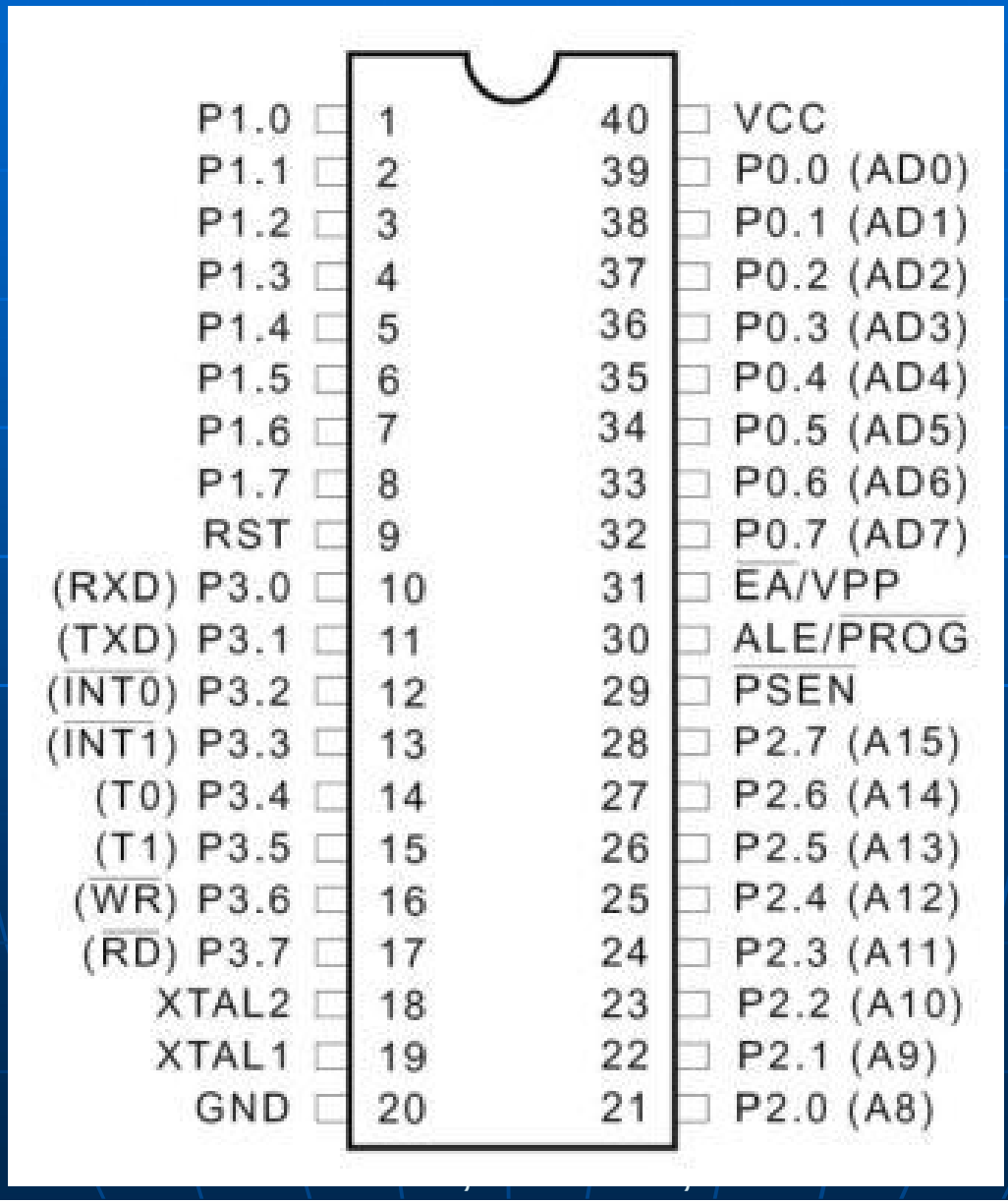
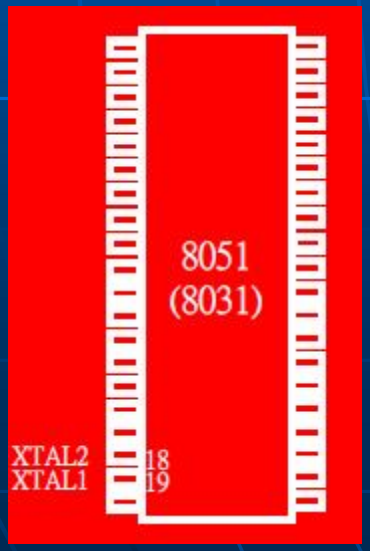
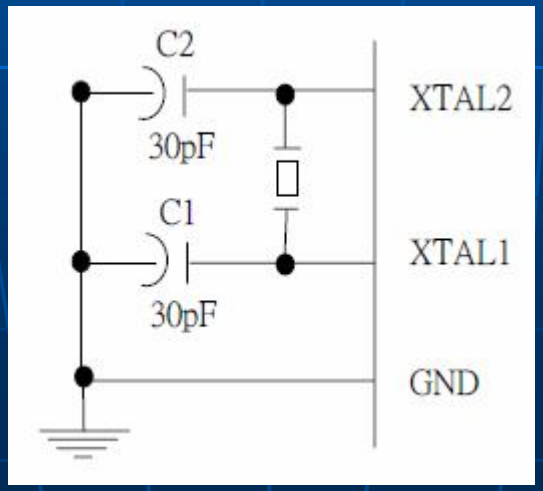
Pin Diagram of the 8051



