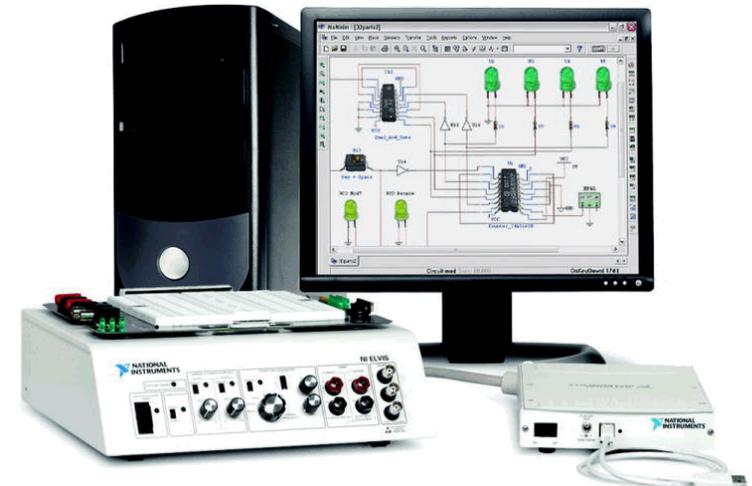
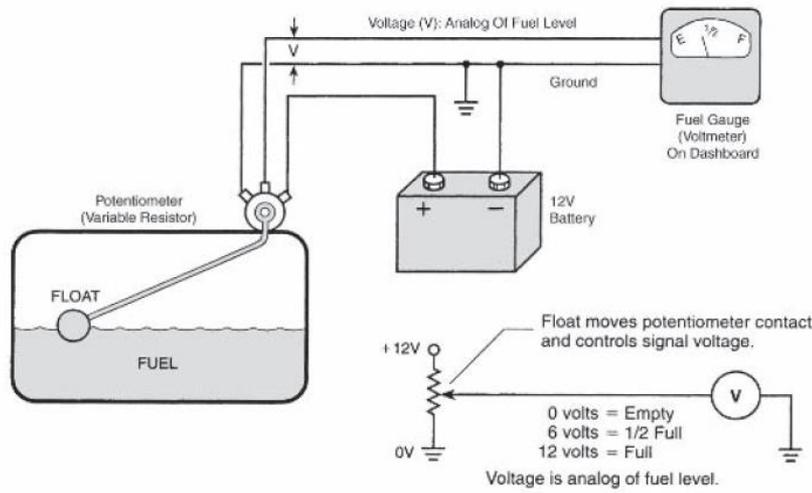
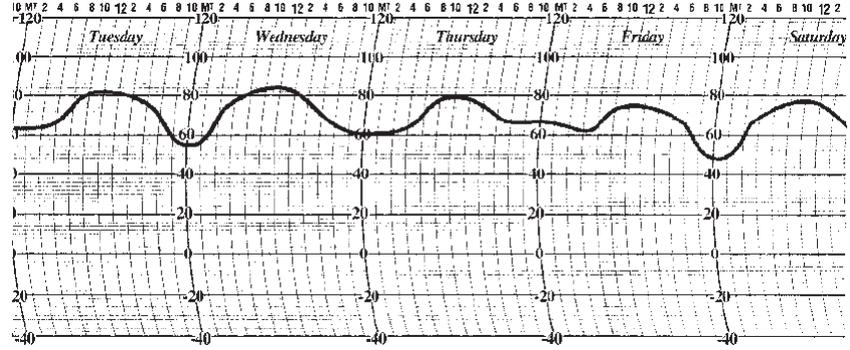
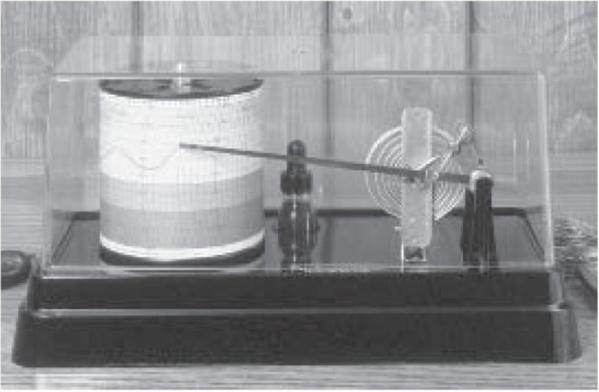


- **Aquisição dados**
- **Conversão DA**
- **Conversão AD**
- **Outros tipos de conversores AD**
- **Características de conversores AD e D/A**

