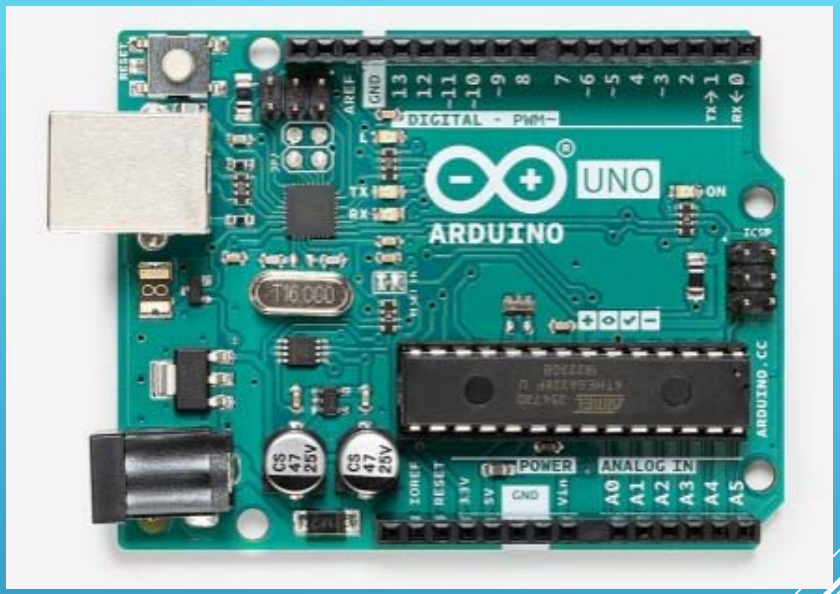
SISTEMAS EMBARCADOS APLICADOS I - CONFIGURAÇÃO

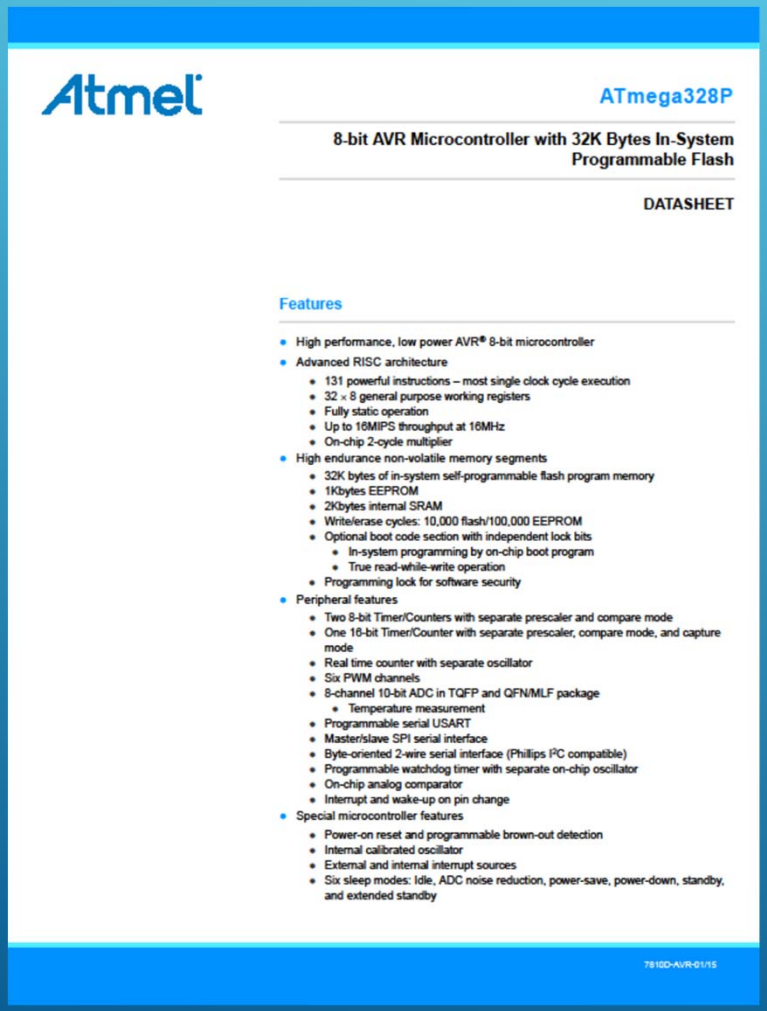
Prof. Dr. Dalton Vidor

CARACTERÍSTICAS – ARDUINO UNO:

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13



CARACTERÍSTICAS – ATMEGA328P / PIC16F877A:



Atmel

ATmega328P

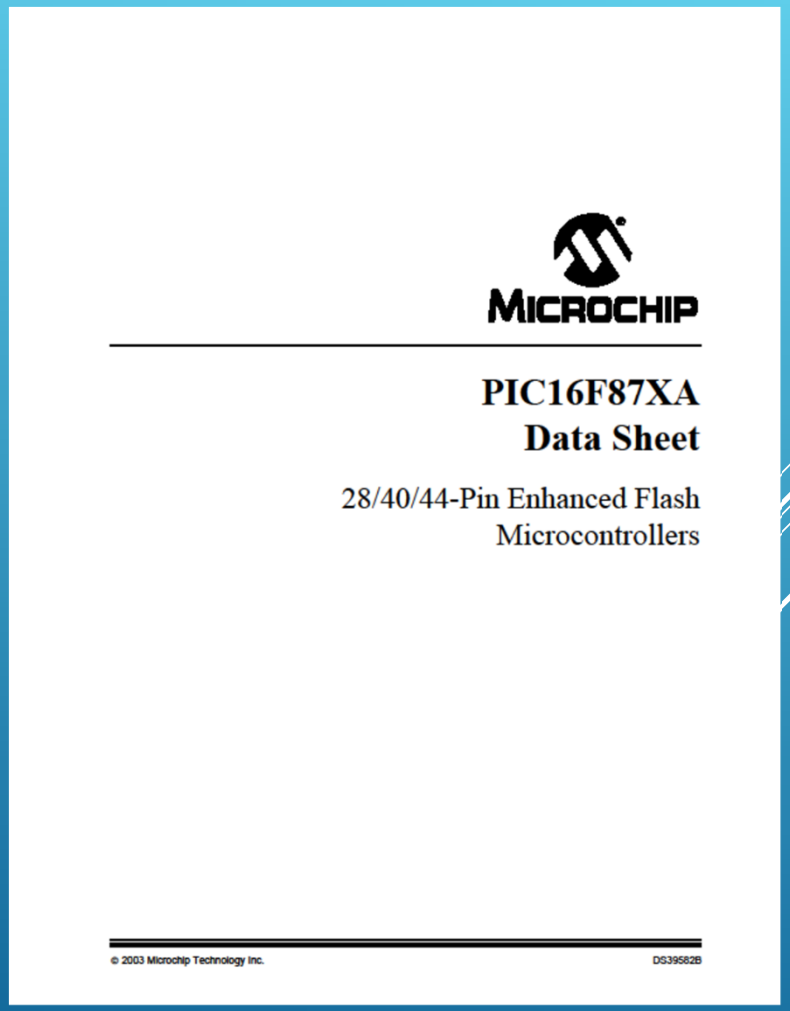
8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash

