

# 8051 MICROCONTROLLER

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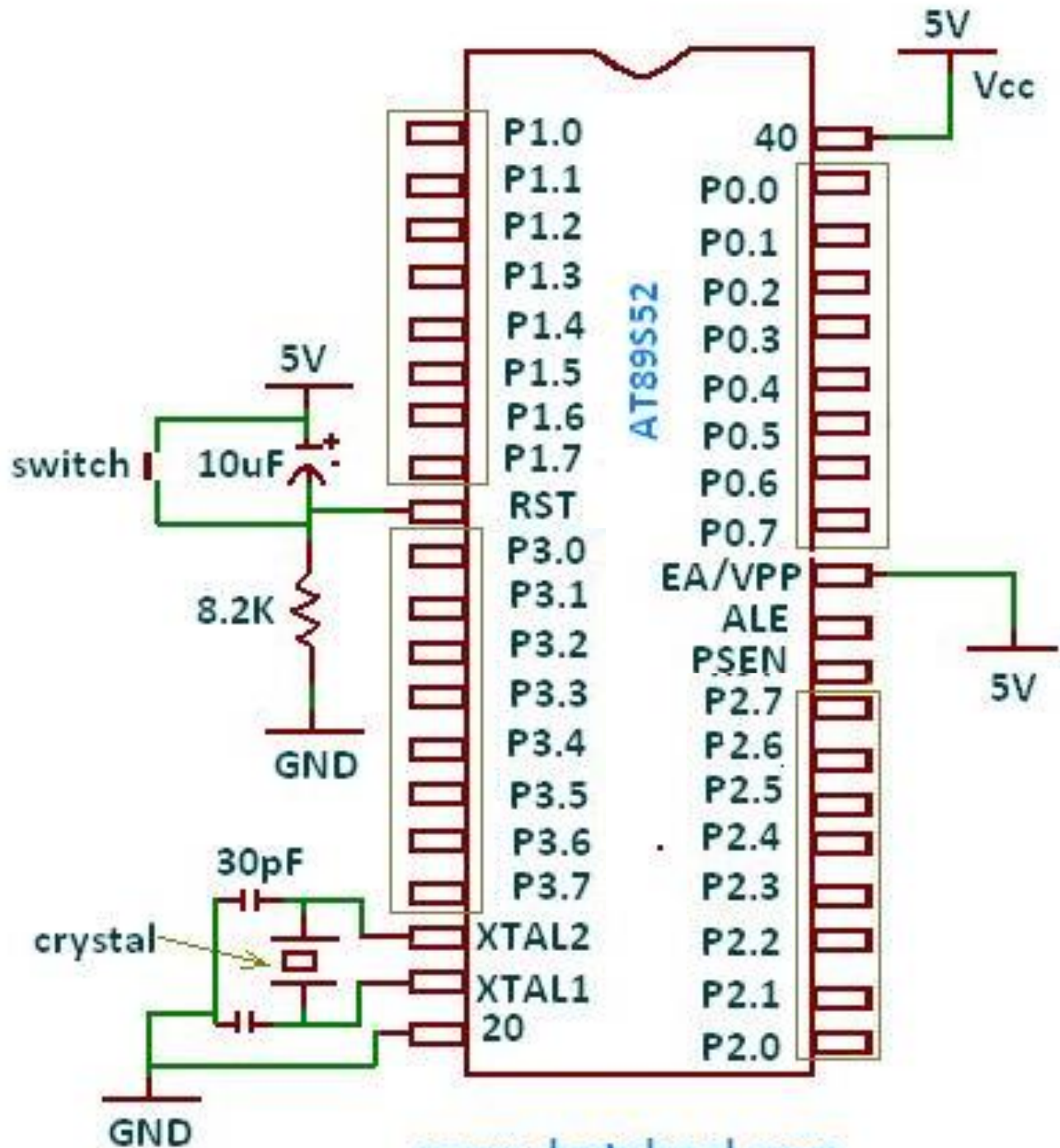
# WHY DO WE NEED TO LEARN MICROPROCESSORS/CONTROLLERS?

- The microprocessor is the core of computer systems.
- Nowadays many communication, digital entertainment, portable devices, are controlled by them.
- A designer should know what types of components he needs, ways to reduce production costs and product reliable.