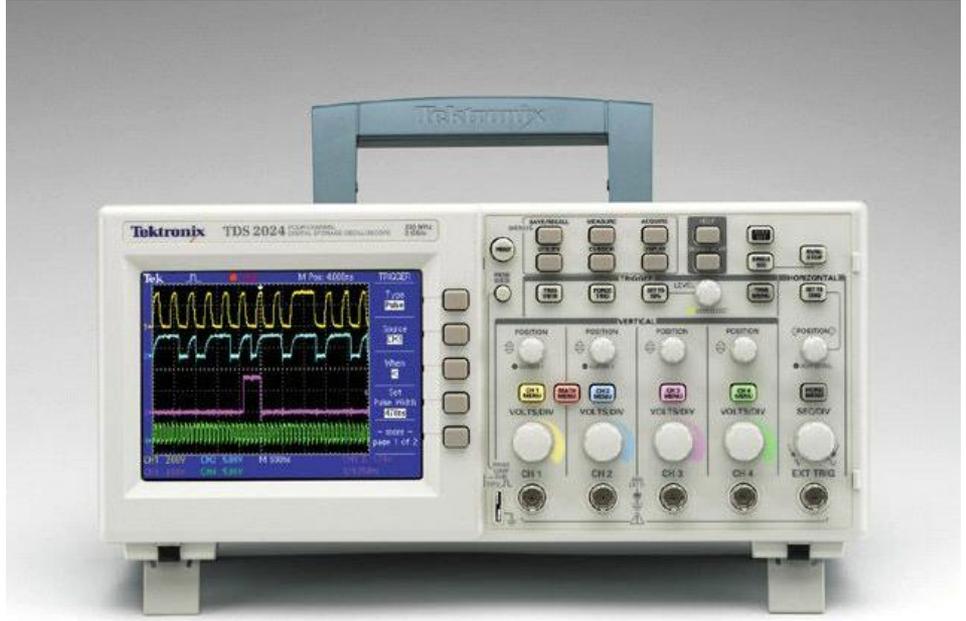


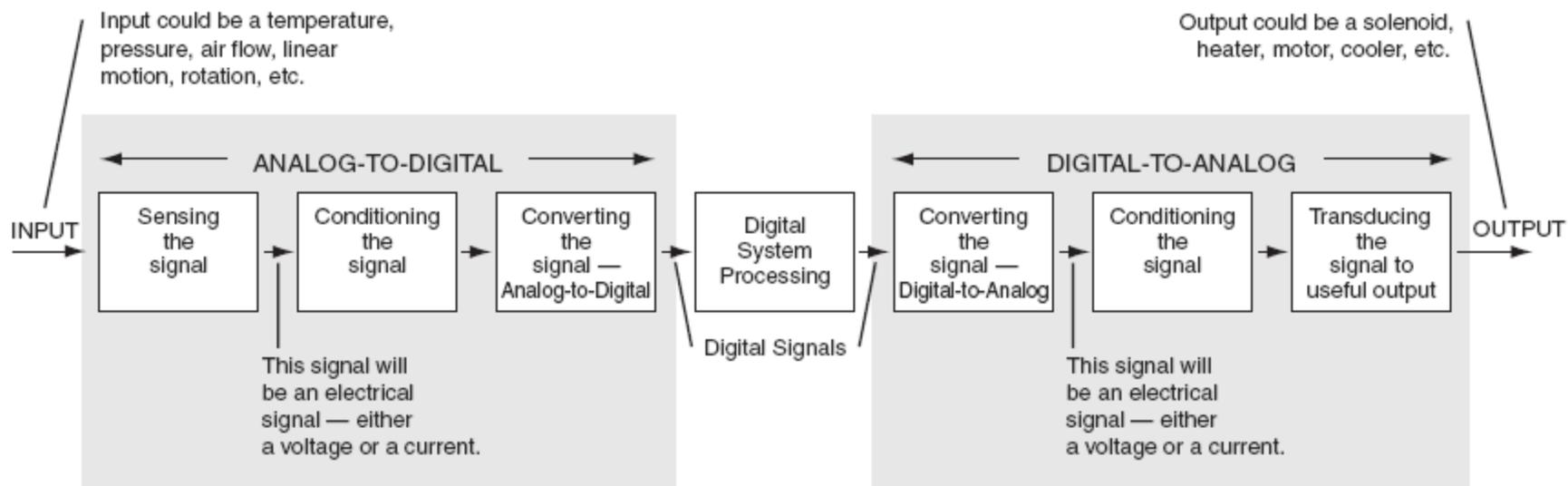


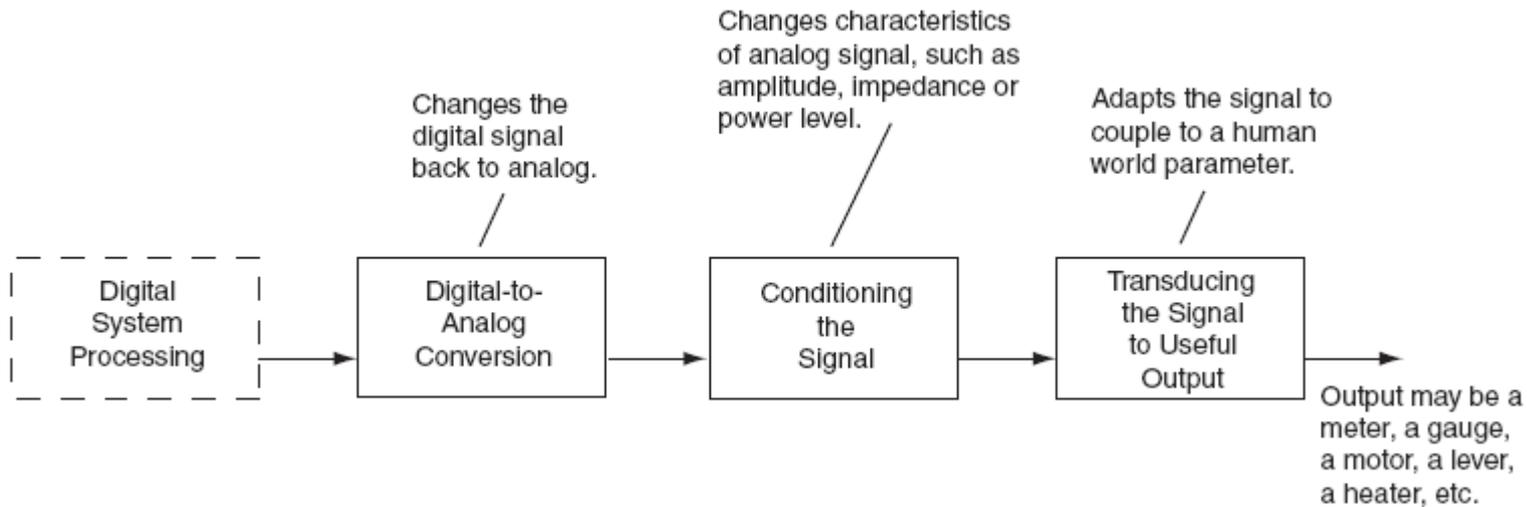


Multímetro

Osciloscópio

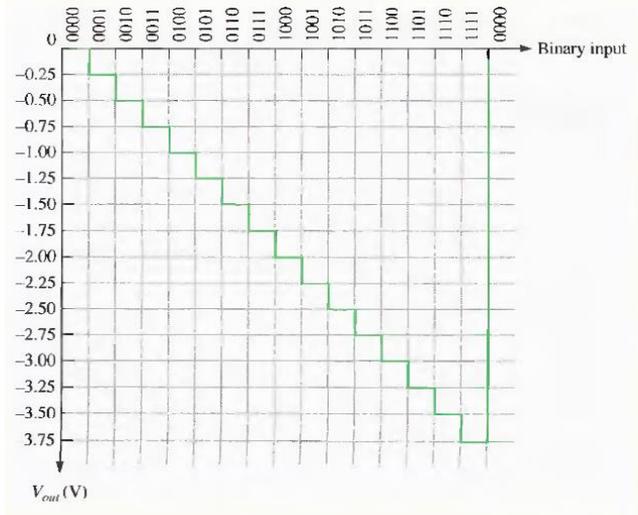
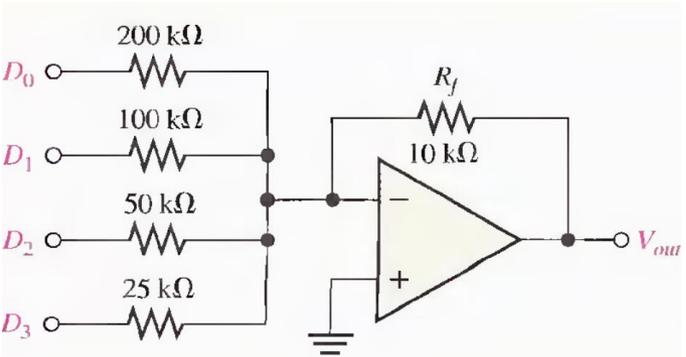




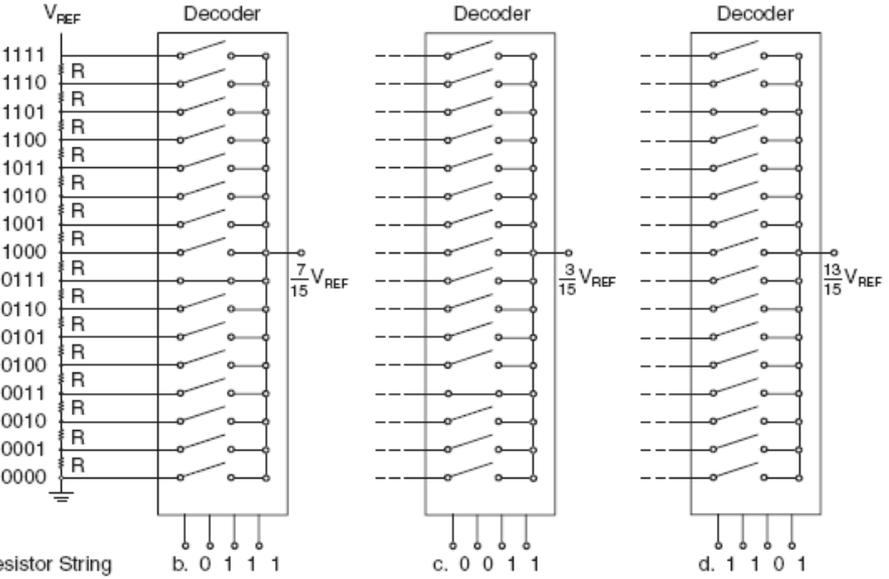


0's e 1's para níveis de tensão analógicos

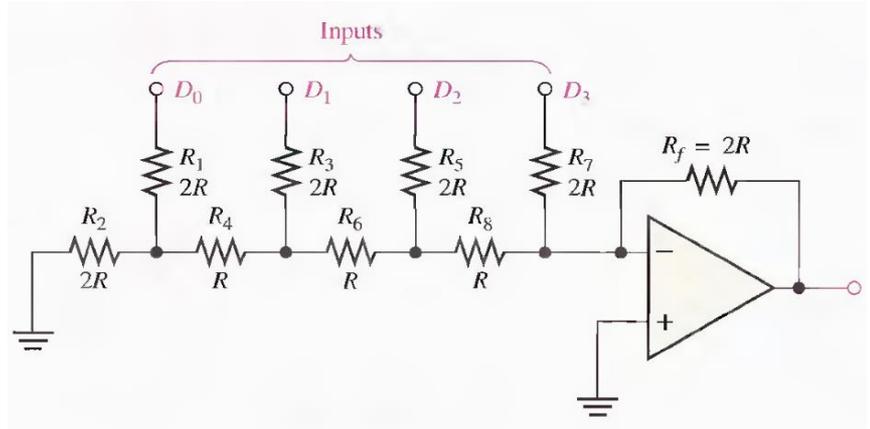
DA com entrada digital binária ponderada