DATASHEET

Features

- High performance, low power AVR® 8-bit microcontroller
- Advanced RISC architecture
  - 131 powerful instructions – most single clock cycle execution
  - 32 × 8 general purpose working registers
  - Fully static operation
  - Up to 16MIPS throughput at 16MHz
  - On-chip 2-cycle multiplier
- High endurance non-volatile memory segments
  - 32K bytes of in-system self-programmable flash program memory
  - 1Kbytes EEPROM
  - 2Kbytes internal SRAM
  - Write/erase cycles: 10,000 flash/100,000 EEPROM
  - Optional boot code section with independent lock bits
    - In-system programming by on-chip boot program
    - True read-while-write operation
  - Programming lock for software security
- Peripheral features
  - Two 8-bit Timer/Counters with separate prescaler and compare mode
  - One 16-bit Timer/Counter with separate prescaler, compare mode, and capture mode
  - Real time counter with separate oscillator
  - Six PWM channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
    - Temperature measurement
  - Programmable serial USART
  - Master/slave SPI serial interface
  - Byte-oriented 2-wire serial interface (Phillips I²C compatible)
  - Programmable watchdog timer with separate on-chip oscillator
  - On-chip analog comparator
  - Interrupt and wake-up on pin change
- Special microcontroller features
  - Power-on reset and programmable brown-out detection
  - Internal calibrated oscillator
  - External and internal interrupt sources
  - Six sleep modes: Idle, ADC noise reduction, power-save, power-down, standby, and extended standby

7810D-AVR-01/15



MICROCHIP

PIC16F87XA
Data Sheet

28/40/44-Pin Enhanced Flash Microcontrollers

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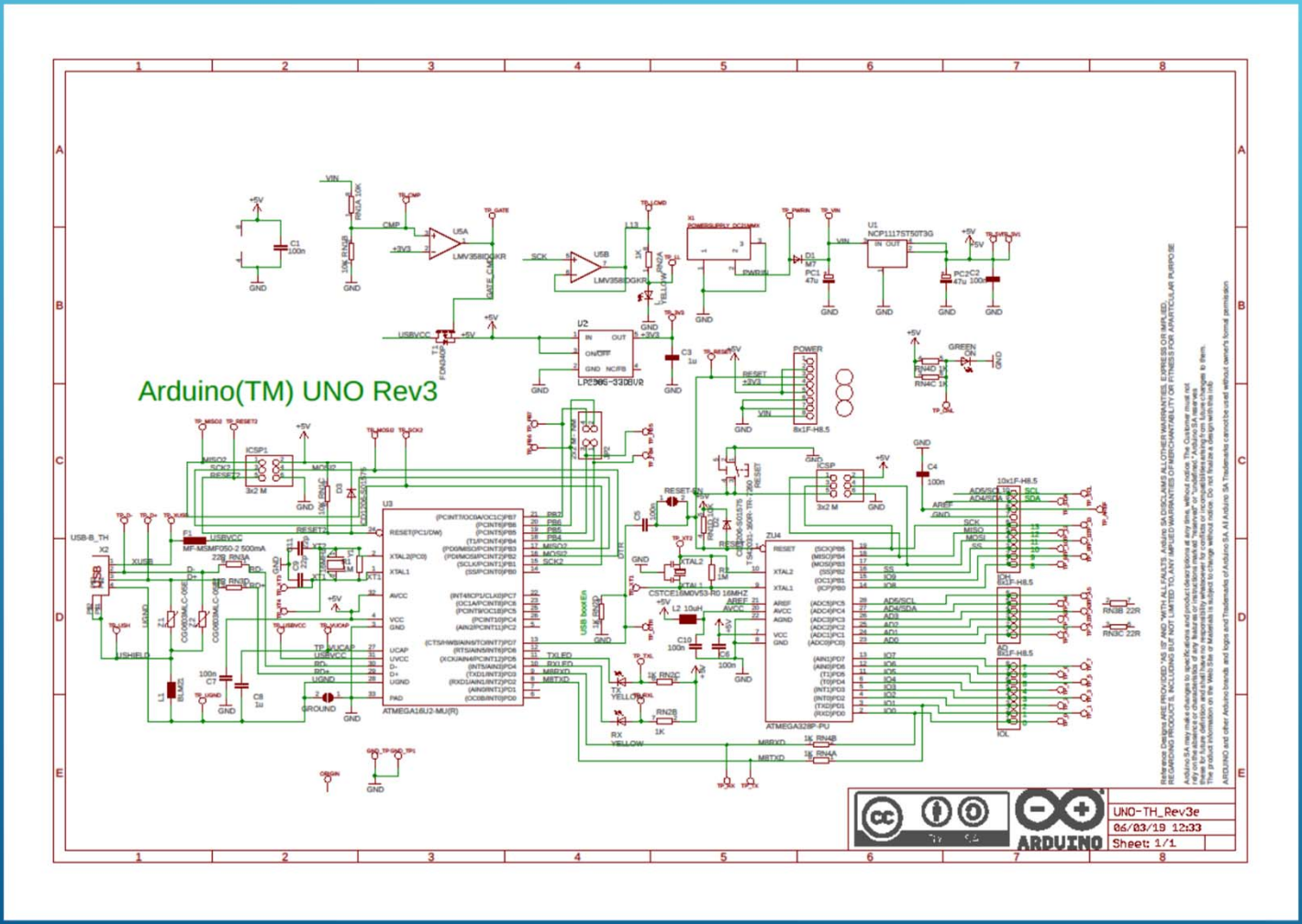
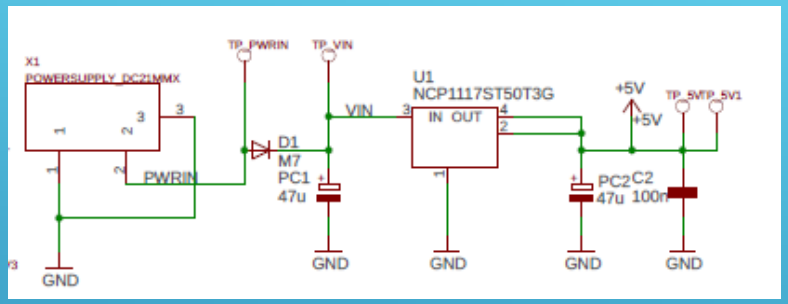
CARACTERÍSTICAS – PLACA ARDUINO:

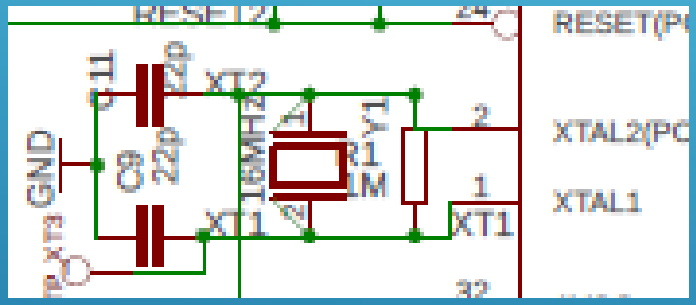


ESTRUTURA BÁSICA - MICROCONTROLADORES:

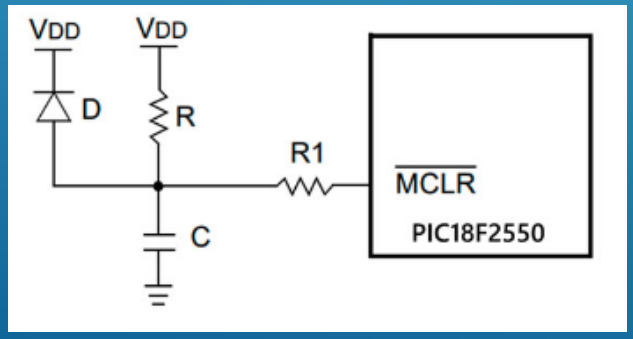
- Alimentação – 5V ou 3V3



- Oscilador – Cristal, ressonador cerâmico, RC, RC interno, PLL



- Reset – Iniciar “no começo”



ESTRUTURA BÁSICA - MICROCONTROLADORES:

- PINOS DIGITAIS – Tensão e corrente de pino e de porta

DC Current per I/O Pin	20 mA

DC current per I/O pin		40.0		mA
DC current V_{CC} and GND pins		200.0		mA
Injection current at V_{CC} = 0V		±5.0(1)		mA
Injection current at V_{CC} = 5V		±1.0		mA

Note: 1. Maximum current per port = ±30mA

- PINOS ANALÓGICOS – Entradas – A/D e Comparadores

PWM Digital I/O Pins	6
Analog Input Pins	6

- Six PWM channels
- 8-channel 10-bit ADC in TQFP and QFN/MLF package

- Entradas de 0 a 5V são convertidas em um valor numérico entre 0 e 1023 (A/D de 10 bits).
- Saída PWM entre 0 e 255 (8 bits).
- PWM necessita filtro para retornar um valor CC.

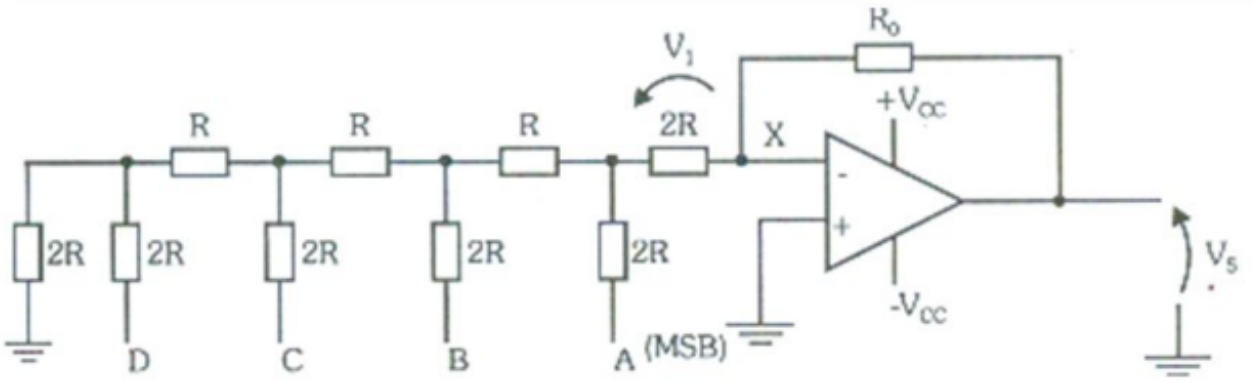
- PINOS ANALÓGICOS – Saídas – D/A e PWM

BOARD	PWM PINS	PWM FREQUENCY
Uno, Nano, Mini	3, 5, 6, 9, 10, 11	490 Hz (pins 5 and 6: 980 Hz)
Mega	2 - 13, 44 - 46	490 Hz (pins 4 and 13: 980 Hz)

ESTRUTURA BÁSICA - MICROCONTROLADORES:

- D/A com rede de resistores.
- Problema é necessitar de vários pinos (saídas digitais) conforme o número de bits utilizados.

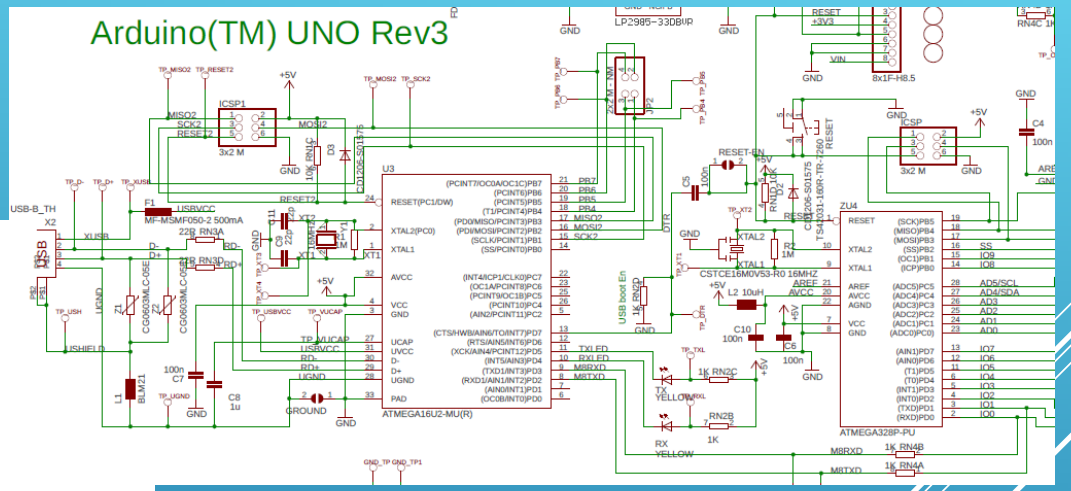
Conversores D/A com Rede R-2R e Amplificador Operacional



$$V_s = \left(-\frac{R_0}{2R}\right)\left[\frac{V_{cc}}{3}\left(A+\frac{B}{2}+\frac{C}{4}+\frac{D}{8}\right)\right]$$