# DIFFERENT ASPECTS OF A MICROPROCESSOR/CONTROLLER

- Hardware : Interface to the real world
- Software : Order how to deal with inputs

# OUR AT



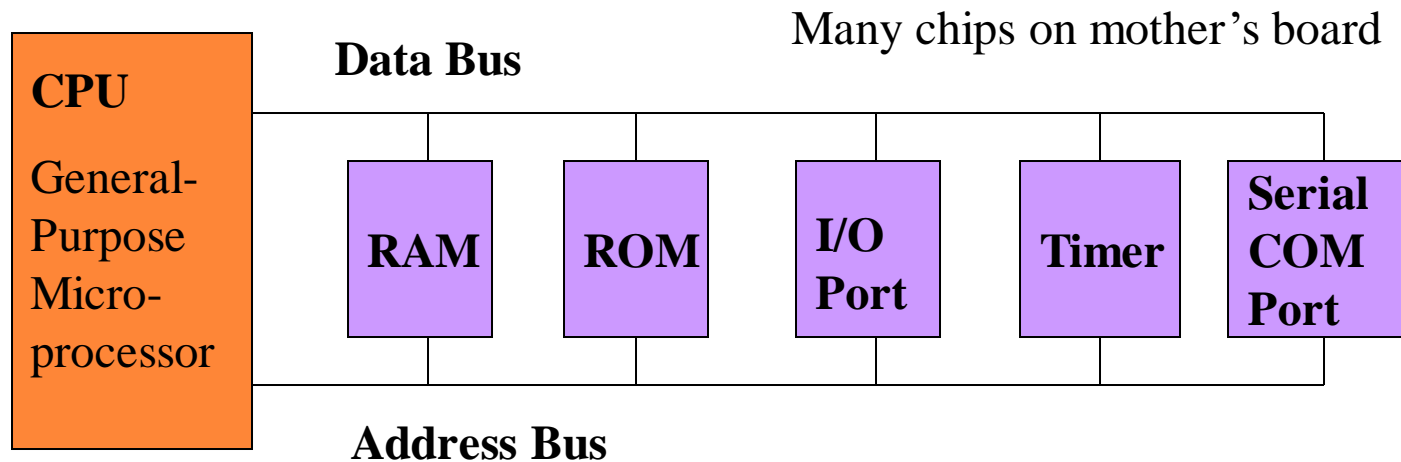
# THE NECESSARY TOOLS FOR A MICROPROCESSOR/CONTROLLER

- CPU: Central Processing Unit
- I/O: Input /Output
- Bus: Address bus & Data bus
- Memory: RAM & ROM
- Timer
- Interrupt
- Serial Port
- Parallel Port

# MICROPROCESSORS:

## General-purpose microprocessor

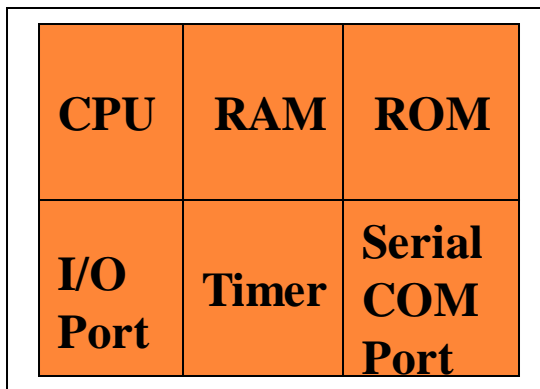
- CPU for Computers
- No RAM, ROM, I/O on CPU chip itself
- Example : Intel's x86, Motorola's 680x0



General-Purpose Microprocessor System

# Microcontroller :

- A smaller computer
- On-chip RAM, ROM, I/O ports...
- Example : Motorola's 6811, Intel's 8051, Zilog's Z8 and PIC 16X



← A single chip

Microcontroller

# Microprocessor vs. Microcontroller

## Microprocessor

- CPU is stand-alone, RAM, ROM, I/O, timer are separate
- designer can decide on the amount of ROM, RAM and I/O ports.
- expansive
- versatility
- general-purpose