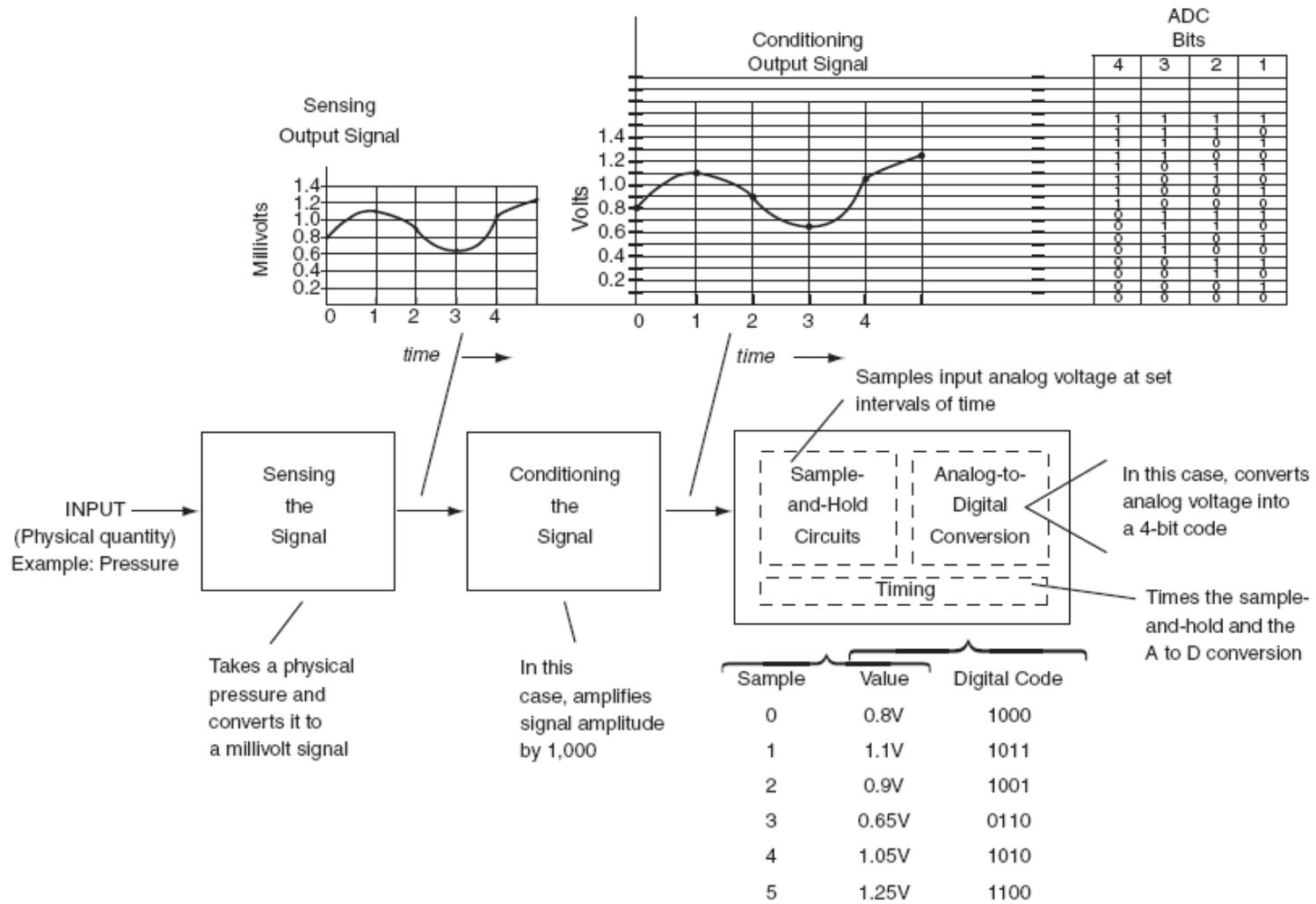


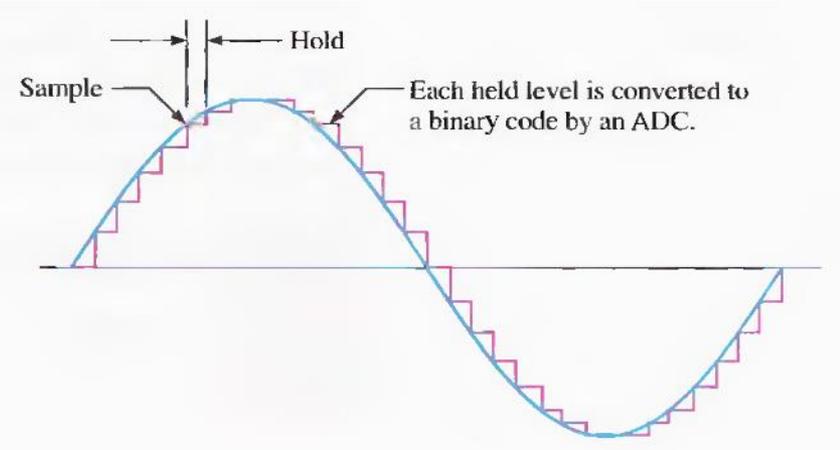
DA com cadeia de resistores



DA com escada R/2R

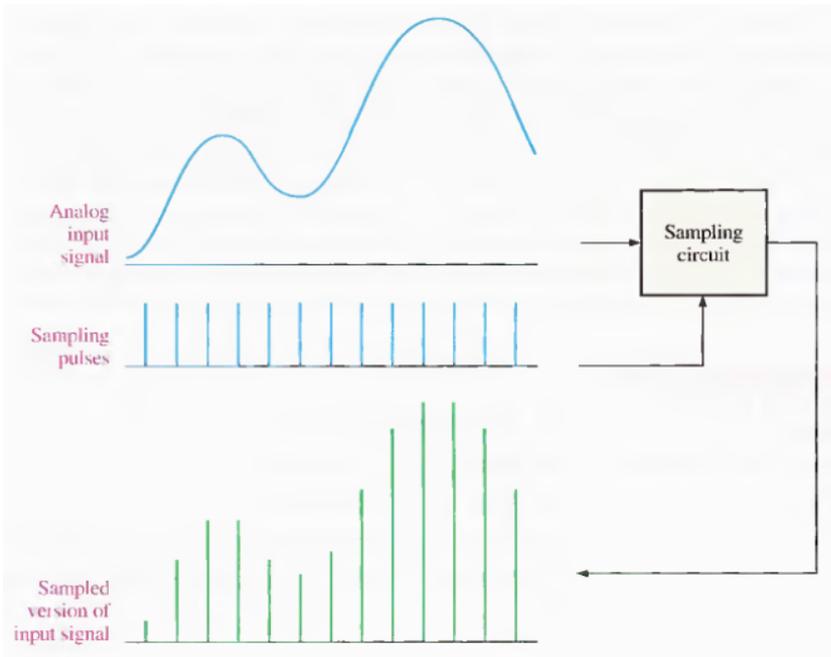
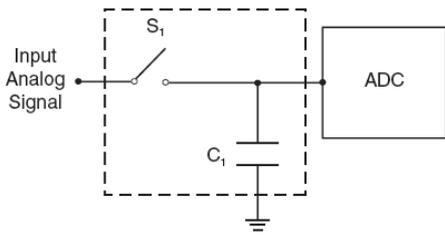




