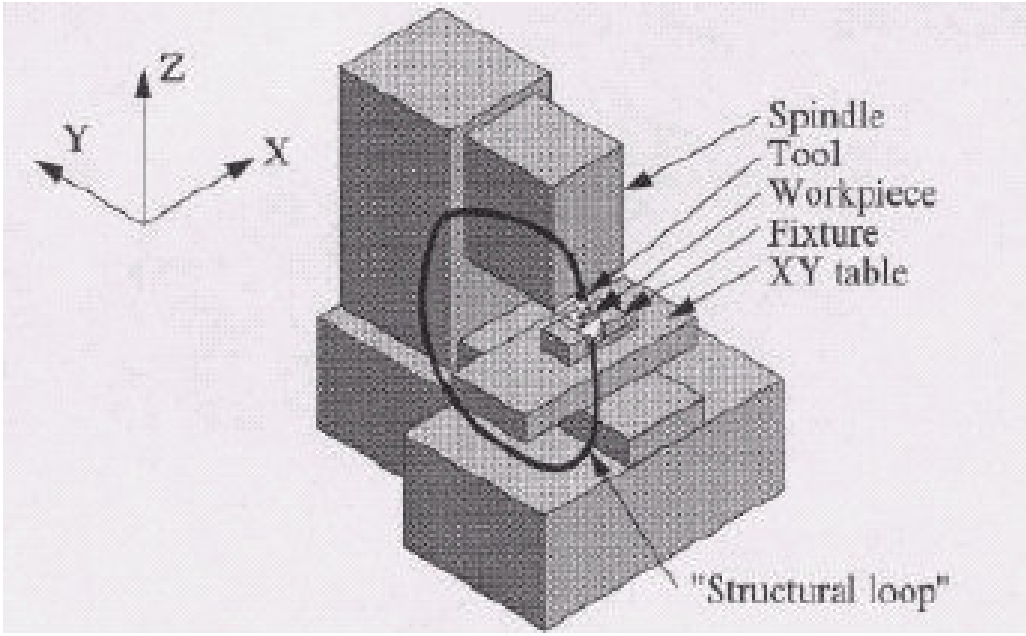


Estrutura mecânica

Loop estrutural

rigidez

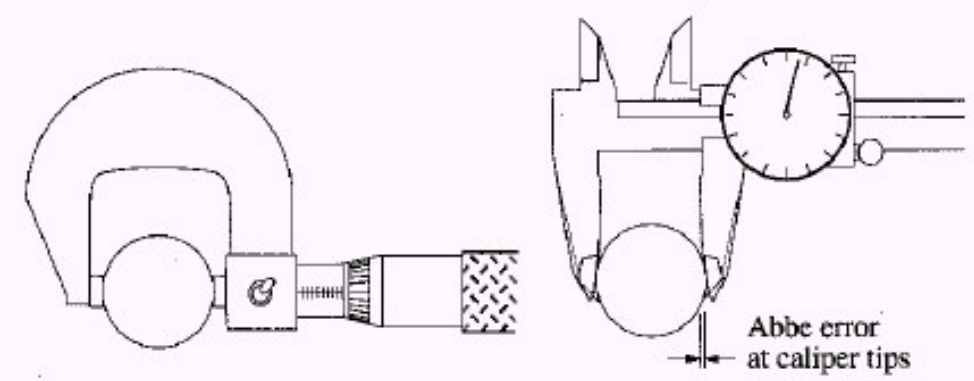
freqüência natural



Livro do prof. Slocum

Princípios de projeto

Abbe



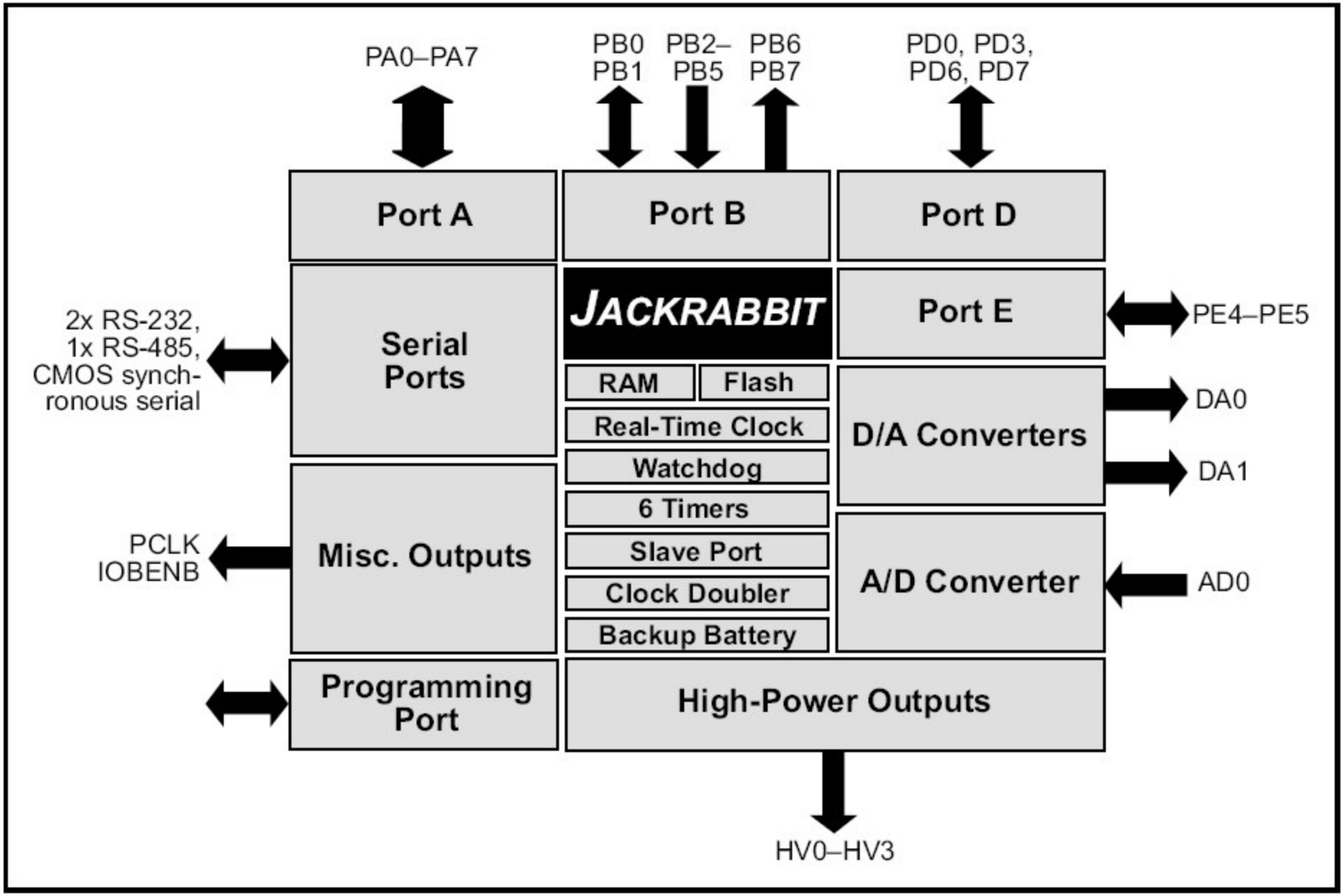
Movimento suave,

Engastamento ...

Controlador CNC

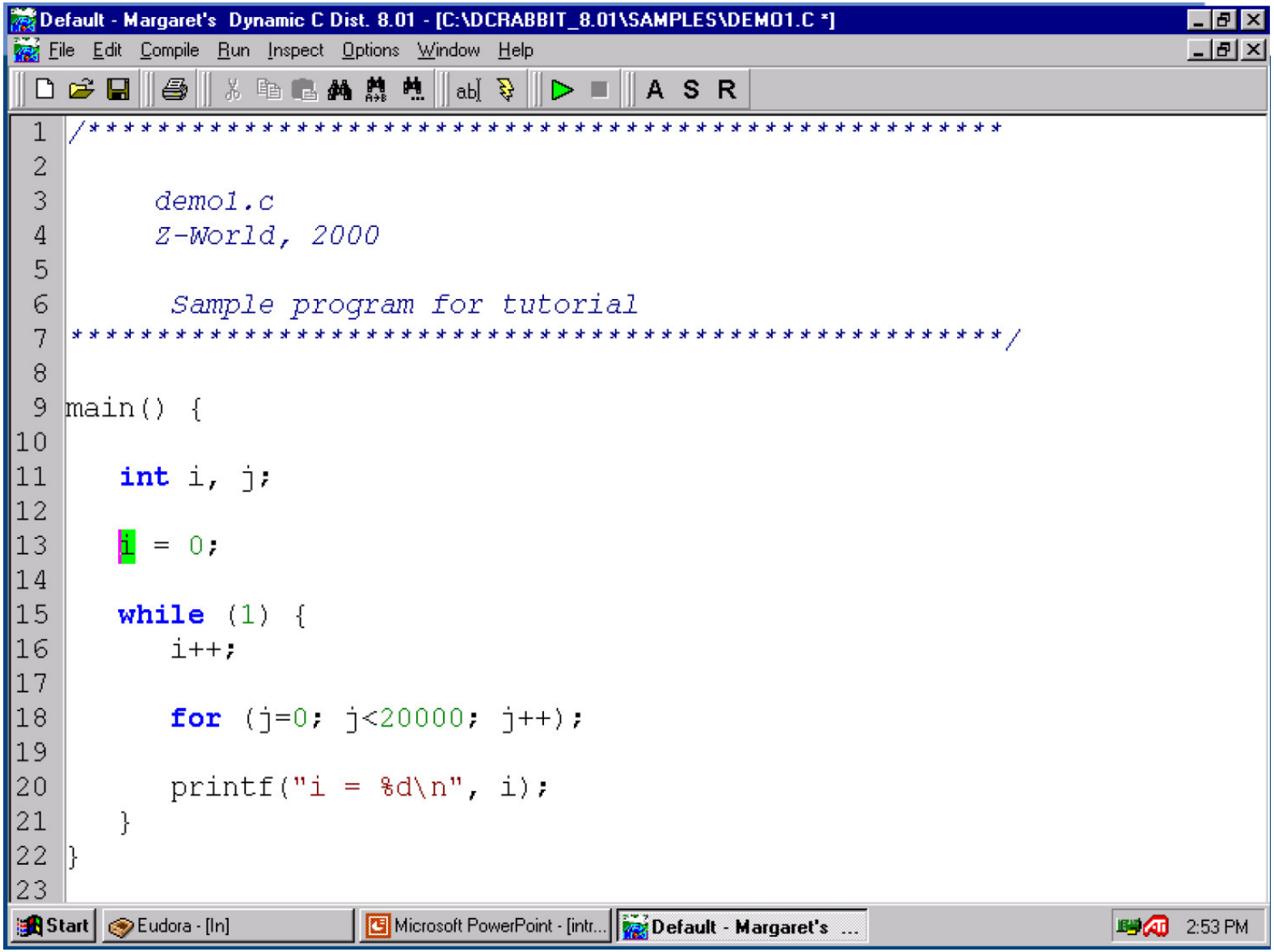
Microcontrolador Rabbit 2000, 128 k Flash, 32 k SRAM, etc.

www.rabbitsemiconductor.com, www.zworld.com


PA0–PA7
PB0
PB1
PB2–
PB5
PB6
PB7
PD0, PD3,
PD6, PD7
Port A
Port B
Port D
JACKRABBIT
Port E
PE4–PE5
2x RS-232,
1x RS-485,
CMOS synch-
ronous serial
Serial
Ports
RAM
Flash
Real-Time Clock
Watchdog
6 Timers
Slave Port
Clock Doubler
Backup Battery
D/A Converters
DA0
DA1
PCLK
IOBENB
Misc. Outputs
A/D Converter
AD0
Programming
Port
High-Power Outputs
HV0–HV3