## Microcontroller

- CPU, RAM, ROM, I/O and timer are all on a single chip
- fix amount of on-chip ROM, RAM, I/O ports
- for applications in which cost, power and space are critical
- single-purpose



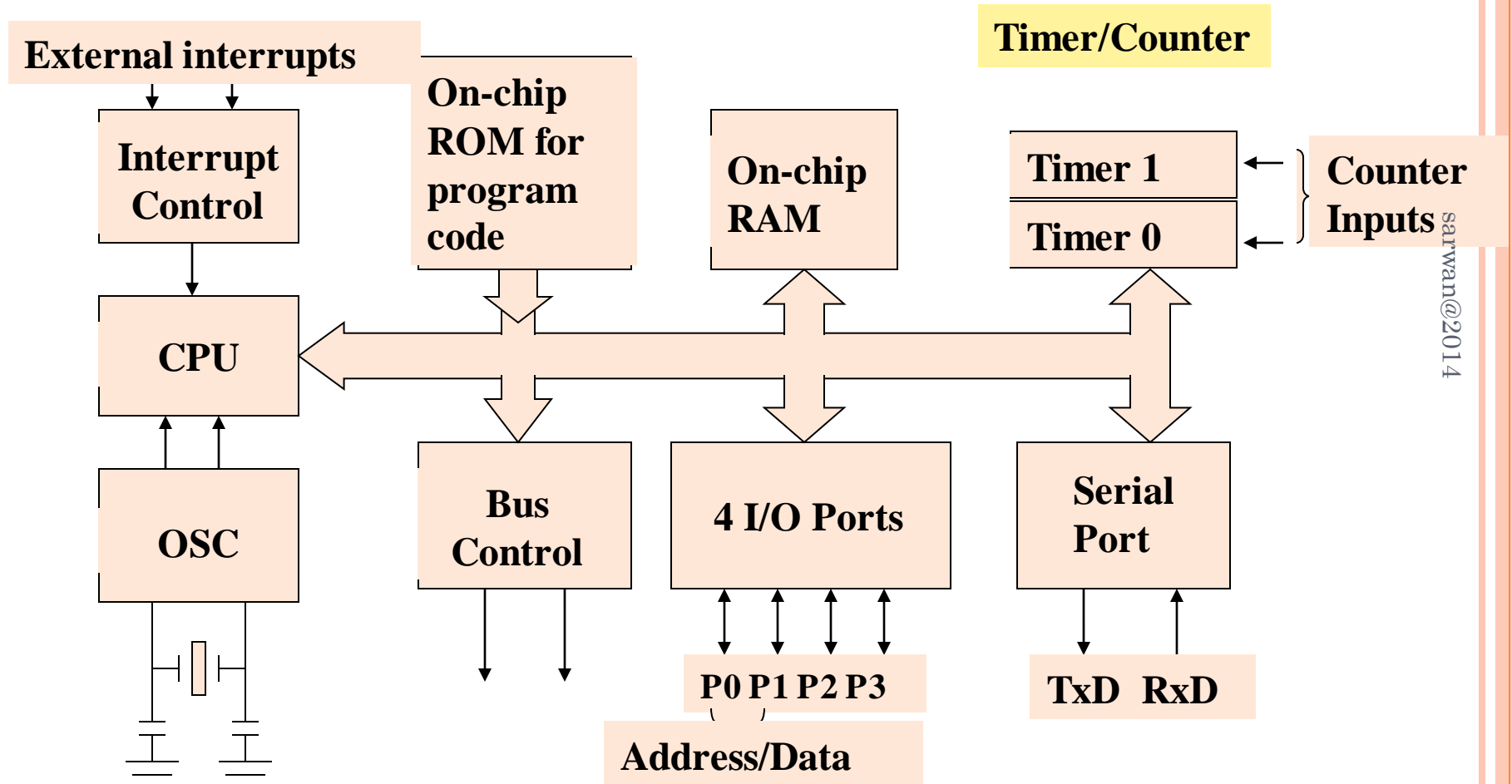
# Embedded System

- Embedded system means the processor is embedded into that application.
- An embedded product uses a microprocessor or microcontroller to do one task only.
- In an embedded system, there is only one application software that is typically burned into ROM.
- Example : printer, keyboard, video game player