ESTRUTURA BÁSICA - MICROCONTROLADORES:

- Interface com o usuário:
- USART (USB no Arduino)



19. USART0

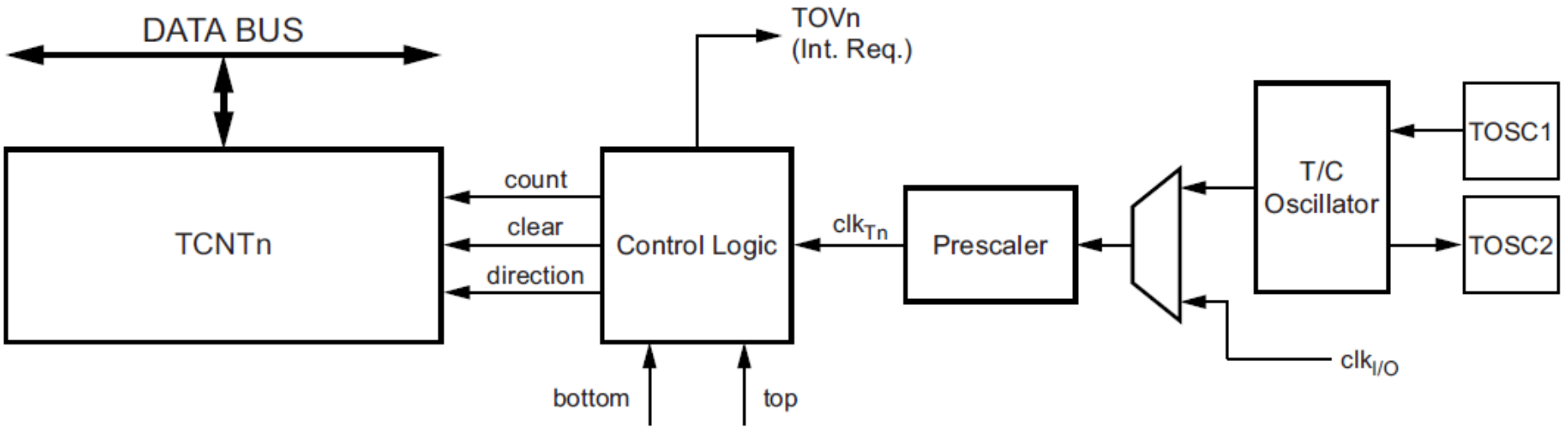
19.1 Features

- Full duplex operation (independent serial receive and transmit registers)
- Asynchronous or synchronous operation
- Master or slave clocked synchronous operation
- High resolution baud rate generator
- Supports serial frames with 5, 6, 7, 8, or 9 data bits and 1 or 2 stop bits
- Odd or even parity generation and parity check supported by hardware
- Data overrun detection
- Framing error detection
- Noise filtering includes false start bit detection and digital low pass filter
- Three separate interrupts on TX complete, TX data register empty and RX complete
- Multi-processor communication mode
- Double speed asynchronous communication mode

ESTRUTURA BÁSICA - MICROCONTROLADORES:

- Interface com o ambiente:
- TIMERS ou "CONTADORES" – podem ser contagens de tempo ou contagens de eventos

Figure 17-2. Counter Unit Block Diagram

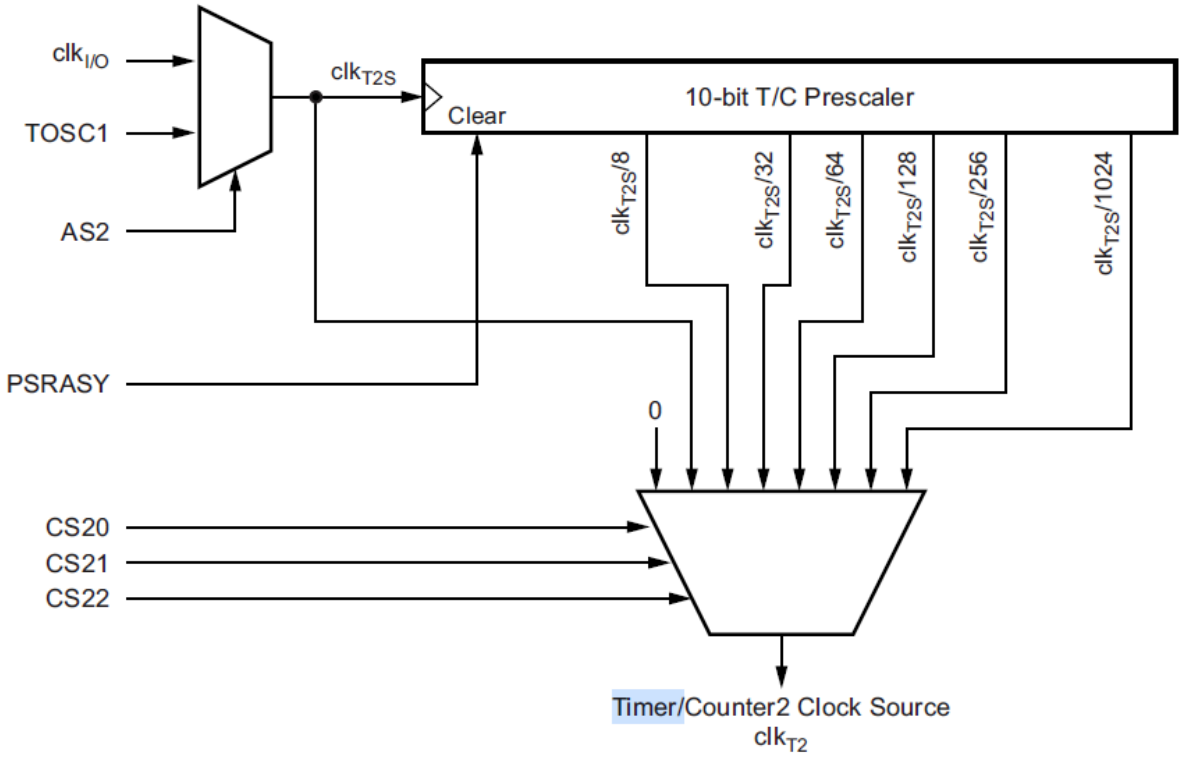


ESTRUTURA BÁSICA - MICROCONTROLADORES:

- Interface com o ambiente:
- TIMERS ou "CONTADORES" – podem ser contagens de tempo ou contagens de eventos

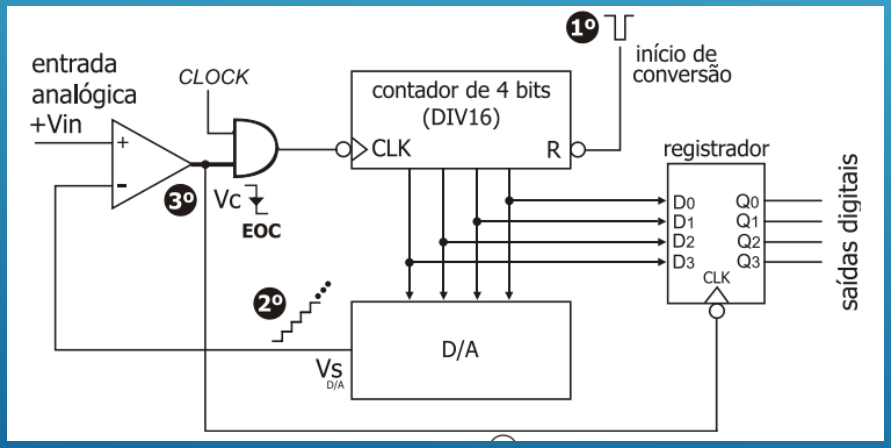
17.10 Timer/Counter Prescaler

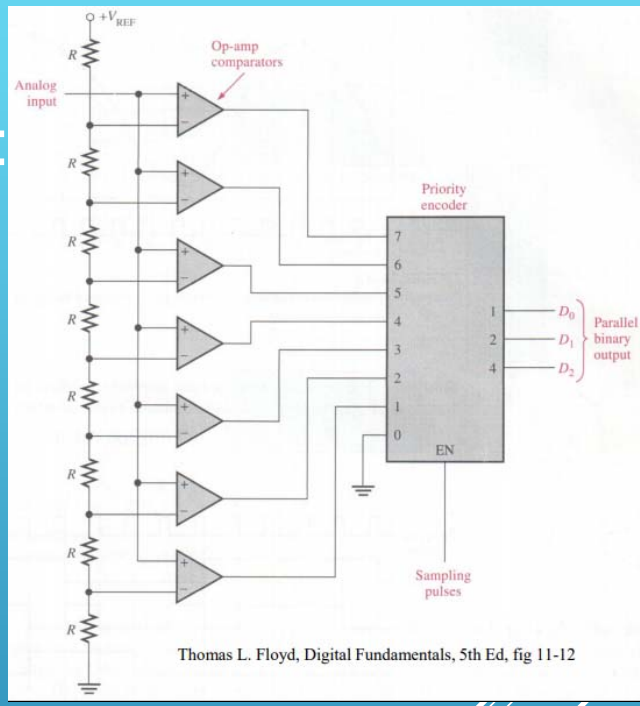
Figure 17-12.Prescaler for Timer/Counter2



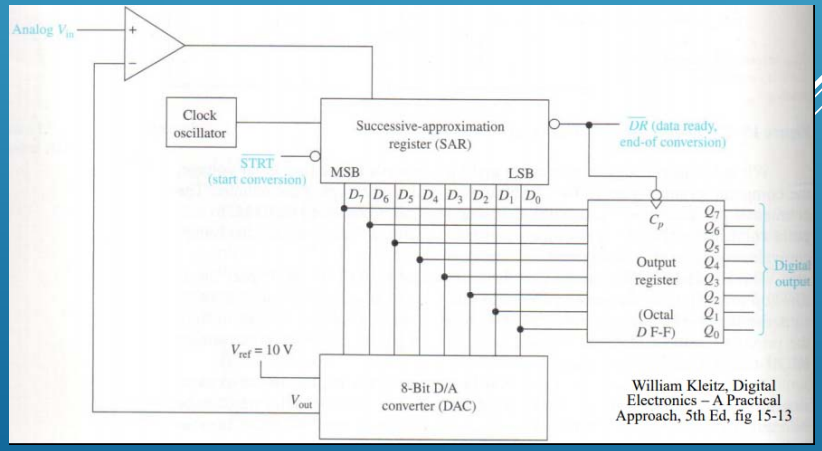
ESTRUTURA BÁSICA - MICROCONTROLADORES:

- Interface com o ambiente:
- Conversor A/D de aproximação sucessiva.
- (tipo RAMPA, APROXIMAÇÃO SUCESSIVA ou FLASH)