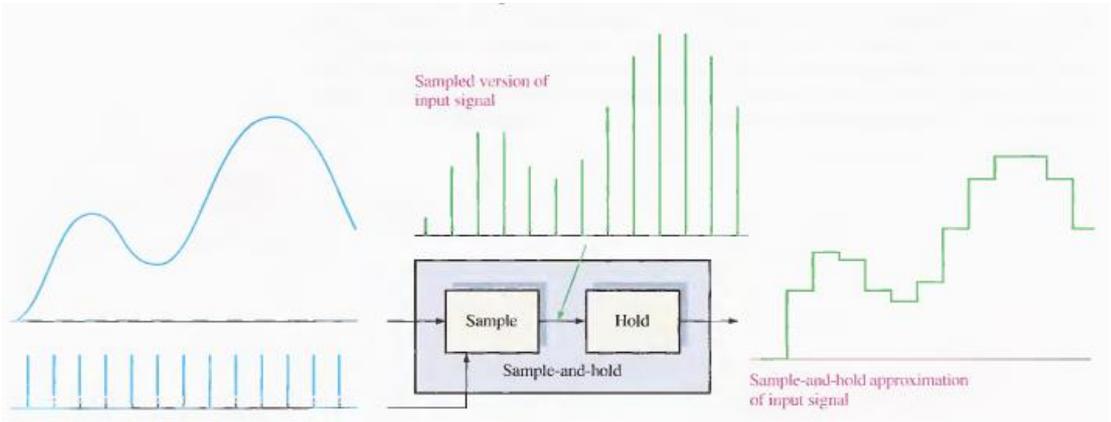


Representação em um determinado número de níveis

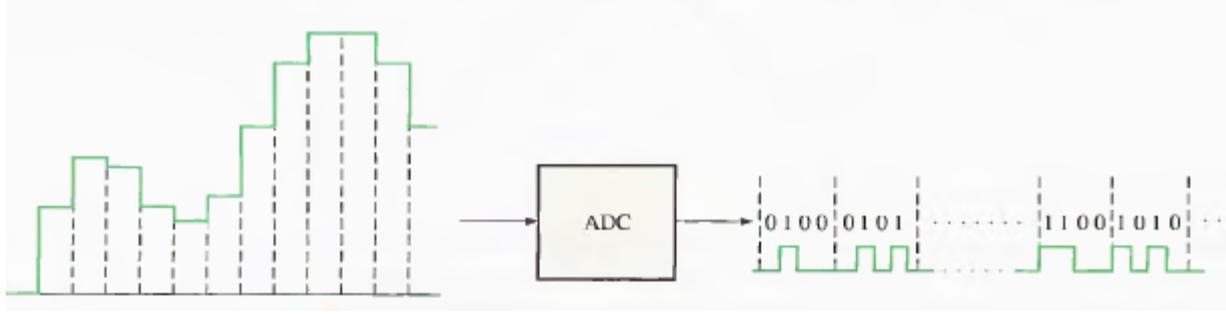
Amostrar e reter



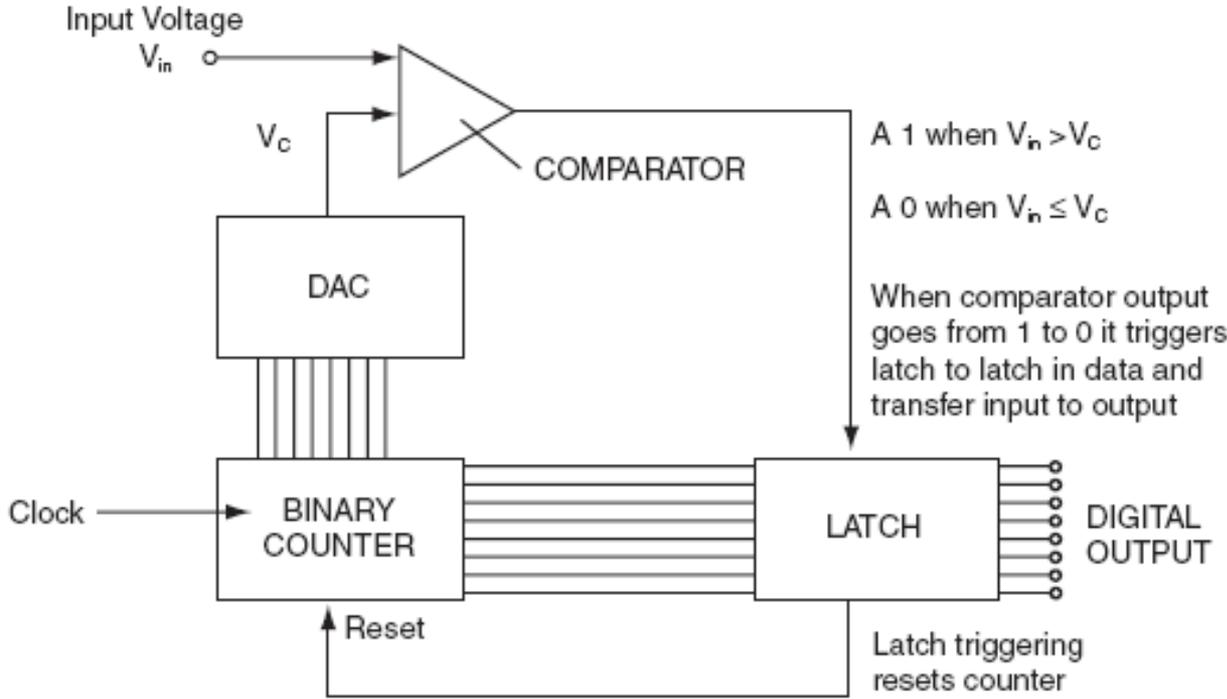
Amostrar e reter



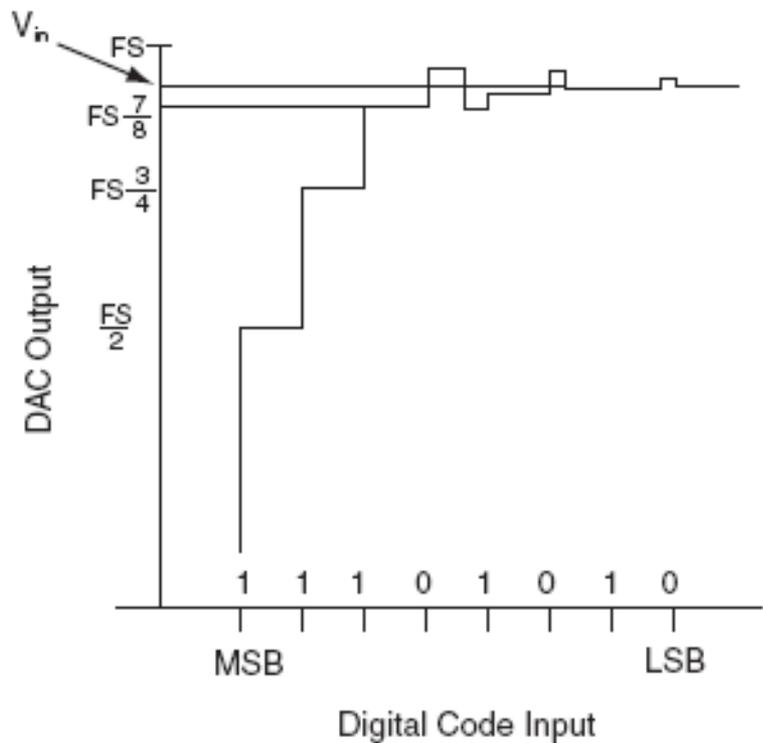
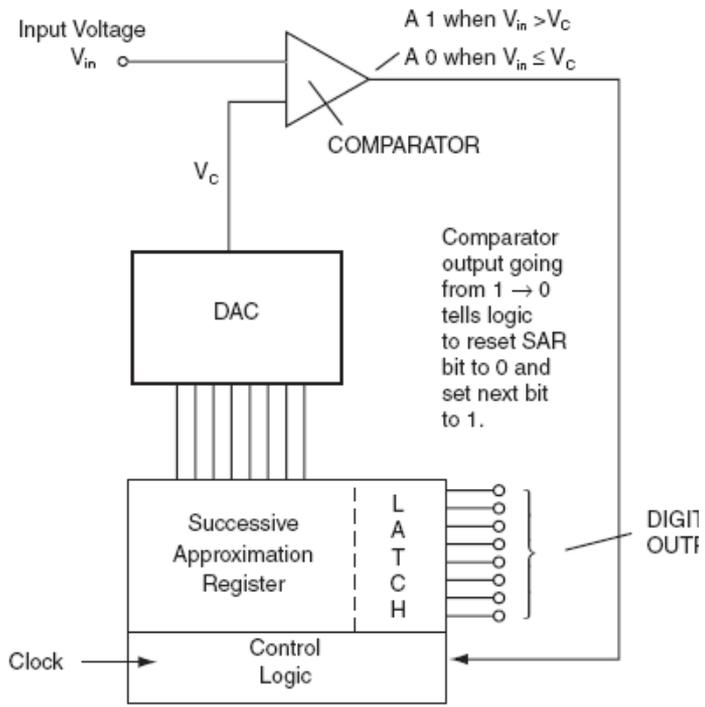
Amostras retidas → Números binários