Software de desenvolvimento

Dynamic C

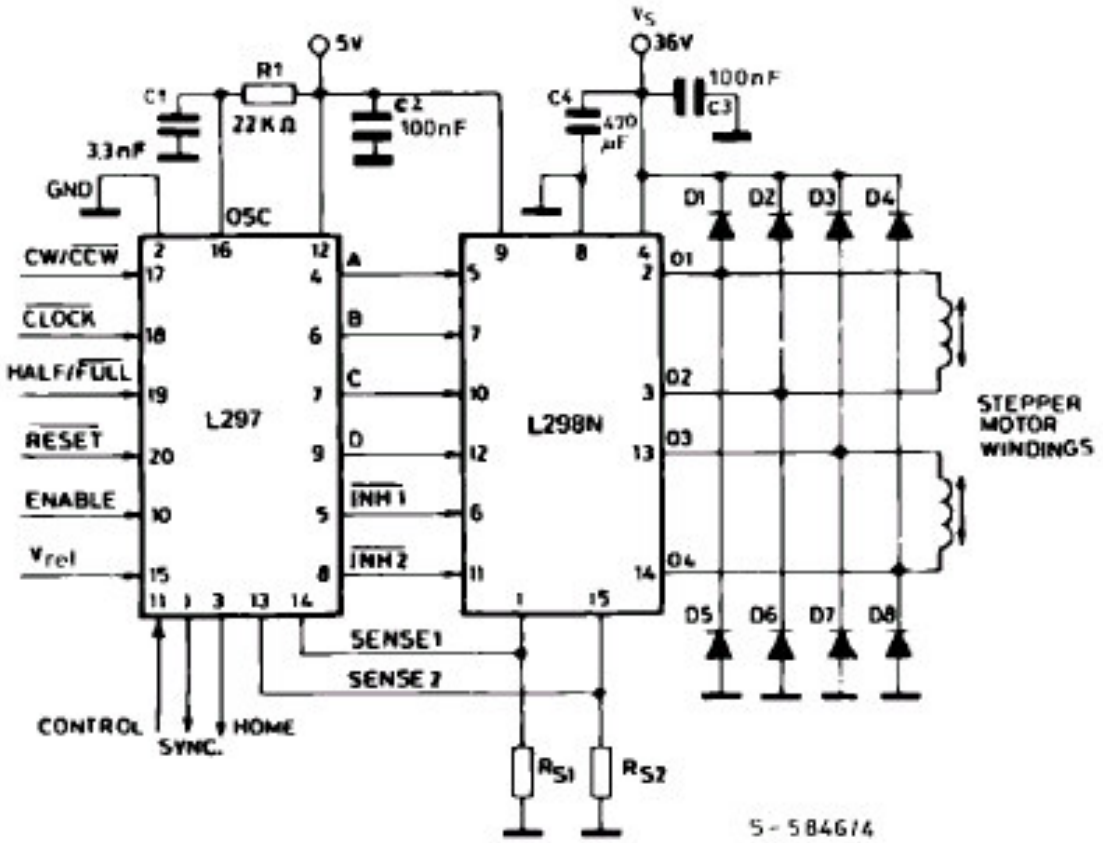


Controlador de motor de passo

Torque, velocidade

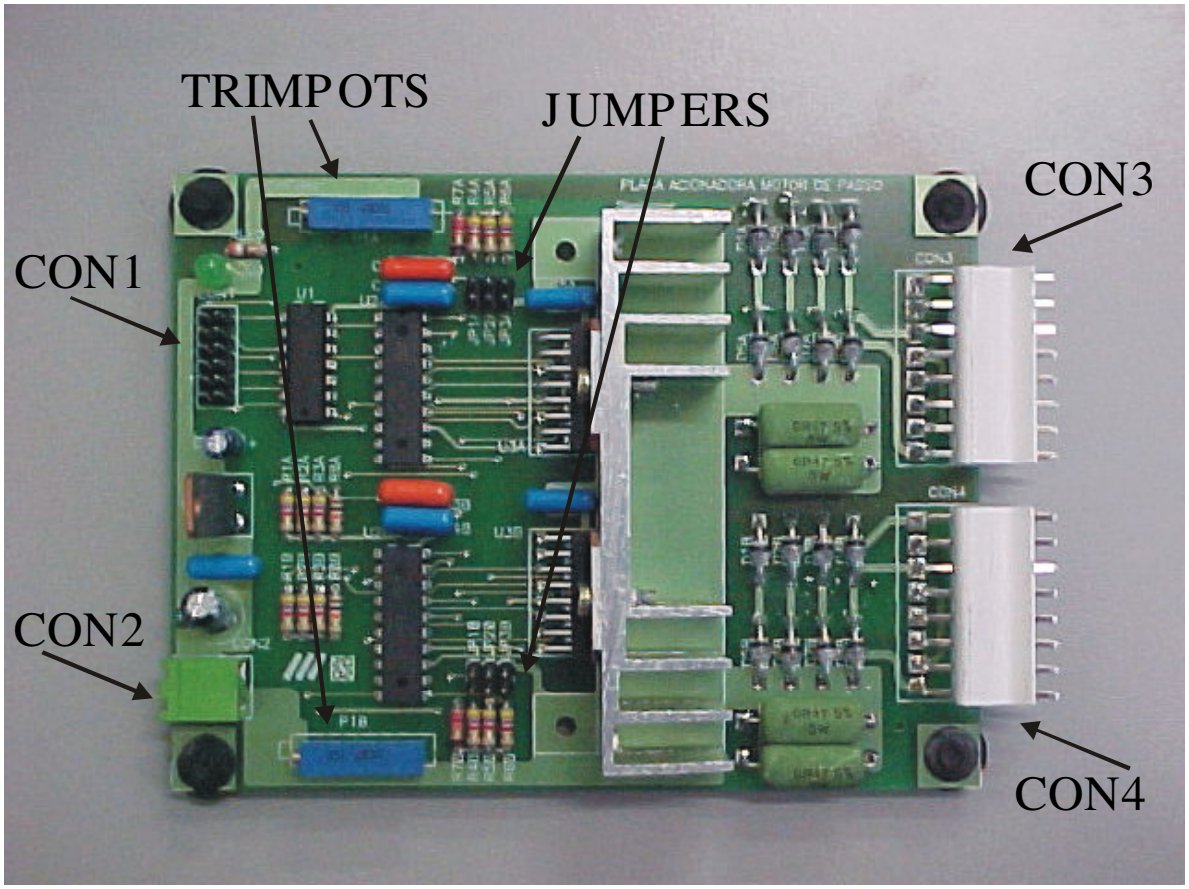
corrente

constante de tempo: L/R

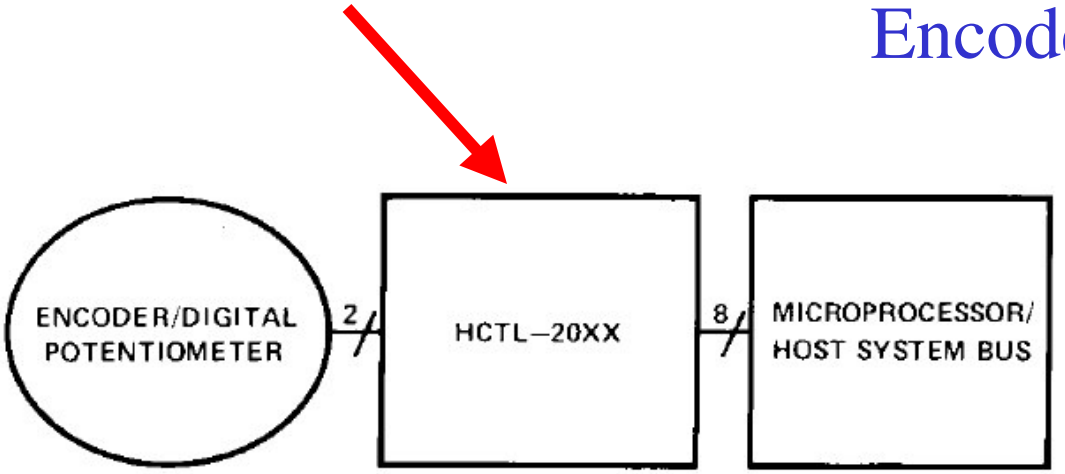


R_{S1} R_{S2} = 0.5 Ω
D1 to D8 = 2 Fast Diodes

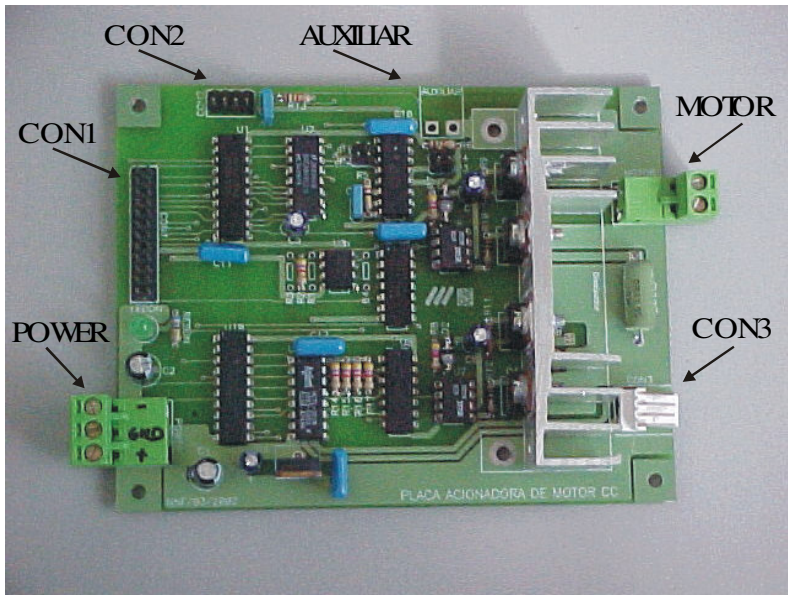
VF ≤ 1.2 @ I = 2 A