Thomas L. Floyd, Digital Fundamentals, 5th Ed, fig 11-12

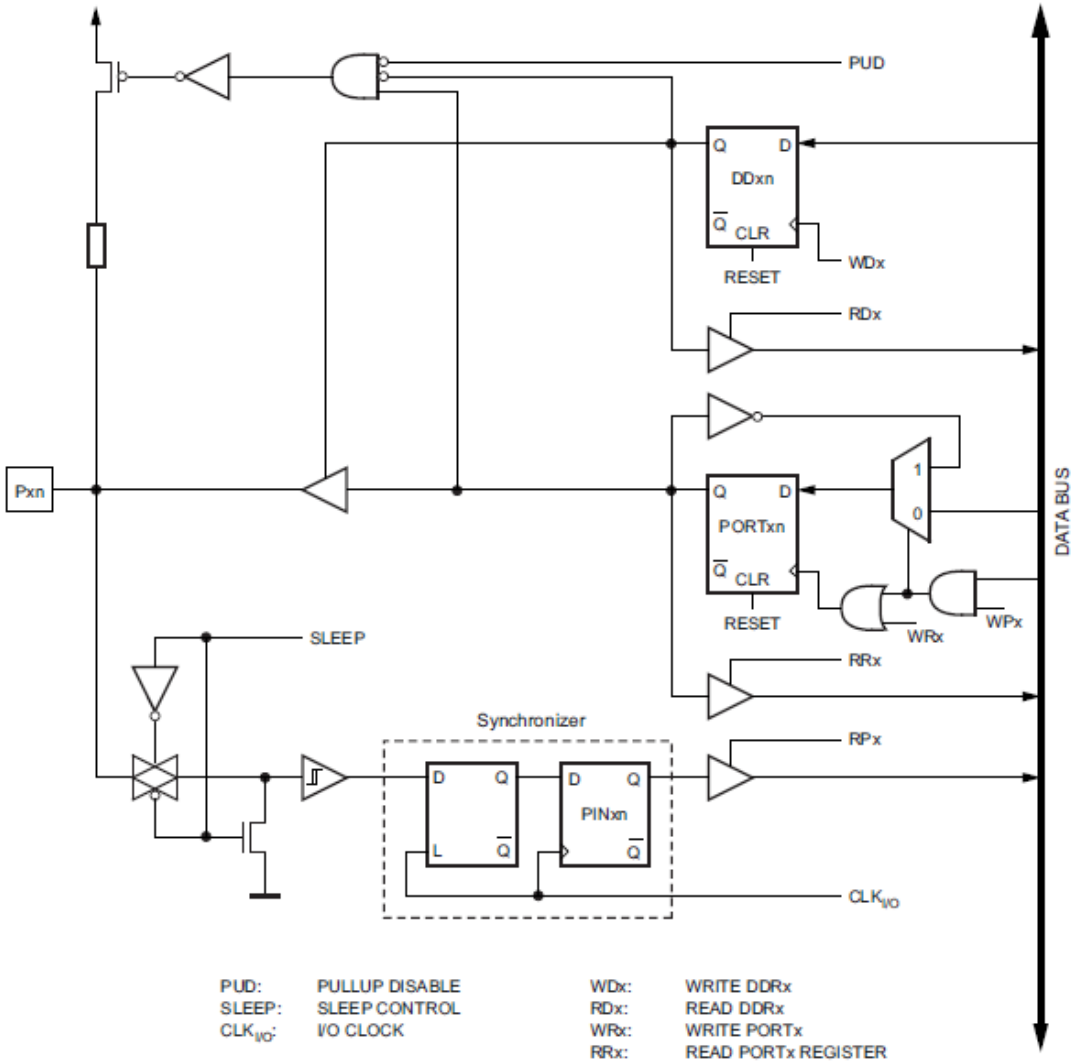


William Kleitz, Digital Electronics – A Practical Approach, 5th Ed, fig 15-13

ESTRUTURA BÁSICA - MICROCONTROLADORES:

- PINOS DIGITAIS:

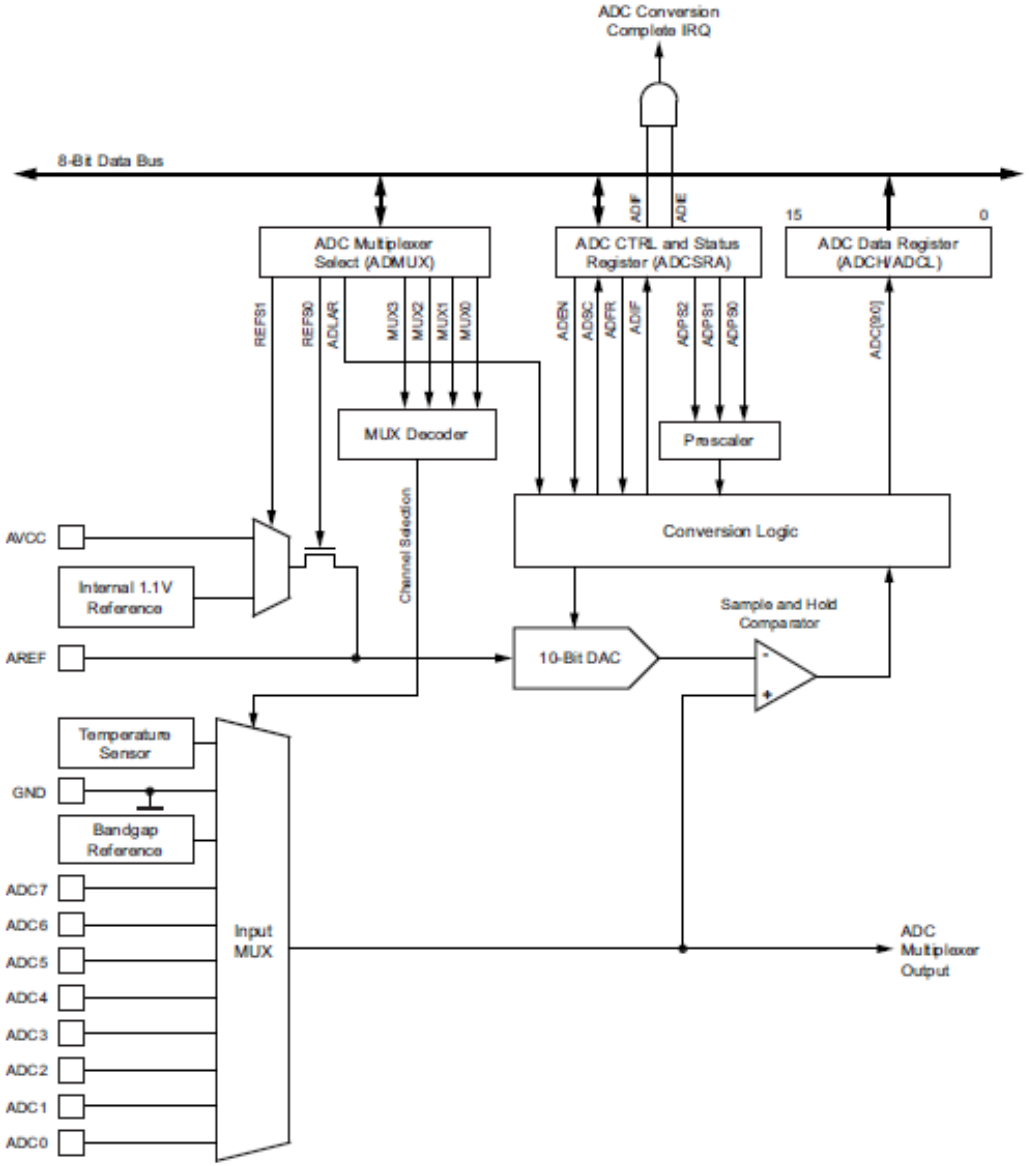
Figure 13-2. General Digital I/O(1)