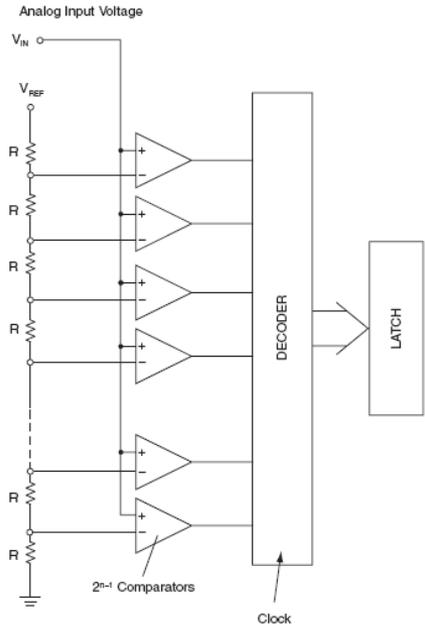
Conversor AD com contador binário



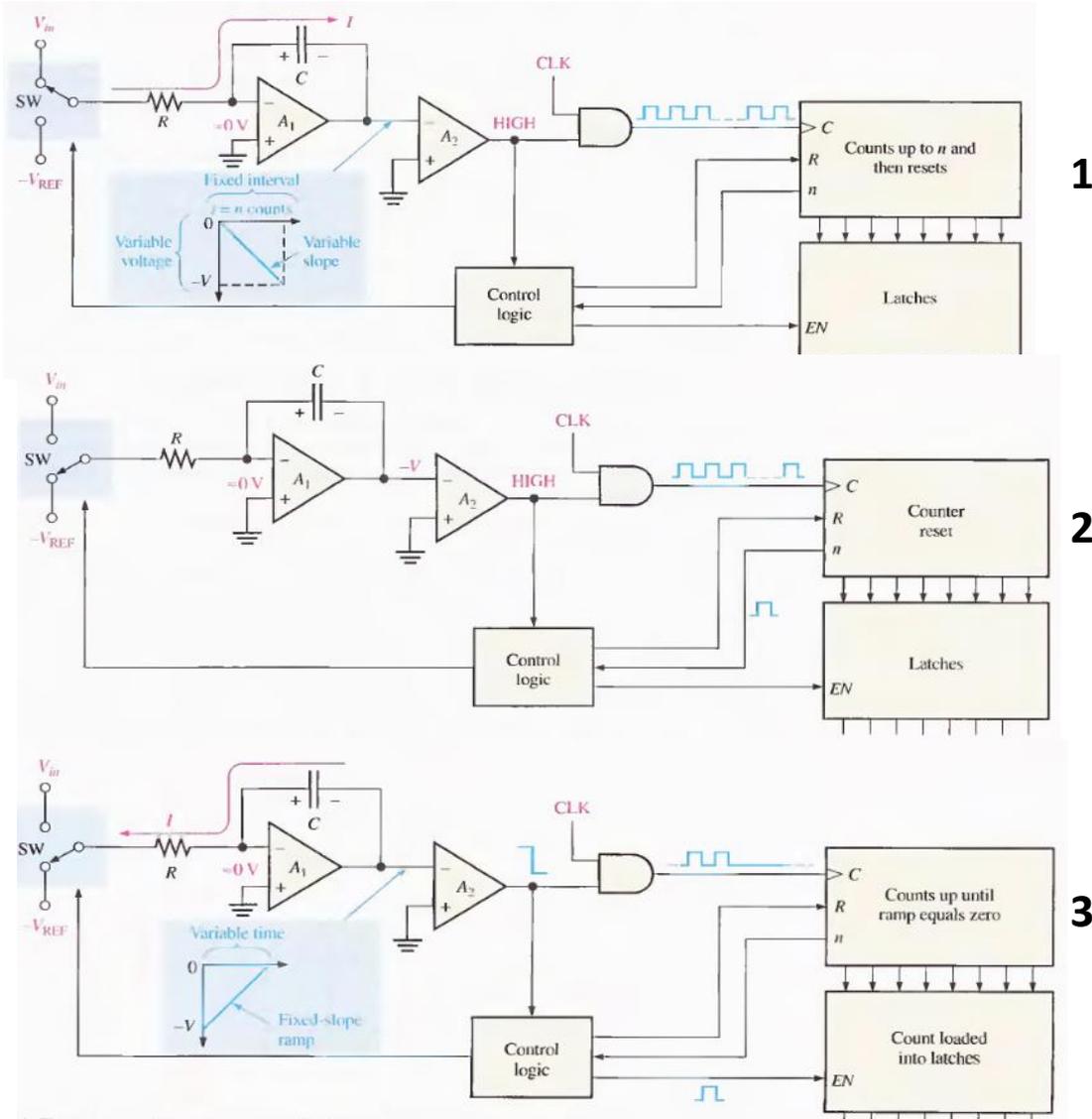
Conversor AD com Aproximação Sucessiva



Conversor AD tipo Flash



Conversor AD Dual-Slope



Conversão para Sinal Digital

Características de conversores AD e DA

Número de bits

Taxa de amostragem

Faixa de tensão de entrada

Resolução $Q = \frac{\Delta V}{2^n}$

Erro de quantização $e_q = \pm \frac{Q}{2}$

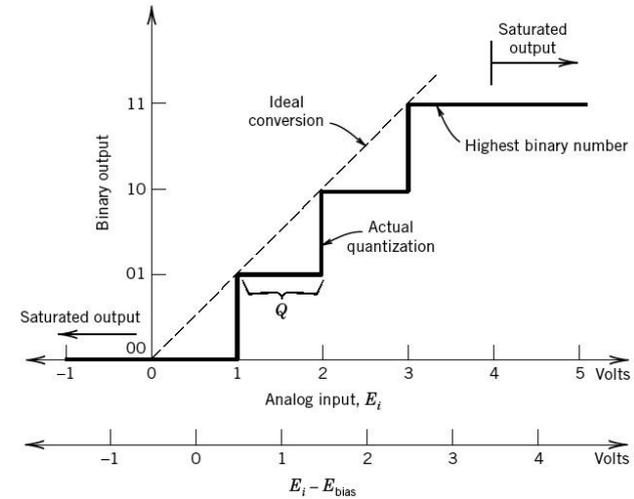
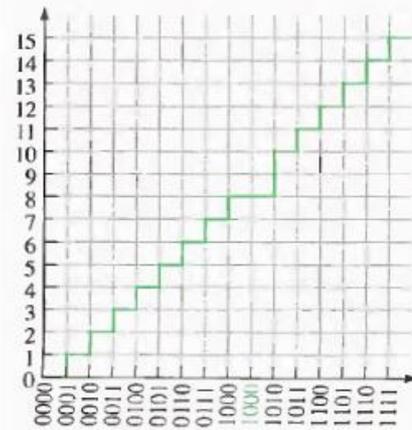
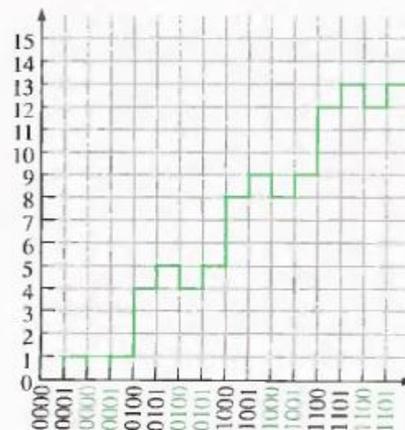


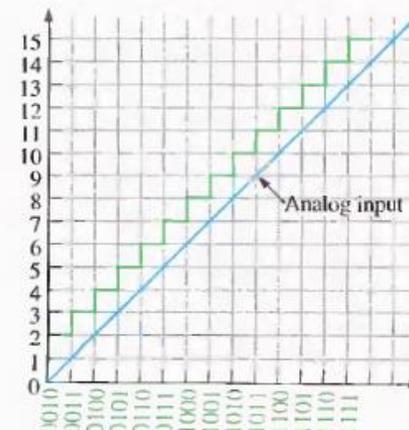
Figure 7.7 Binary quantization and saturation.