trr ≤ 200 ns

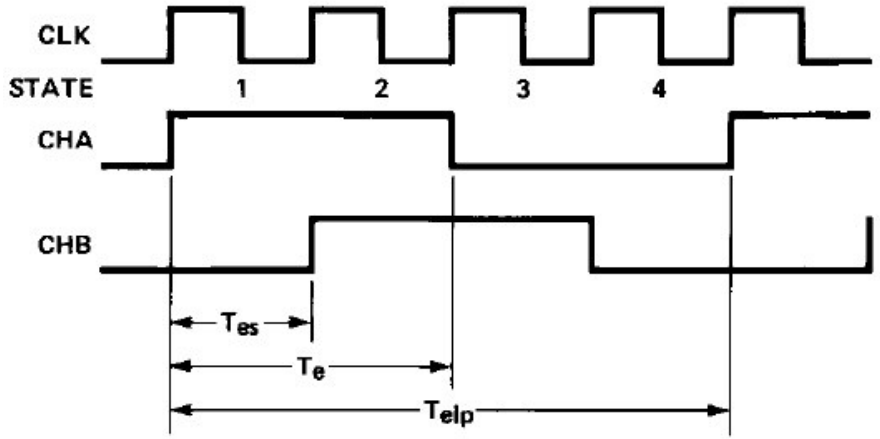

TRIMPOTS
JUMPERS
CON3
CON1
CON2
CON4

Encoder



Encoder: 5000 pulsos/volta

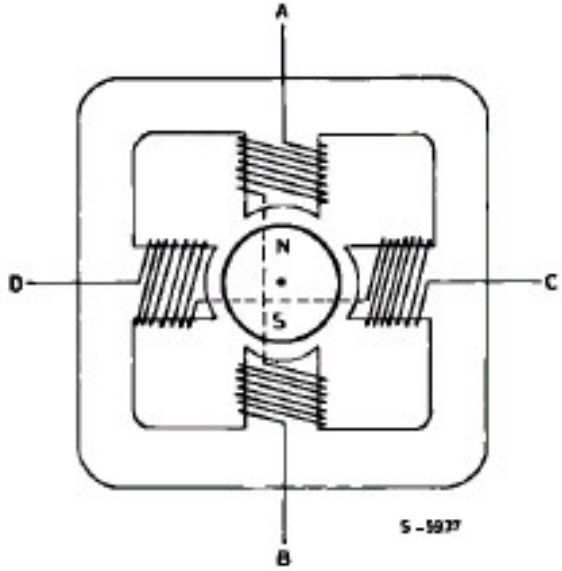


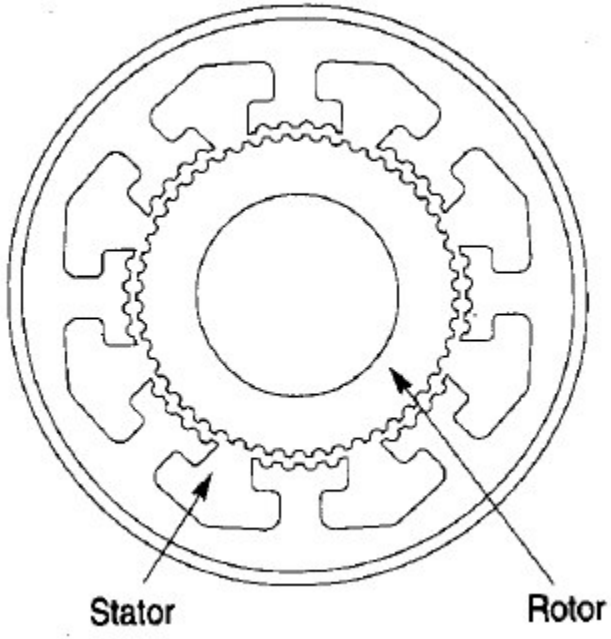


HCTL-2016

Motor de passo

Imã permanente
Relutância variável
Híbrido

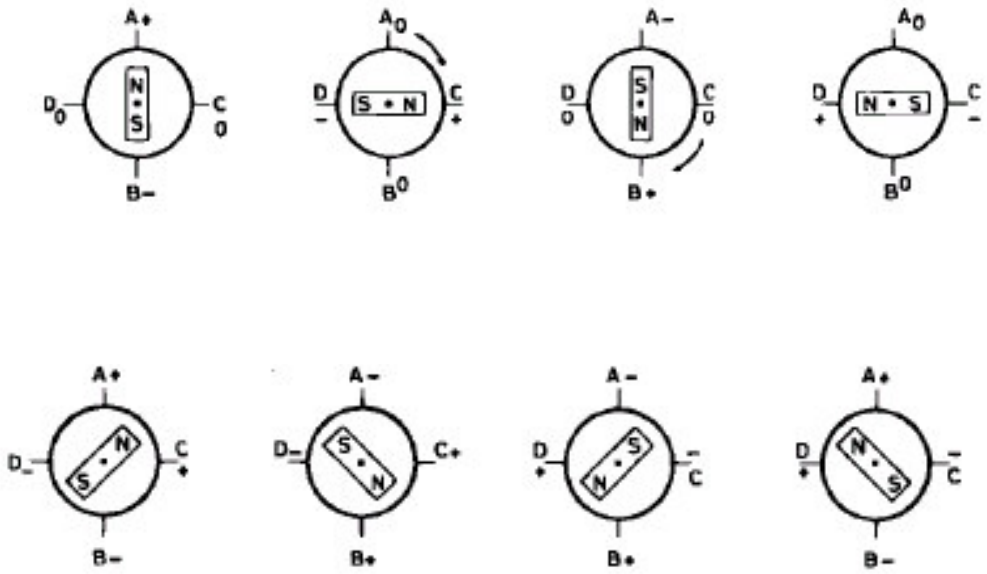




