

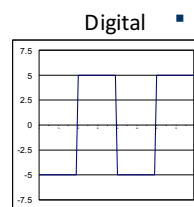
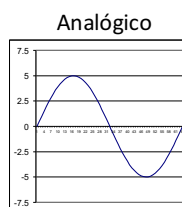
## Interfaces com o exterior: CONVERSÃO ANALÓGICO-DIGITAL

### Sistemas digitais

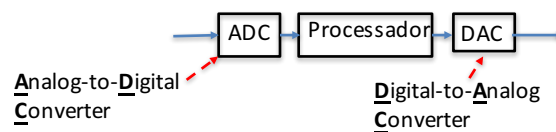
**Sistemas analógicos** processam sinais que variam no tempo e podem tomar qualquer valor dentro de uma gama.

Em **sistemas digitais** sinais são modelados como se tomassem sempre um dos (dois) valores discretos.

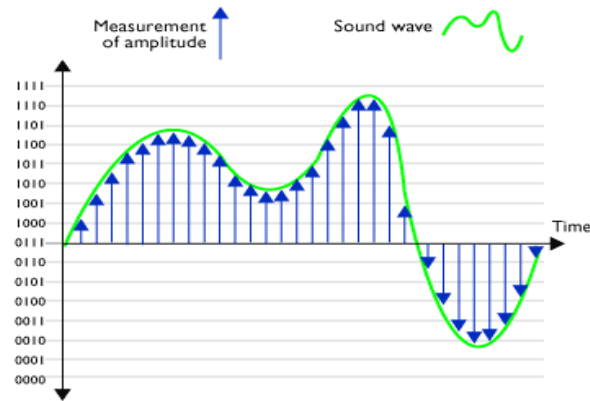
- reprodução de resultados;
- facilidade de projecto;
- desempenho;
- precisão
- imunidade ao ruído;



O mundo físico é analógico -  
Necessário converter os sinais  
Analógicos numa representação digital  
Para poderem ser processados por um  
computador



## Conversão de Analógico para Digital

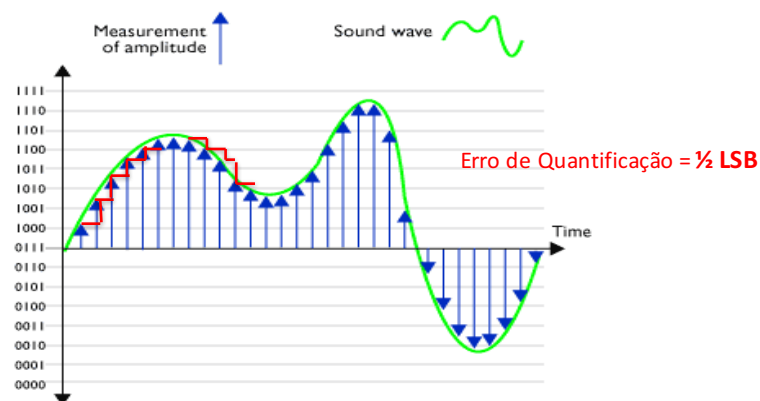


Each measurement is assigned a number (byte) according to its amplitude. The end result is a file comprising a string of bytes, eg ...  
1001 1110 0001 1010 0111 0100 1111 1101 etc

AC2 ADC - ABF

4

## Erro de Quantificação



Each measurement is assigned a number (byte) according to its amplitude. The end result is a file comprising a string of bytes, eg ...  
1001 1110 0001 1010 0111 0100 1111 1101 etc

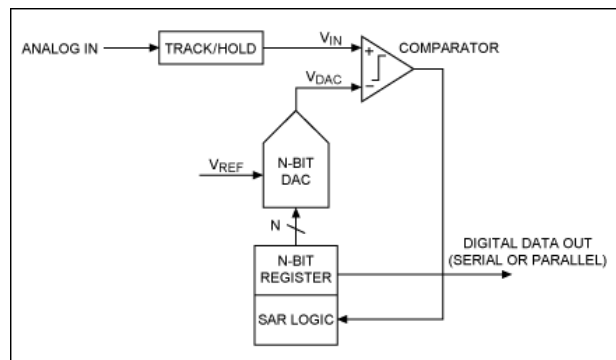
AC2 ADC - ABF

5

## Conversão por aproximações sucessivas Successive Approximation Register ADC

Tempo de conversão = N ciclos de relógio (ADC de N-bits)