(a) Missing code (green)

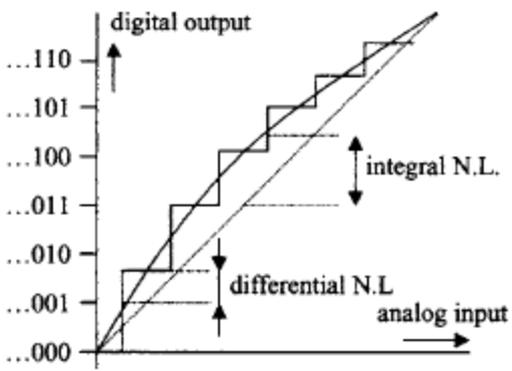


(b) Incorrect codes (green)

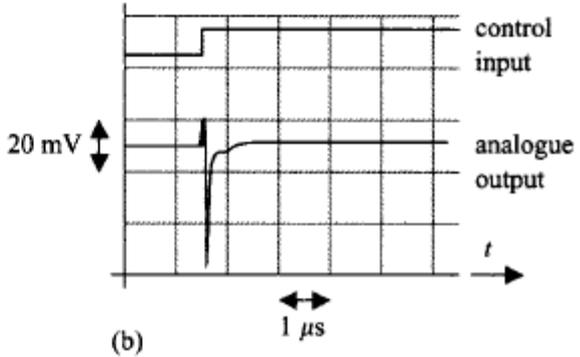
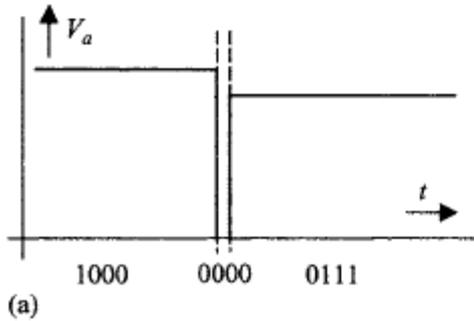


(c) Offset

Características de conversores AD e DA

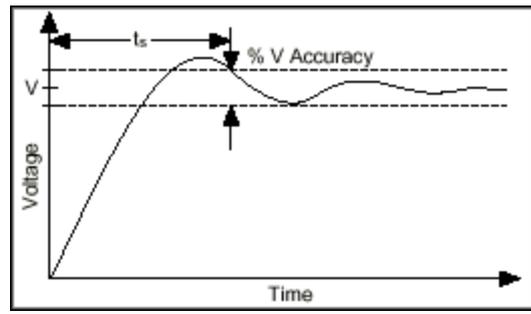
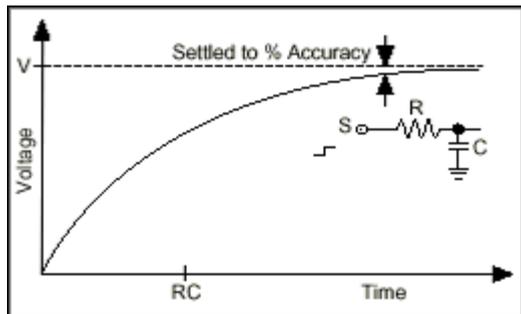
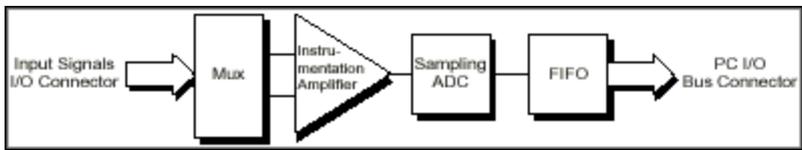


Não-linearidade diferencial e integral



Glitching

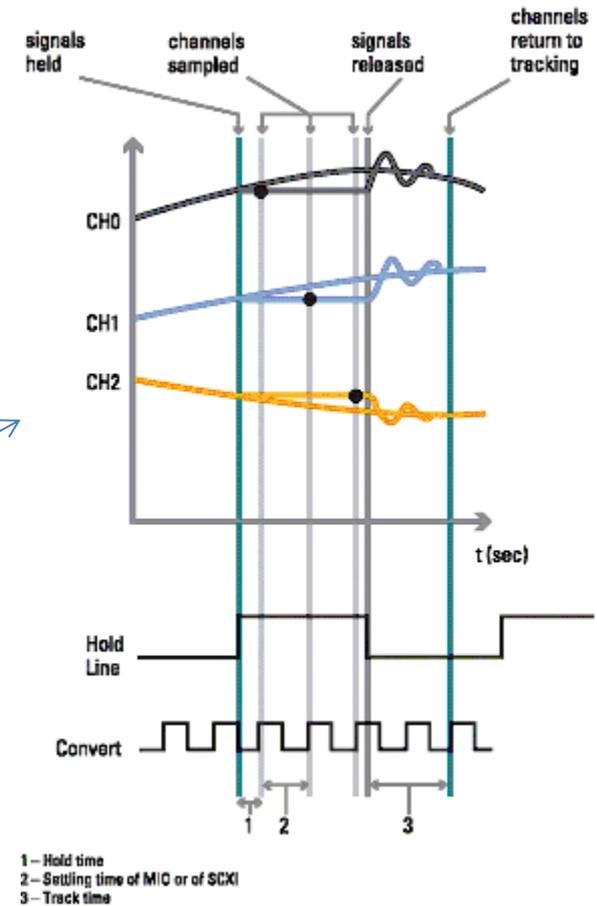
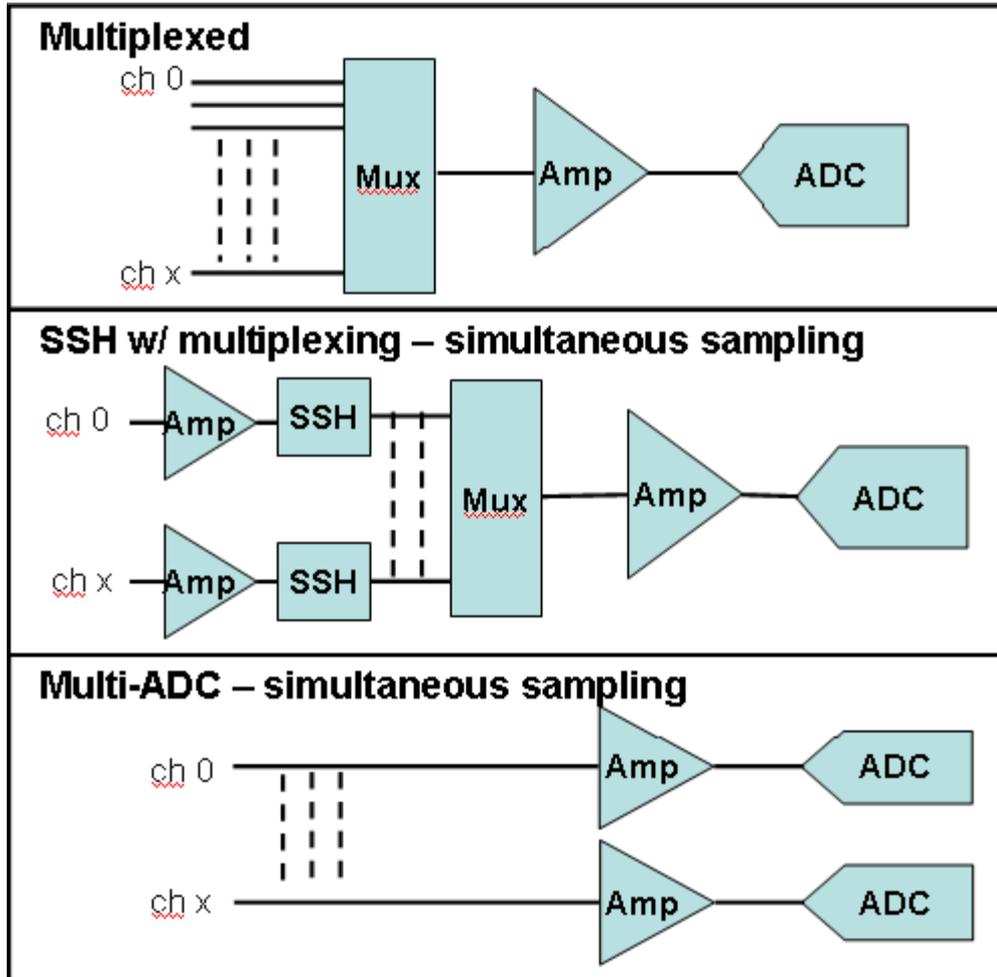
Tempo de ajuste – settling time