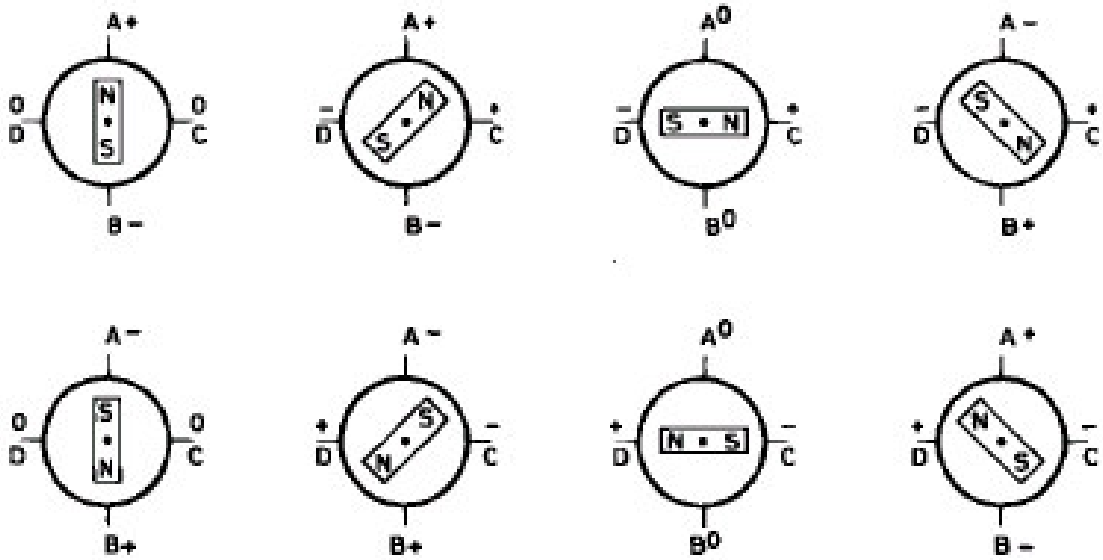
Passo completo: 200 p/volta

Meio passo: 400 p/volta

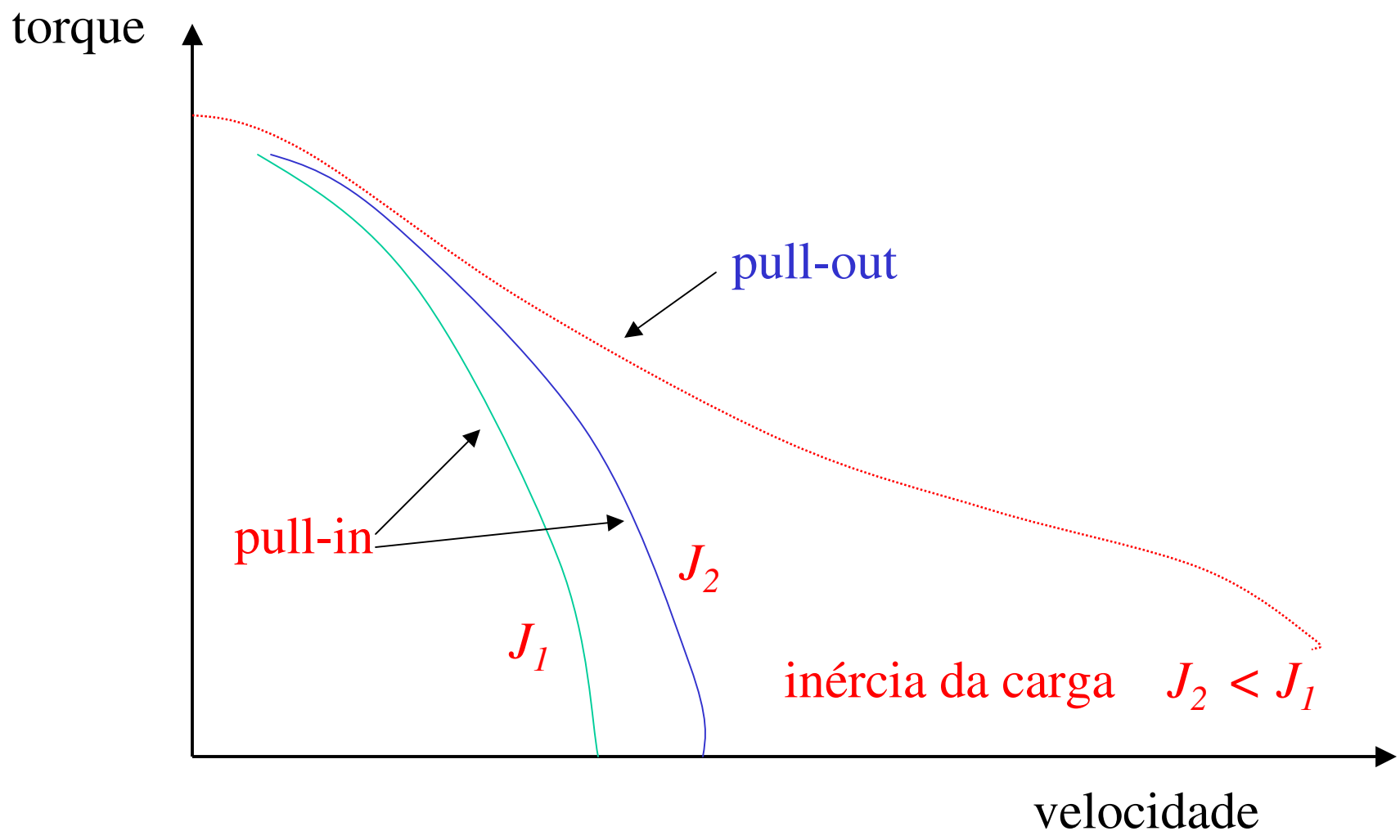
Curva de torque x velocidade



Meio passo

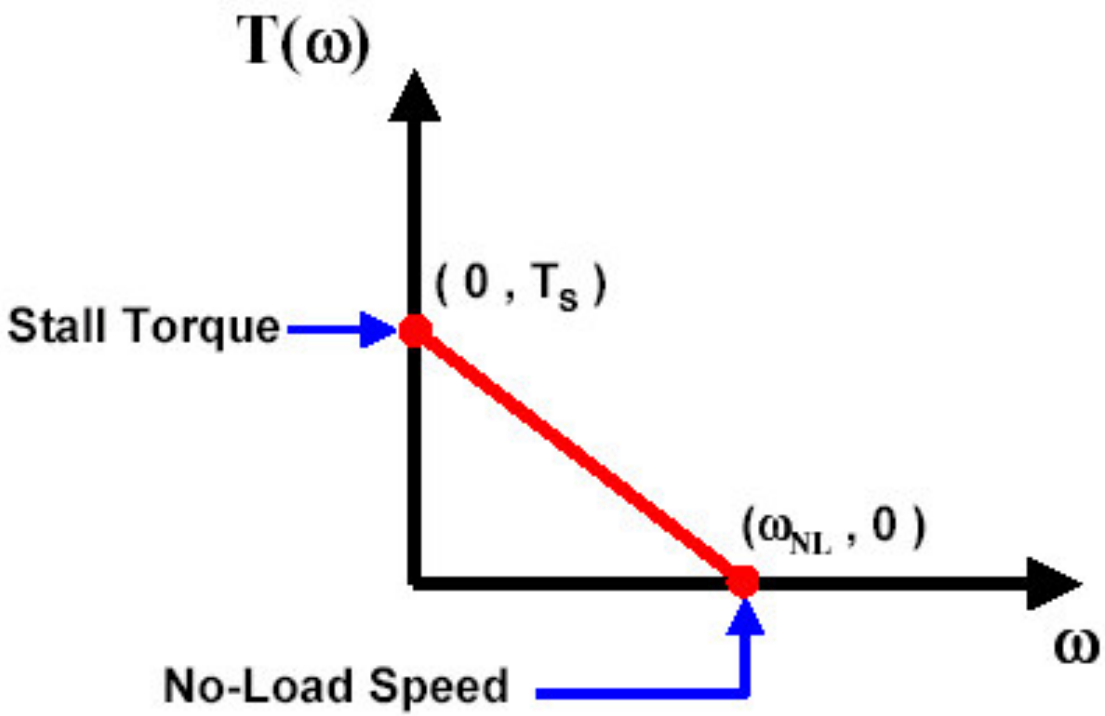


Curva torque x velocidade: motor de passo



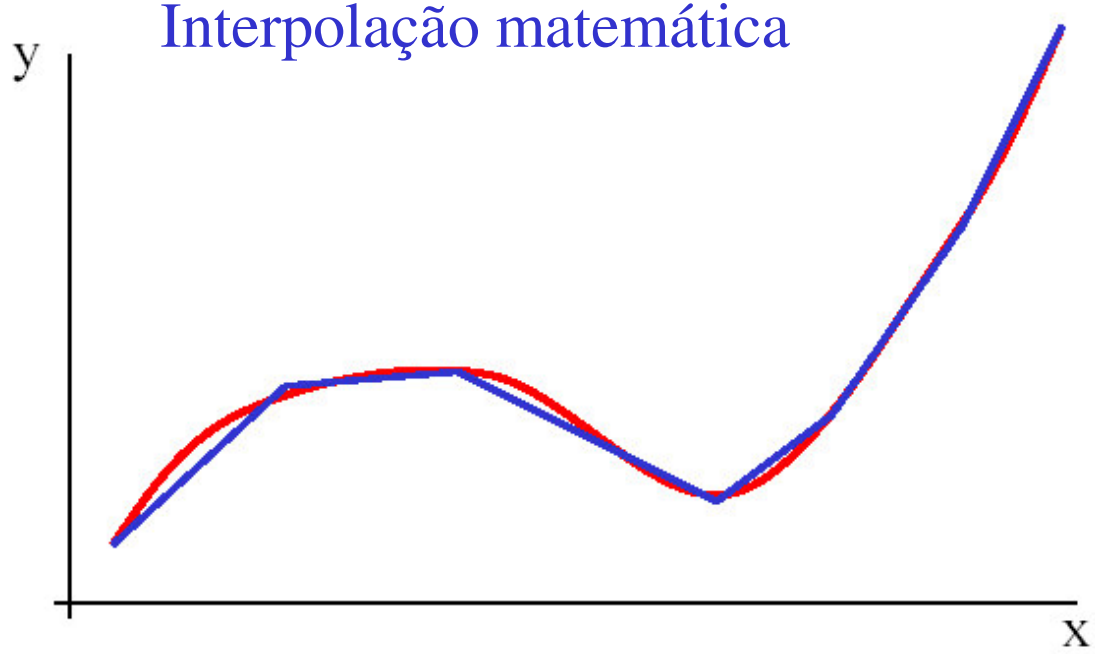
Acoplamento motor - carga

Curva torque x velocidade: motor CC