XTAL1 and XTAL2

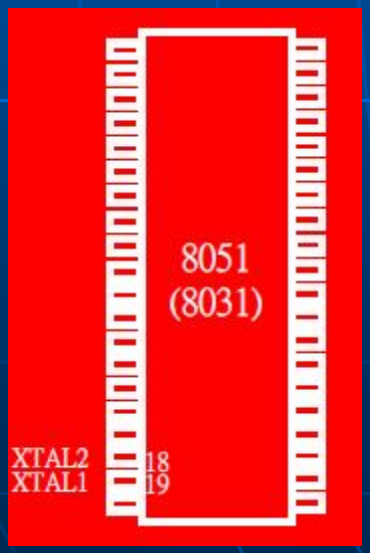
- The 8051 has an on-chip oscillator but requires an external clock to run it
  - A quartz crystal oscillator is connected to inputs XTAL1 (pin19) and XTAL2 (pin18)
  - The quartz crystal oscillator also needs two capacitors of 30 pF value

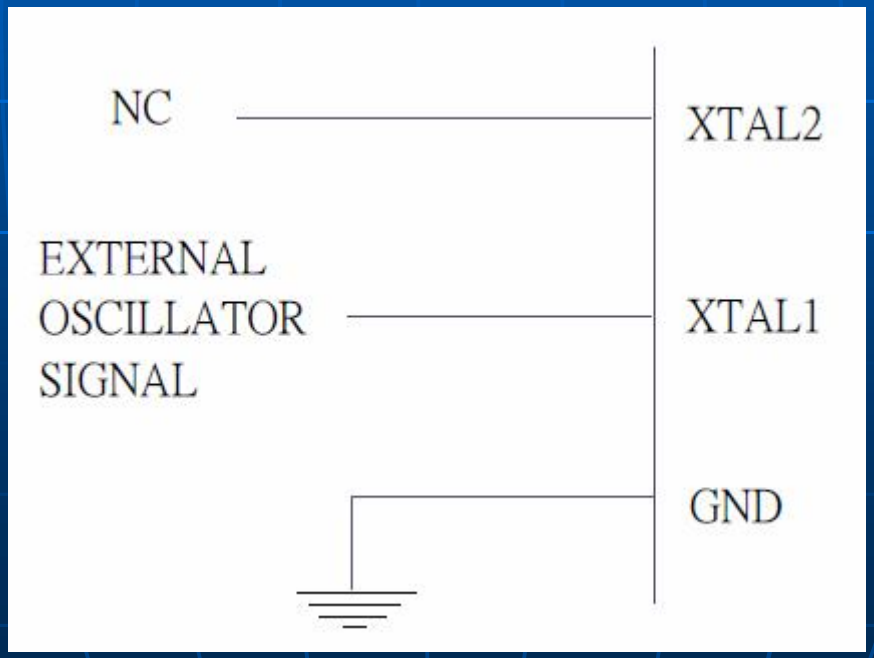




XTAL1 and XTAL2 .....