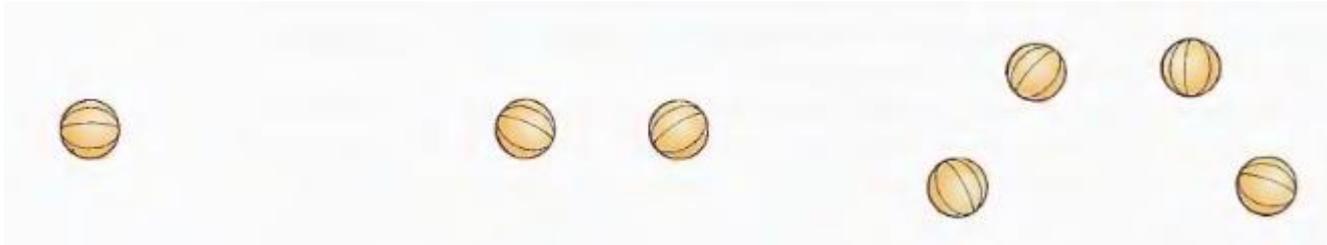
Conversão para Sinal Digital

Características de conversores AD e DA

Múltiplos canais



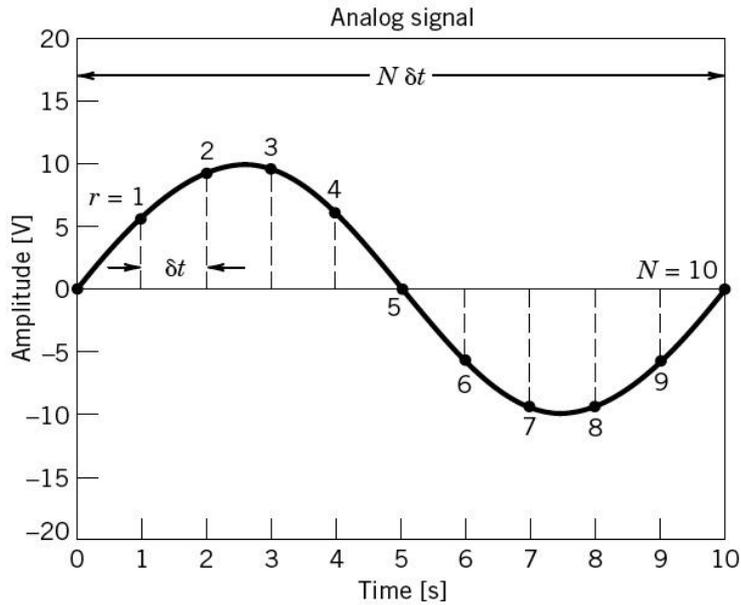
Aliasing



Diferentes tempos de amostragem

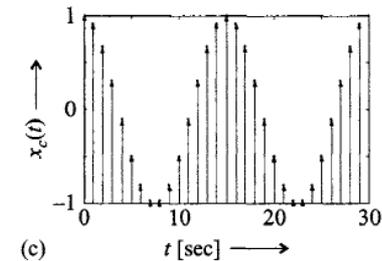
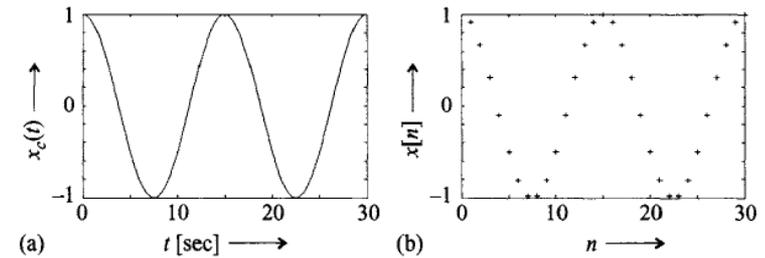
Conversão para Sinal Digital

Aliasing



Discrete time signal	
$\{y(r\delta t)\}$	
r	Discrete data
0	0
1	5.9
2	9.5
3	9.5
4	5.9
5	0
6	-5.9
7	-9.5
8	-9.5
9	-5.9
10	0

Figure 7.1 Analog and discrete representations of a time-varying signal.

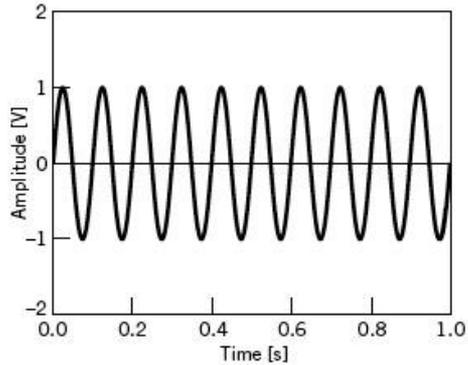


Conversão para Sinal Digital

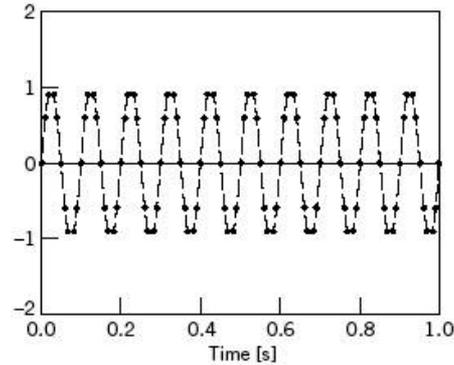
Aliasing

Frequência de Nyquist

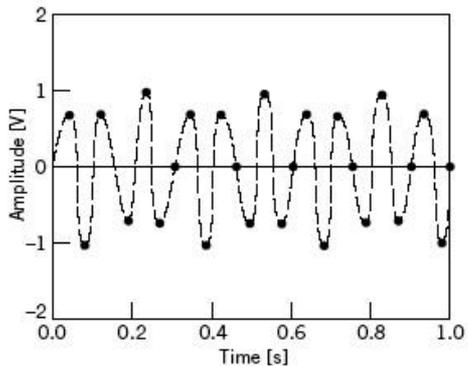
$$f_{\text{sampl}} \geq 2f_{\text{cut}}$$



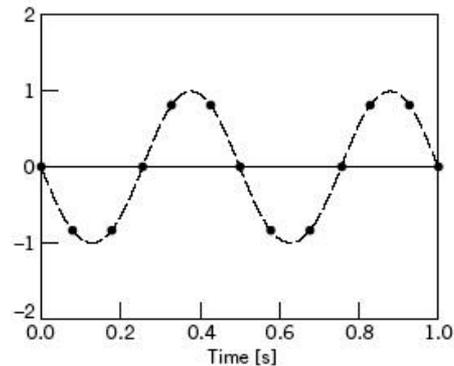
(a) Original 10-Hz sine wave analog signal



(b) $f_s = 100$ Hz



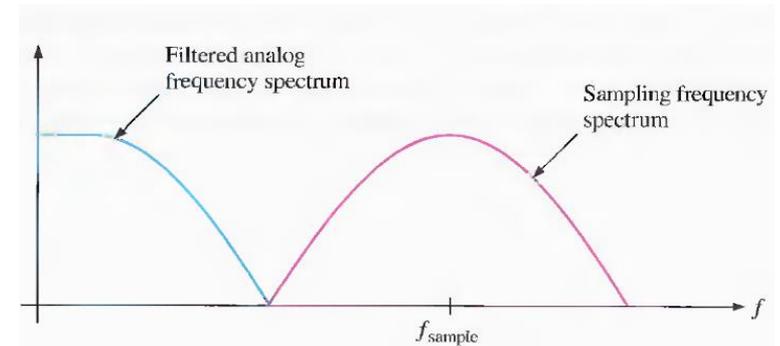
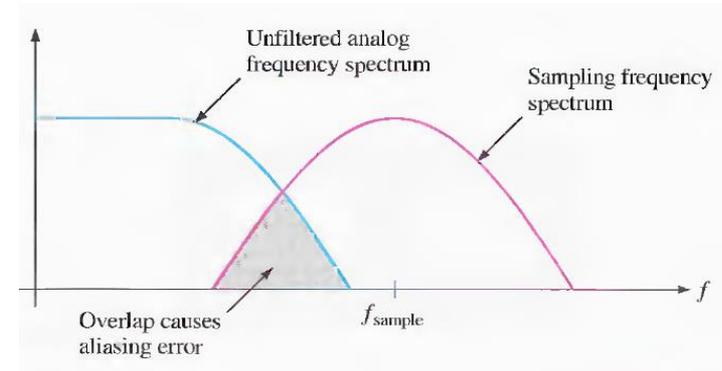
(c) $f_s = 27$ Hz



(d) $f_s = 12$ Hz

Figure 7.2 The effect of sample rate on signal frequency and amplitude interpretation.