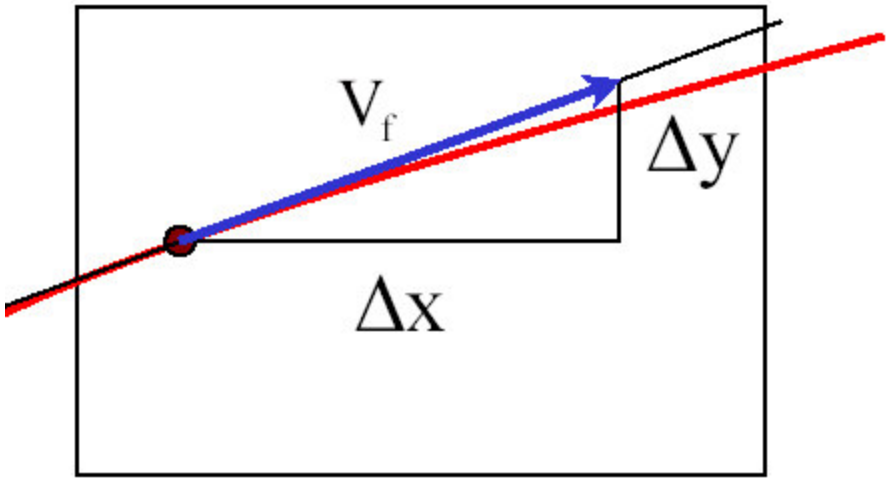
Software de controle

Interpolação matemática



Resolução: menor incremento

Interpolação: linear, circular



Linguagem de Programação

interpretador

Funções preparatórias G

G00 posicionamento rápido ponto a ponto

G01 [Xd.d] [Yd.d] [Zd.d] [Fd.d] movimento linear

G90 modo absoluto

G91 modo relativo