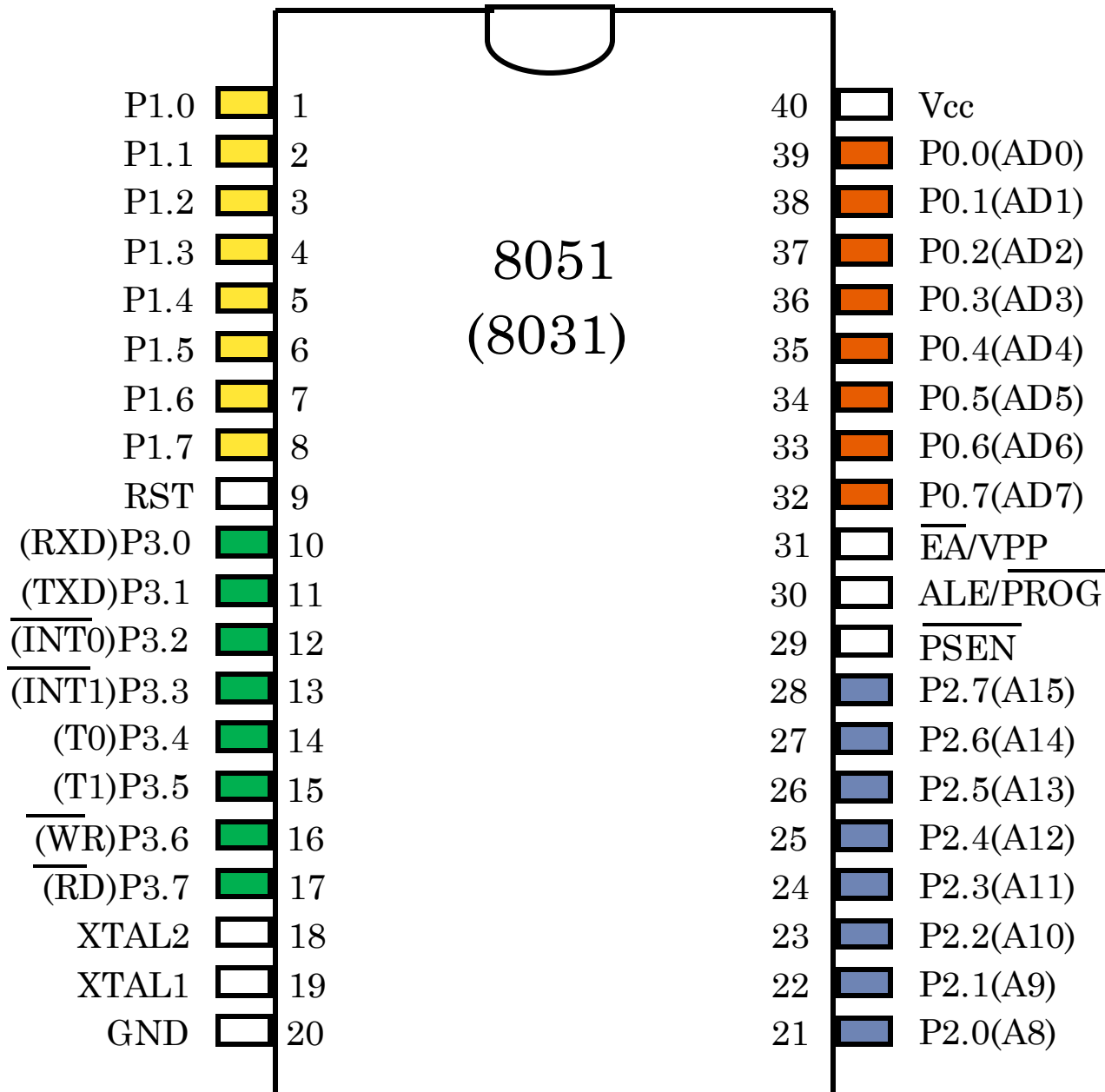
# Three criteria in Choosing a Microcontroller

1. meeting the computing needs of the task efficiently and cost effectively
  - speed, the amount of ROM and RAM, the number of I/O ports and timers, size, packaging, power consumption
  - easy to upgrade
  - cost per unit
2. availability of software development tools
  - assemblers, debuggers, C compilers, emulator, simulator, technical support
3. wide availability and reliable sources of the microcontrollers.