Começando pelo bit mais significativo, em cada ciclo fica estabelecido o valor de 1 bit da conversão



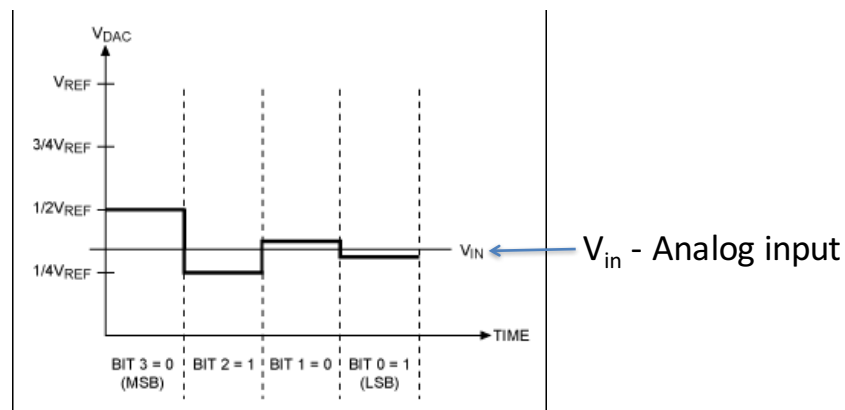
AC2 ADC - ABF

6

**ADC de N-bits:**

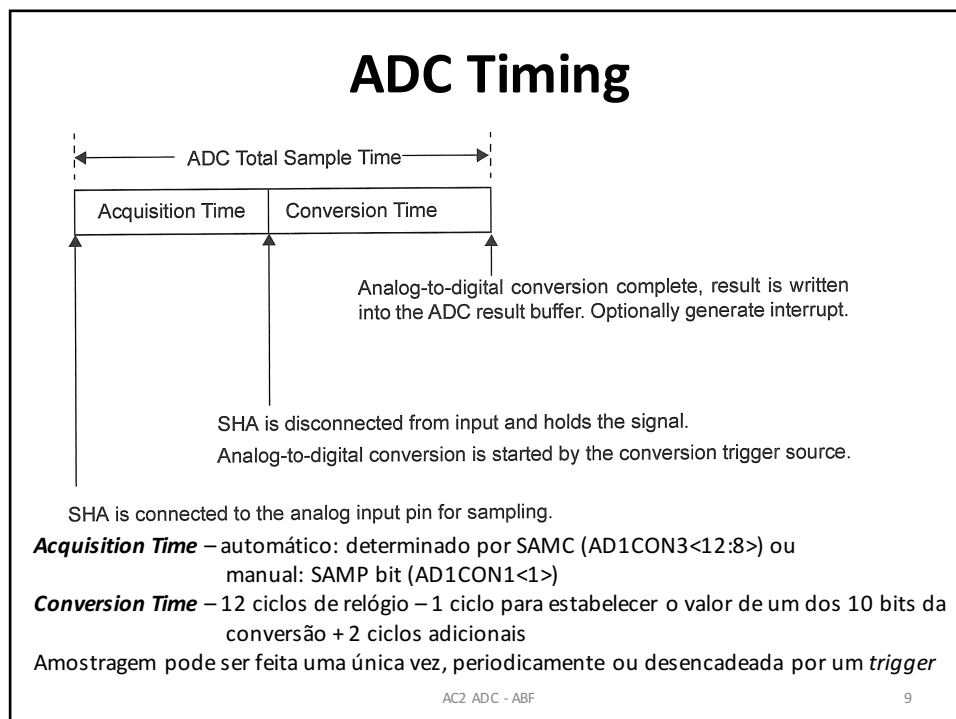
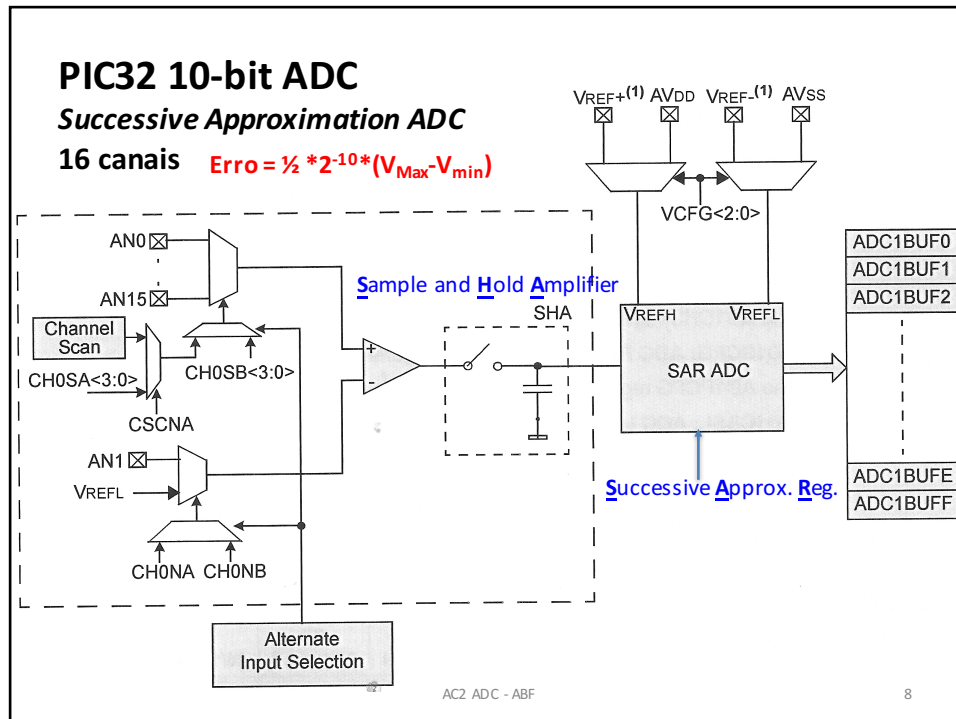
```
for (i = N; i ≥ 0; i--) {
    if ( $V_{IN} - V_{DAC} \geq 0$ )
        Reg[i] = 1;
    else {Reg[i] = 0;
}
```