Filtragem



Na prática utilizam-se filtros de amostragem de freq. de corte pelo menos 5x menor que a freq. de amostragem

Ambiguidade de amplitude - Leakage

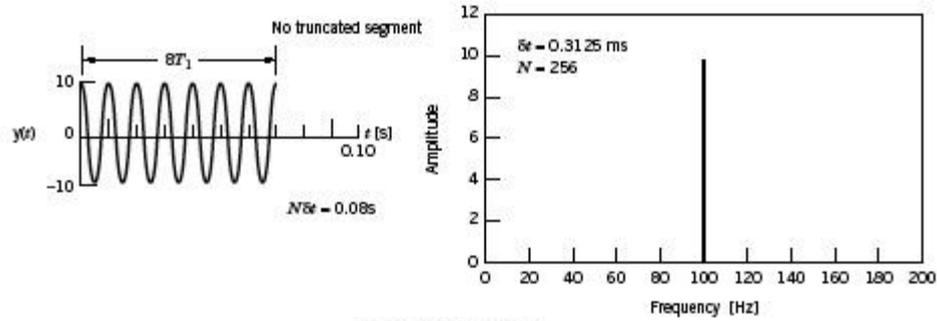
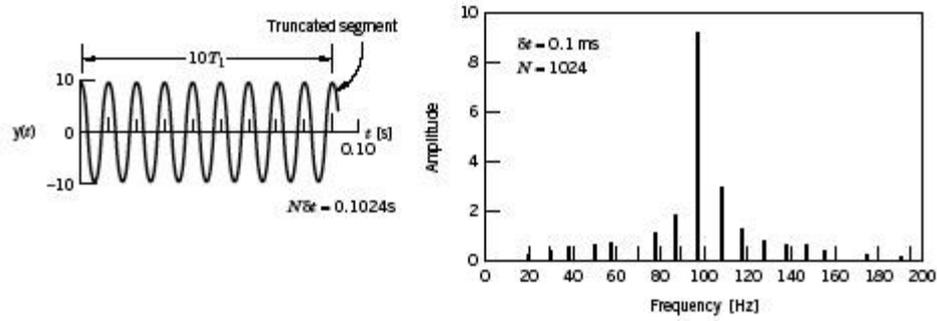
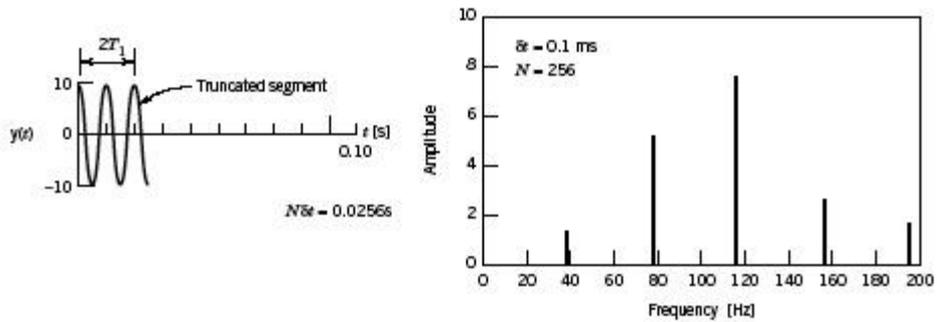
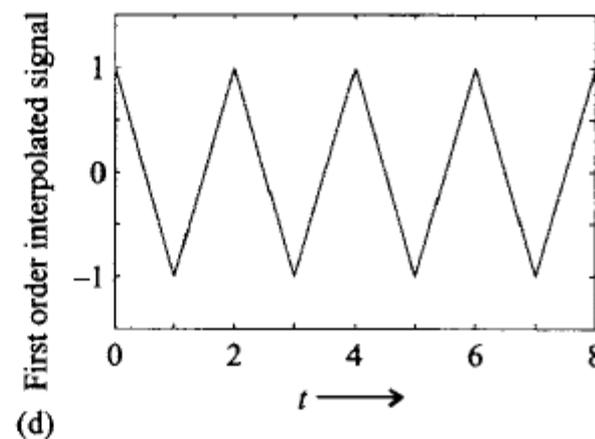
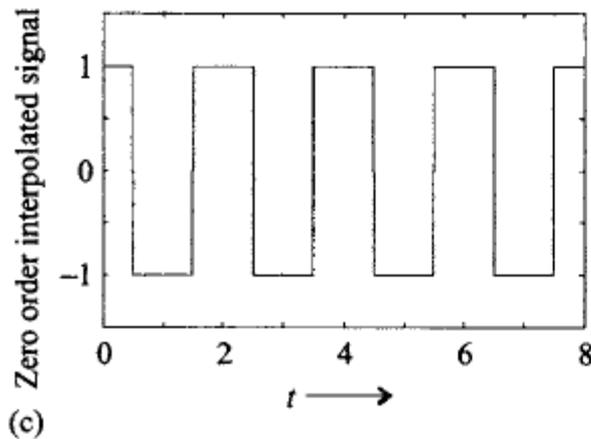
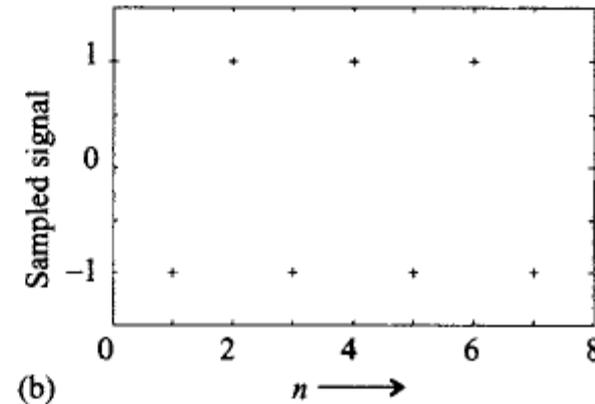
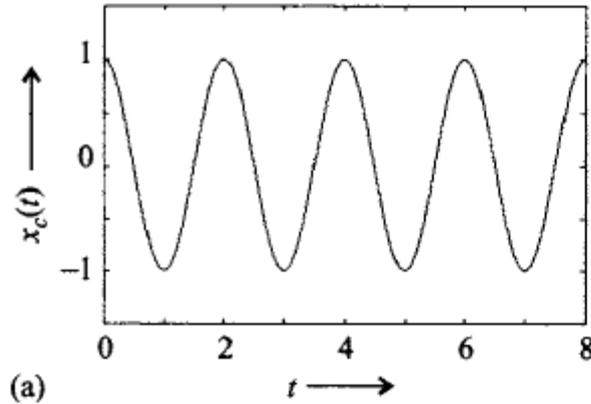


Figure 7.4 Amplitude spectra for $y(t)$. (a) $\delta f = 39$ Hz. (b) $\delta f = 9.8$ Hz. (c) $\delta f = 12.5$ Hz.

Conversão para Sinal Analógico

Filtro de reconstrução



Resposta ideal para um filtro de reconstrução

$$x_r(t) = \sum_{n=-\infty}^{\infty} x[n] \operatorname{sinc} \frac{\pi(t - n\Delta t)}{\Delta t}$$