# BLOCK DIAGRAM



# Pin Description of the 8051

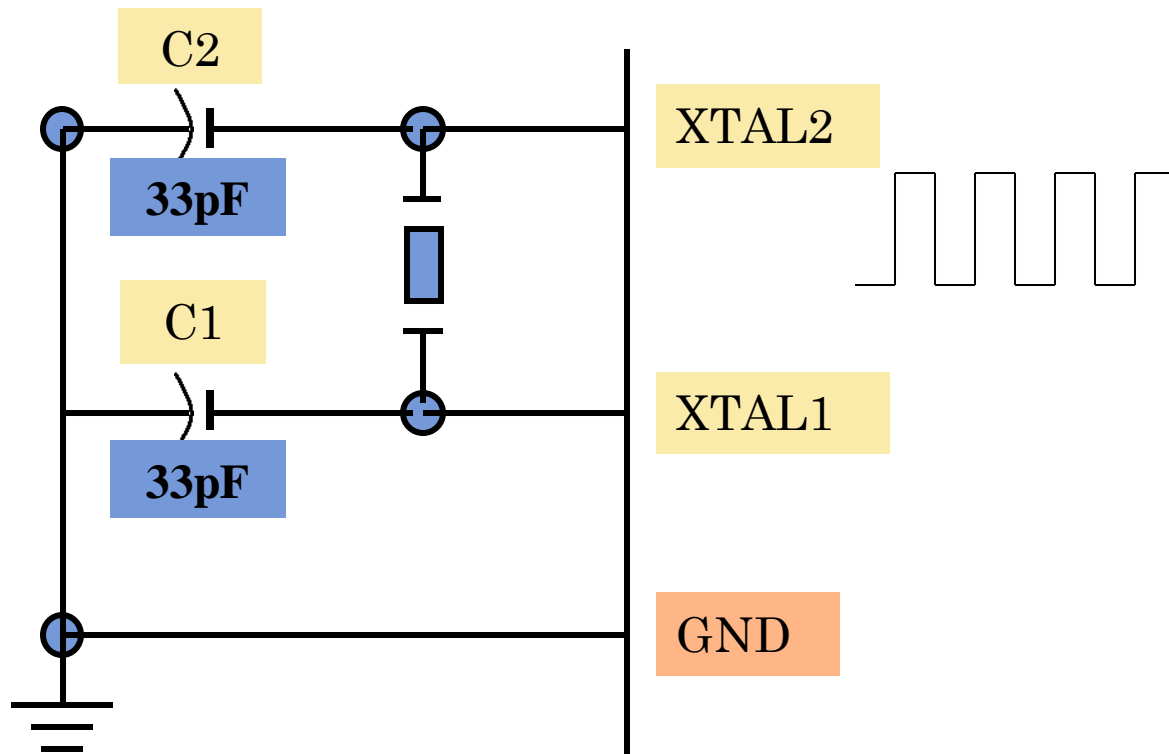


# PINS OF 8051 (1/4)


- Vcc (pin 40) :
  - Vcc provides supply voltage to the chip.
  - The voltage source is +5V.
- GND (pin 20) : ground
- XTAL1 and XTAL2 (pins 19,18)