ESTRUTURA BÁSICA - MICROCONTROLADORES:

- PINOS ANALÓGICOS:
- Multiplexa entradas em um único conversor A/D

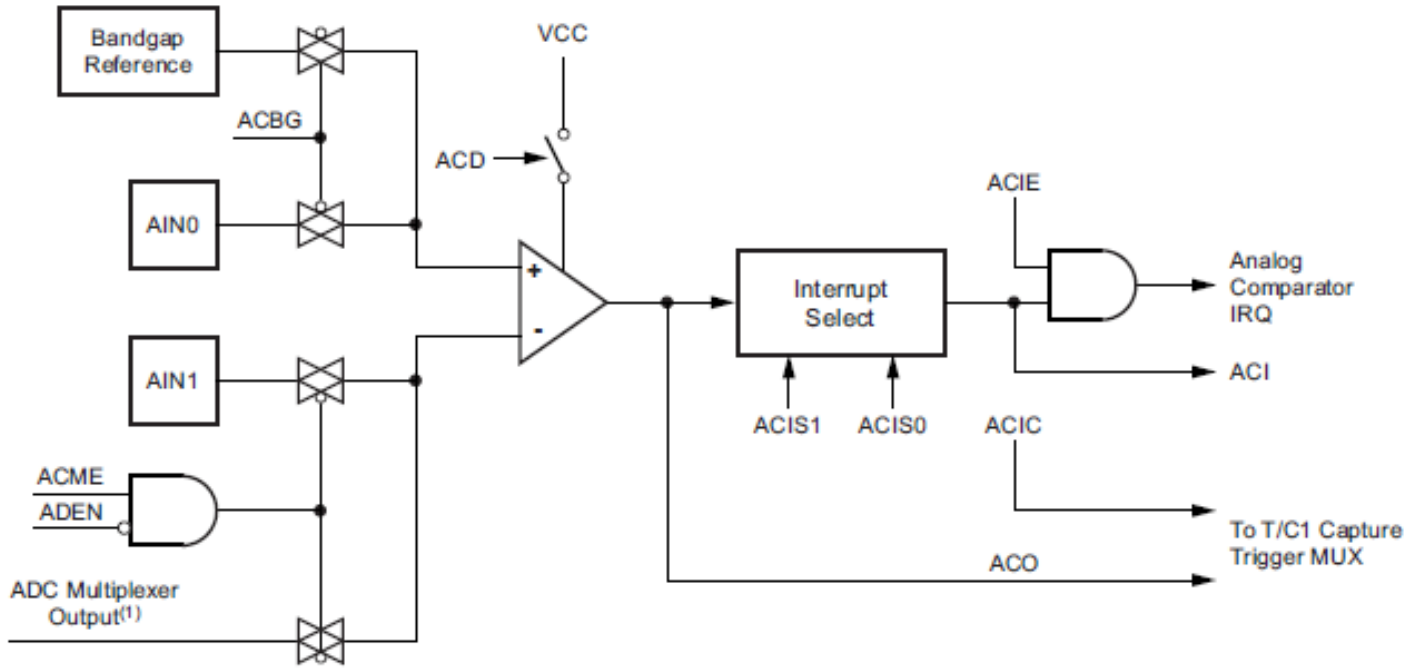
Figure 23-1. Analog to Digital Converter Block Schematic Operation



ESTRUTURA BÁSICA - MICROCONTROLADORES:

- COMPARADORES ANALÓGICOS:

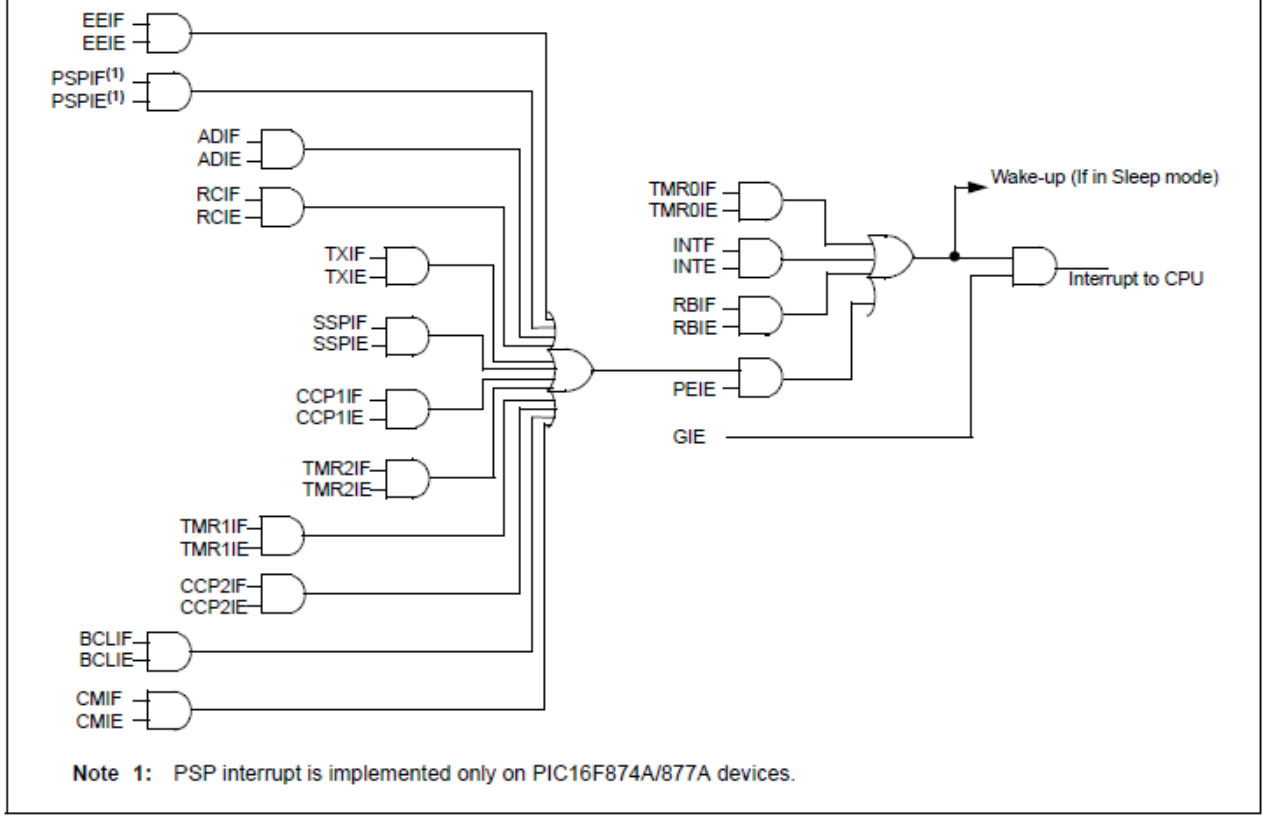
Figure 22-1. Analog Comparator Block Diagram(2)