Funções M

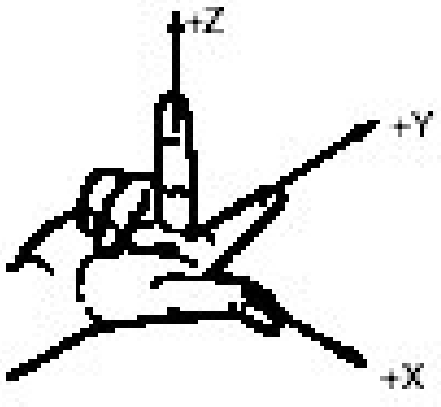
M02 fim de programa, pára eixo árvore

M03 gira eixo árvore no sentido horário

M05 pára movimento do eixo árvore

Sistemas de coordenadas

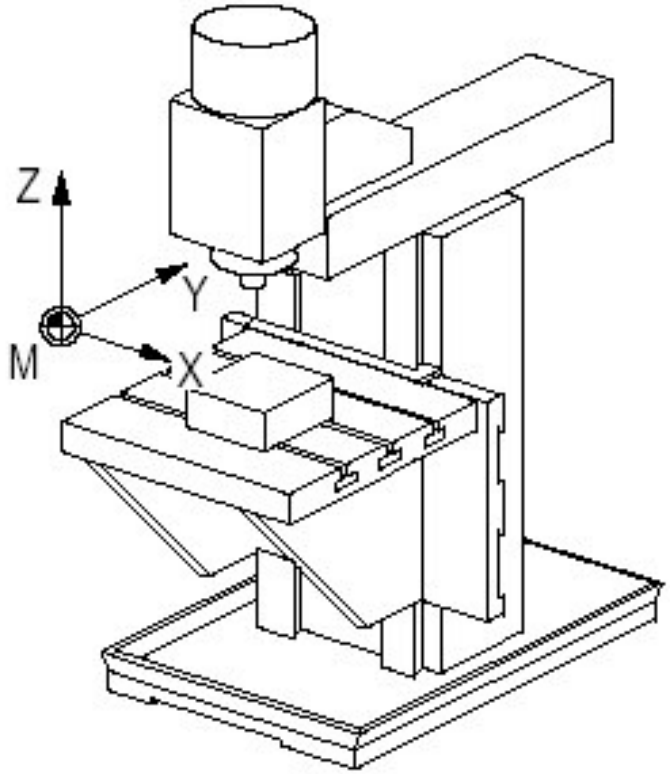
Regra da mão direita



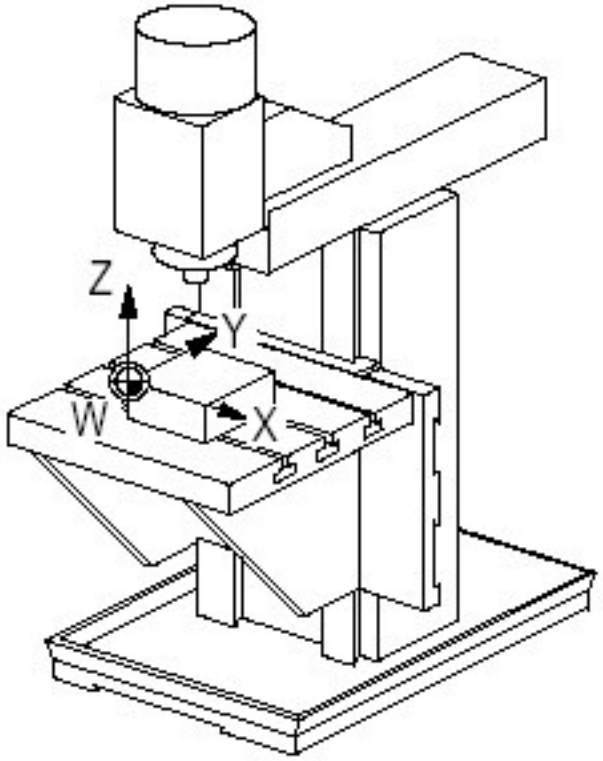
Sistema de coordenadas da máquina: definida pelo fabricante