## Figure (a). XTAL Connection to 8051

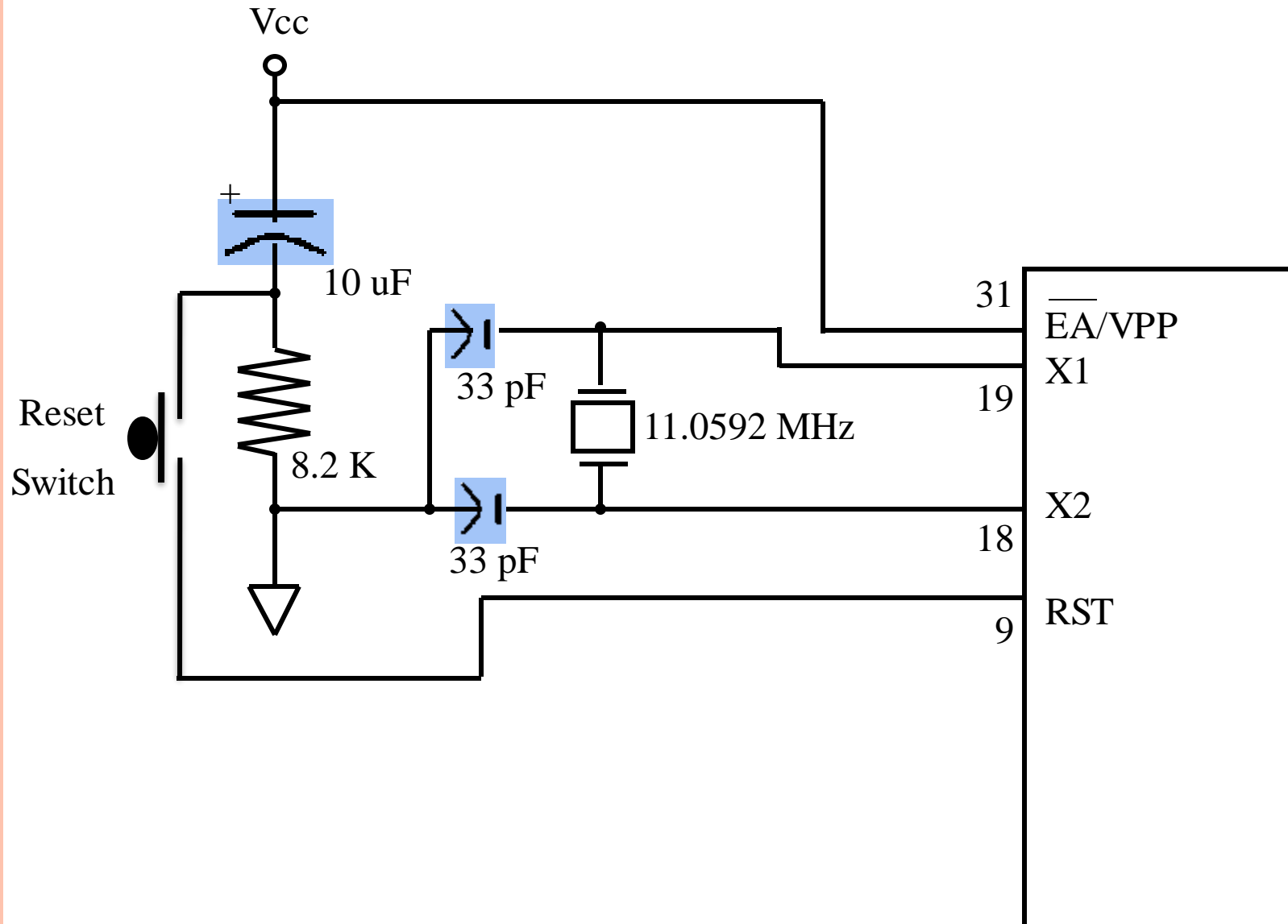
- Using a quartz crystal oscillator
- We can observe the frequency on the XTAL2 pin.



# PINS OF 8051 (2/4)

- RST (pin 9) : reset
  - It is an input pin and is active high (normally low) .
    - The high pulse must be high at least 2 machine cycles.
  - It is a power-on reset.
    - Upon applying a high pulse to RST, the microcontroller will reset and all values in registers will be lost.
    - Reset values of some 8051 registers 

# FIGURE (B). POWER-ON RESET CIRCUIT





# PINS OF 8051 (3/4)

- /EA (pin 31) : external access
  - There is no on-chip ROM in 8031 and 8032 .
  - The /EA pin is connected to GND to indicate the code is stored externally.
  - /PSEN & ALE are used for external ROM.
  - For 8051, /EA pin is connected to Vcc.
  - “/” means active low.
- /PSEN (pin 29) : program store enable
  - This is an output pin and is connected to the OE pin of the ROM.