- If you use a frequency source other than a crystal oscillator, such as a TTL oscillator:
  - It will be connected to XTAL1
  - XTAL2 is left unconnected

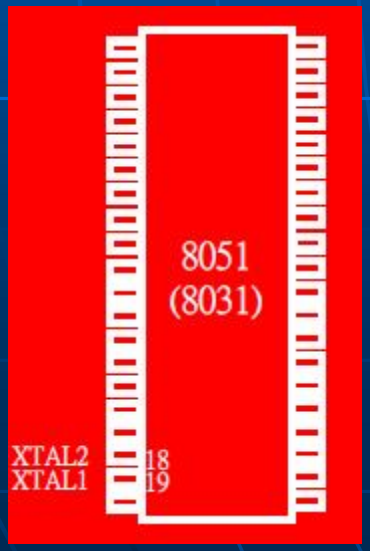




XTAL1 and XTAL2 .....

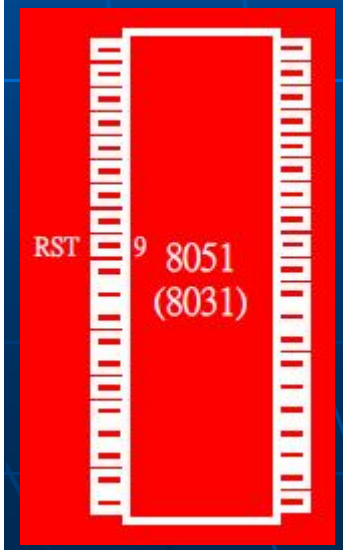
- The **speed of 8051** refers to the maximum oscillator frequency connected to XTAL.

- We can observe the frequency on the XTAL2 pin using the oscilloscope.



RST

- RESET pin is an input and is active high (normally low)
- Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities
- This is often referred to as a power-on reset
- Activating a power-on reset will cause all values in the registers to be lost



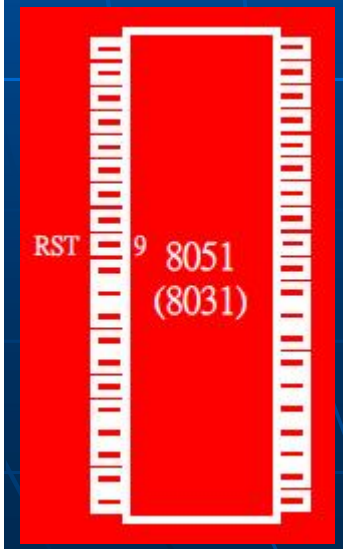
RESET value of some 8051 registers

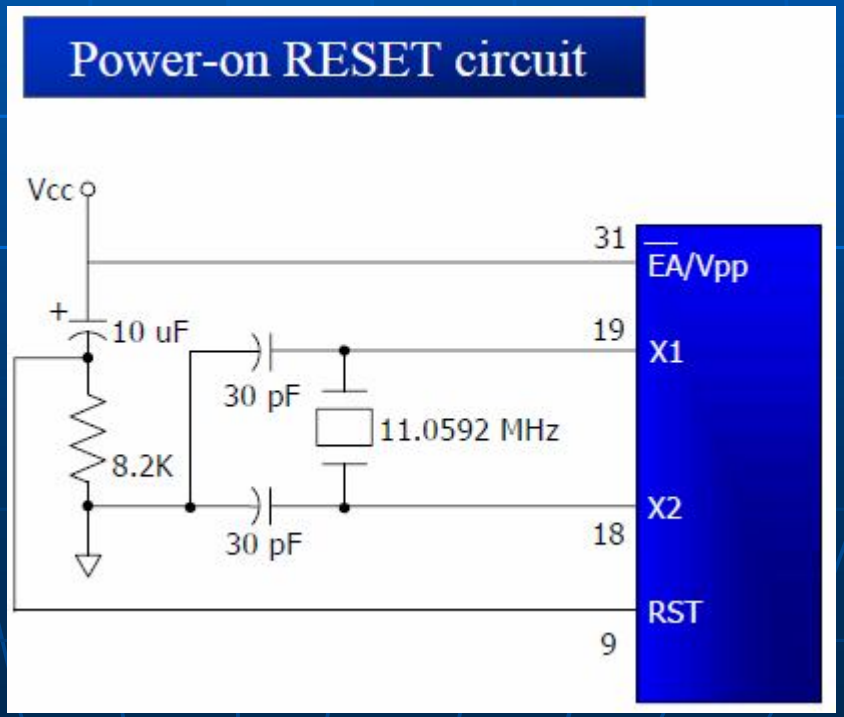
we must place the first line of source code in ROM location 0