ESTRUTURA BÁSICA - MICROCONTROLADORES:

- Interrupções PIC16F877A:

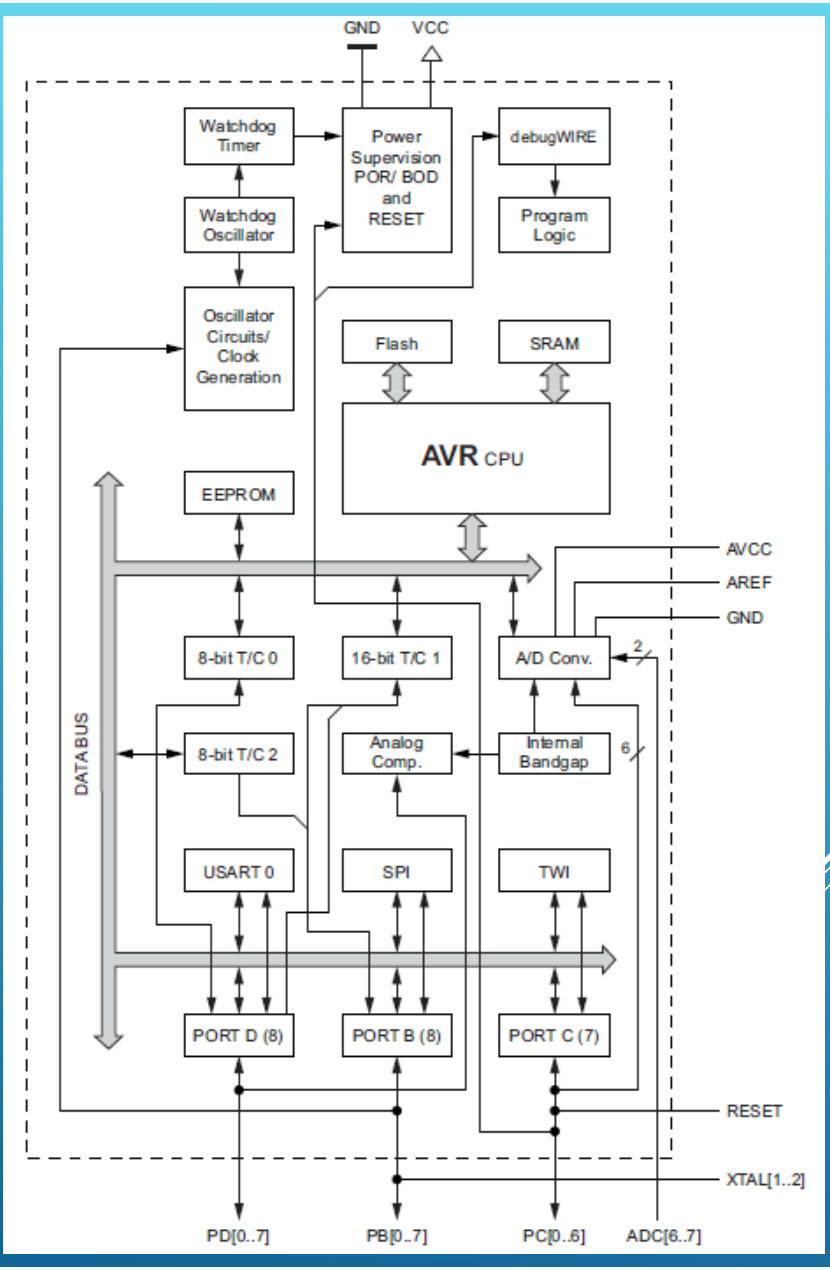
FIGURE 14-10: INTERRUPT LOGIC



Note 1: PSP interrupt is implemented only on PIC16F874A/877A devices.

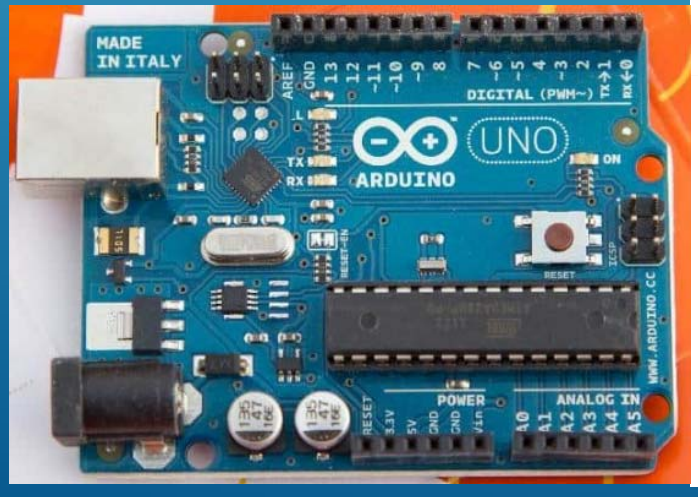
ESTRUTURA BÁSICA - MICROCONTROLADORES:

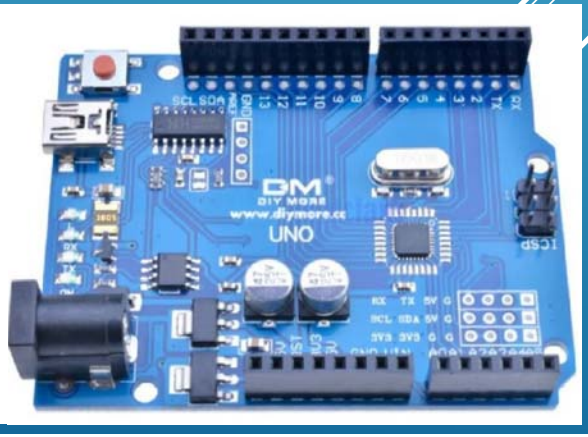
- Estrutura interna AVR:
- Observar Watchdog timer



ESTRUTURA BÁSICA - MICROCONTROLADORES:

- Arduino UNO
- Original e compatíveis





ESTRUTURA BÁSICA - MICROCONTROLADORES:

https://www.tinkercad.com/things/l67TBN3i7Vn-teste-ad-tempo-e-porta-serial