# PINS OF 8051 (4/4)

- ALE (pin 30) : address latch enable
  - It is an output pin and is active high.
  - 8051 port 0 provides both address and data.
  - The ALE pin is used for de-multiplexing the address and data by connecting to the G pin of the 74LS373 latch.
- I/O port pins
  - The four ports P0, P1, P2, and P3.
  - Each port uses 8 pins.
  - All I/O pins are bi-directional.

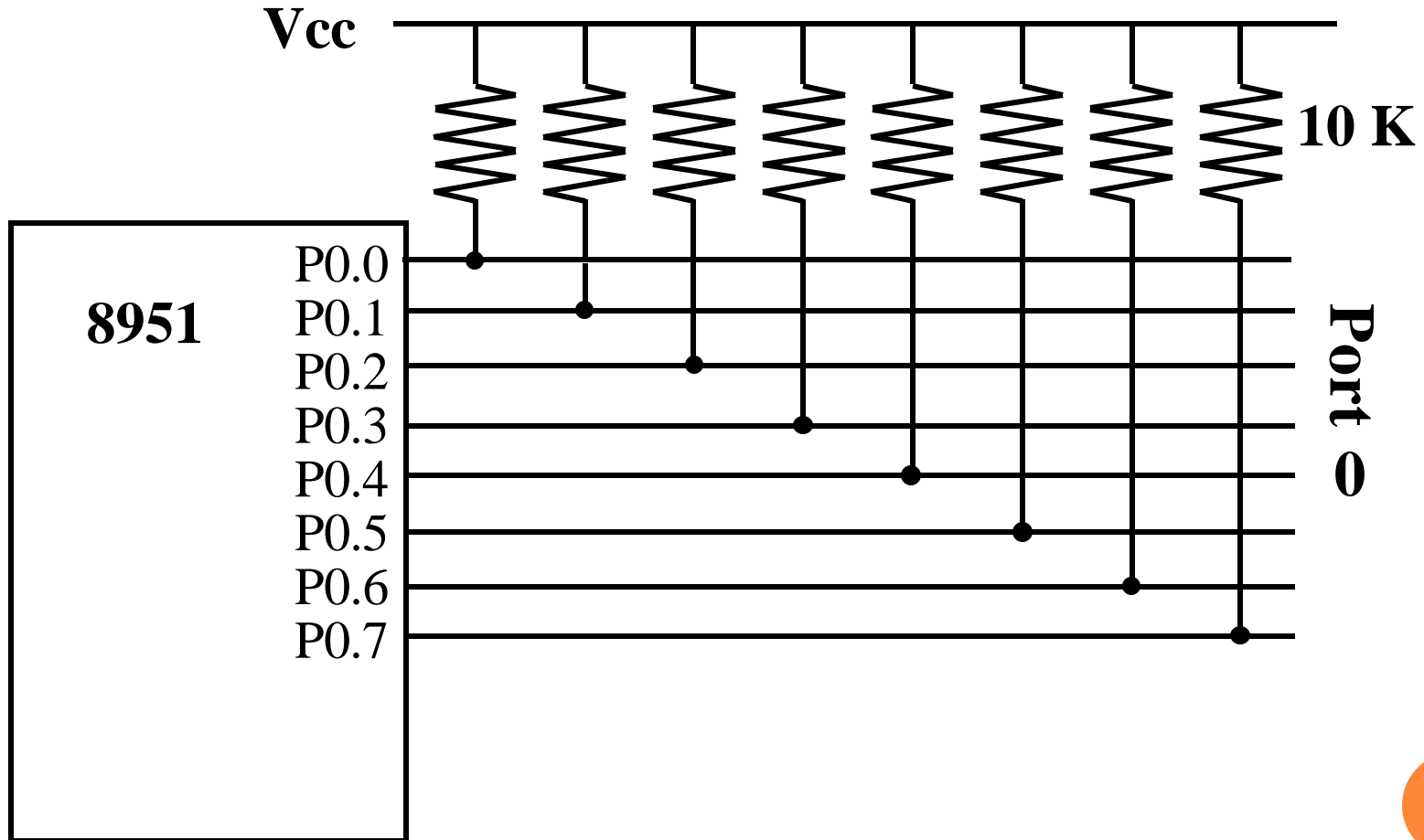
# PINS OF I/O PORT

- The 8051 has four I/O ports
  - Port 0 (pins 32-39) : P0 (P0.0~P0.7)
  - Port 1 (pins 1-8) : P1 (P1.0~P1.7)
  - Port 2 (pins 21-28) : P2 (P2.0~P2.7)
  - Port 3 (pins 10-17) : P3 (P3.0~P3.7)
  - Each port has 8 pins.
    - Named P0.X (X=0,1,...,7) , P1.X, P2.X, P3.X
    - Ex : P0.0 is the bit 0 (LSB) of P0
    - Ex : P0.7 is the bit 7 (MSB) of P0
    - These 8 bits form a byte.