## 4-bit SAR ADC



AC2 ADC - ABF

7



## Registos de Controle da ADC

- **AD1CON1: ADC Control Register 1**
- **AD1CON2: ADC Control Register 2**
- **AD1CON3: ADC Control Register 3**

The AD1CON1, AD1CON2 and AD1CON3 registers control the operation of the ADC module.

- **AD1CHS: ADC Input Select Register**

The AD1CHS register selects the input pins to be connected to the SHA.

- **AD1PCFG: ADC Port Configuration Register<sup>(1,2)</sup>**

The AD1PCFG register configures the analog input pins as analog inputs or as digital I/O.

- **AD1CSSL: ADC Input Scan Select Register<sup>(1)</sup>**

The AD1CSSL register selects inputs to be sequentially scanned.

AC2 ADC - ABF

10

## Registos da ADC do PIC32

Table 17-1: ADC SFR Summary

Name	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
AD1CON1 <sup>(1,2,3)</sup>	31:24	—	—	—	—	—	—	—
	23:16	—	—	—	—	—	—	—
	15:8	ON	—	SIDL	—	FORM<2:0>		
	7:0	SSRC<2:0>		CLRASAM	—	ASAM	SAMP	DONE
AD1CON2 <sup>(1,2,3)</sup>	31:24	—	—	—	—	—	—	—
	23:16	—	—	—	—	—	—	—
	15:8	VCFG<2:0>		OFFCAL	—	CSCNA	—	—
	7:0	BUFS	—	SMPI<3:0>			BUFM	ALTS
AD1CON3 <sup>(1,2,3)</sup>	31:24	—	—	—	—	—	—	—
	23:16	—	—	—	—	—	—	—
	15:8	ADRC	—	—	SAMC<4:0>			
	7:0	ADCS<7:0>						
AD1CHS <sup>(1,2,3)</sup>	31:24	CH0NB	—	—	CH0SB<3:0>			
	23:16	CH0NA	—	—	CH0SA<3:0>			
	15:8	—	—	—	—	—	—	—
	7:0	—	—	—	—	—	—	—
AD1PCFG <sup>(1,2,3)</sup>	31:24	—	—	—	—	—	—	—
	23:16	—	—	—	—	—	—	—
	15:8	PCFG15	PCFG14	PCFG13	PCFG12	PCFG11	PCFG10	PCFG9
	7:0	PCFG7	PCFG6	PCFG5	PCFG4	PCFG3	PCFG2	PCFG1
								PCFG8

Legend: — = unimplemented, read as '0'.

AC2 ADC - ABF

11