Sistema de coordenadas da peça: definida pelo operador

Fresadora

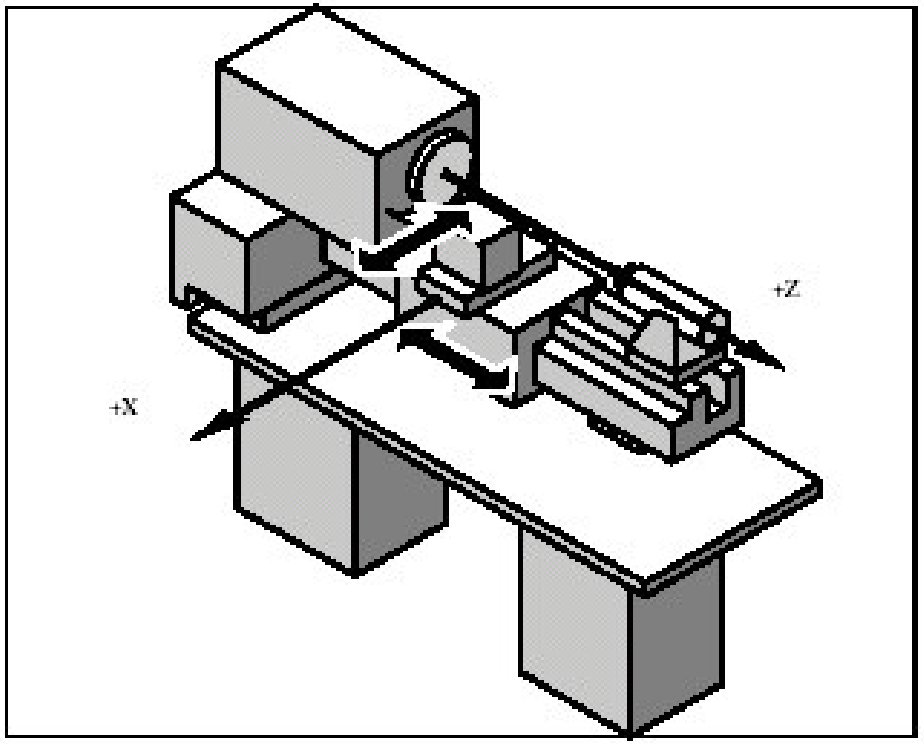


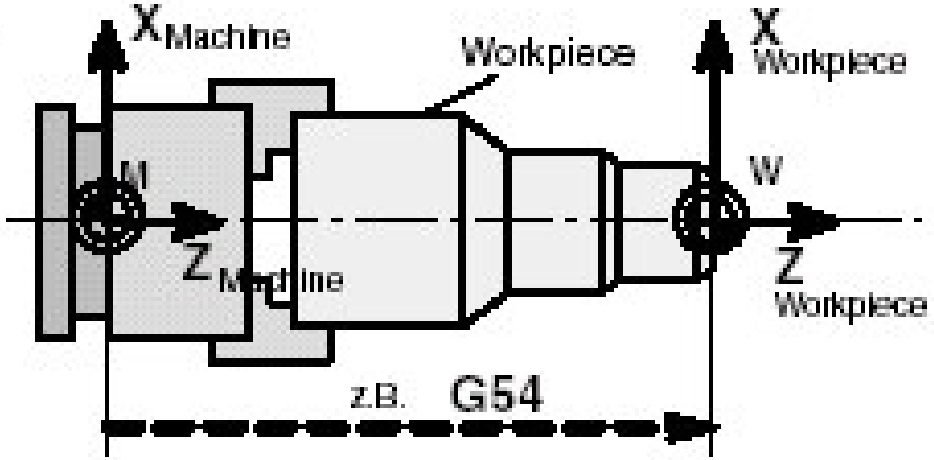
Sistema de coordenadas da máquina



Sistema de coordenadas da peça

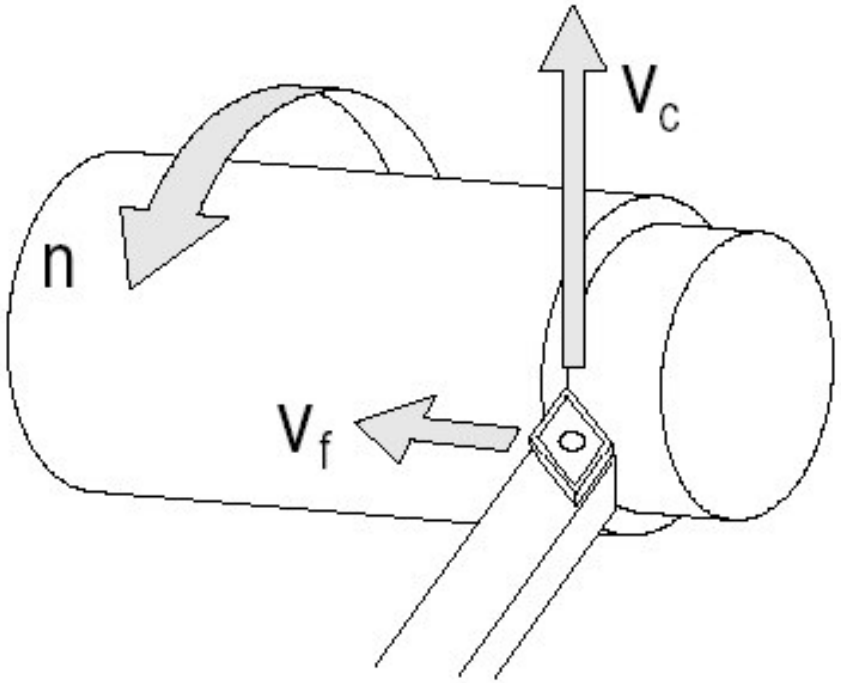
Torno


+Z
+X


X Machine
Workpiece
X Workpiece
W
Z Machine
Z Workpiece
z.B. G54

Parâmetros de usinagem

Forças envolvidas



N = rotação

V_f = velocidade de avanço

V_c = velocidade de corte

Programação

Ciclos de usinagem

Caminhos da ferramenta