- Each port can be used as input or output (bi-direction).

# OTHER PINS

- P1, P2, and P3 have internal pull-up resistors.
  - P1, P2, and P3 are not open drain.
- P0 has no internal pull-up resistors and does not connect to Vcc inside the 8051.
  - P0 is open drain.
  - Compare the figures of P1.X and P0.X. 
- However, for a programmer, it is the same to program P0, P1, P2 and P3.
- All the ports upon RESET are configured as output.

# PORT 0 WITH PULL-UP RESISTORS

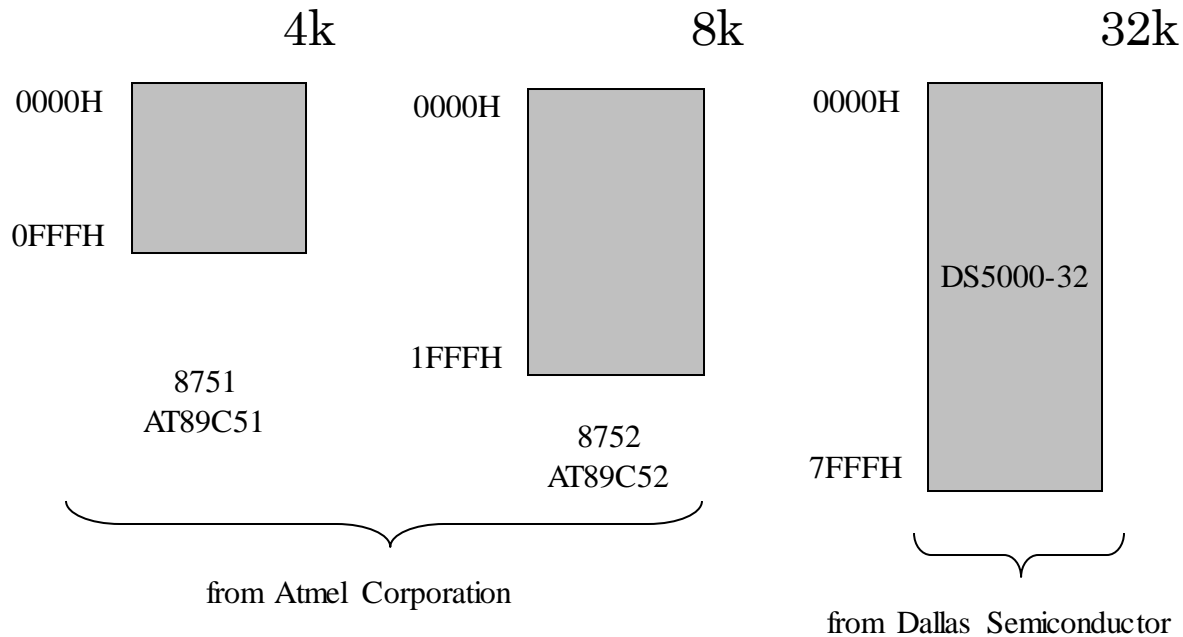


# PORT 3 ALTERNATE FUNCTIONS

P3 Bit	Function	Pin
P3.0	RxD	10
P3.1	TxD	11
P3.2	$\overline{\text{INT0}}$	12
P3.3	$\overline{\text{INT1}}$	13
P3.4	T0	14
P3.5	T1	15
P3.6	$\overline{\text{WR}}$	16
P3.7	$\overline{\text{RD}}$	17

# MEMORY MAPPING IN 8051

- ROM memory map in 8051 family



# LED INTERFACING