Register	Reset Value
PC	0000
DPTR	0000
ACC	00
PSW	00
SP	07
B	00
P0-P3	FF

RST

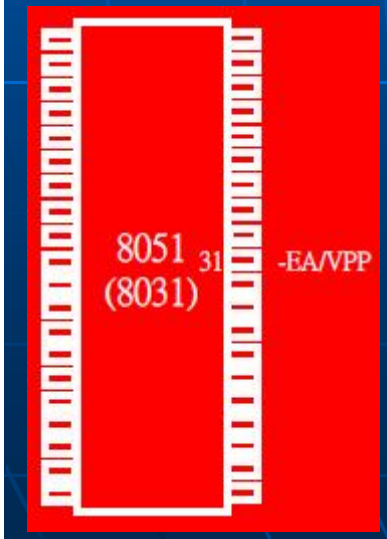
- In order for the RESET input to be effective, it must have a minimum duration of 2 machine cycles.
- In other words, the high pulse must be high for a minimum of 2 machine cycles before it is allowed to go low.





EA’

- EA’, **“external access”**, is an input pin and must be connected to Vcc or GND
- The 8051 family members all come with on-chip ROM to store programs and also have an external code and data memory.



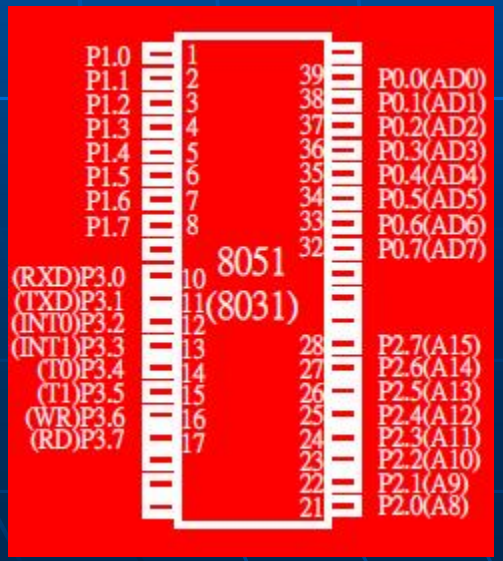
- Normally EA pin is connected to Vcc
- EA pin must be connected to GND to indicate that the code or data is stored externally.

PSEN' and ALE

- PSEN, **"program store enable"**, is an output pin
- This pin is connected to the OE pin of the external memory.
- For External Code Memory, PSEN' = 0
- For External Data Memory, PSEN' = 1
- ALE pin is used for demultiplexing the address and data.

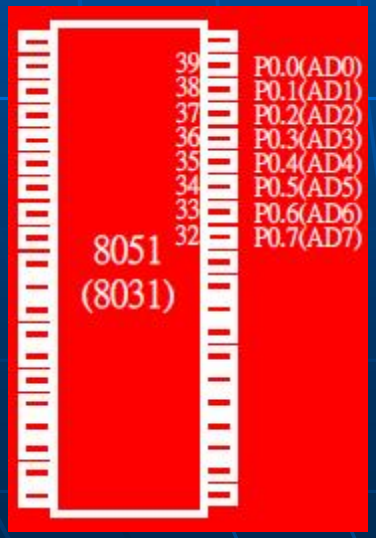
I/O Port Pins

- The four 8-bit I/O ports **P0, P1, P2 and P3** each uses 8 pins.
- All the ports upon RESET are configured as output, ready to be used as input ports by the external device.



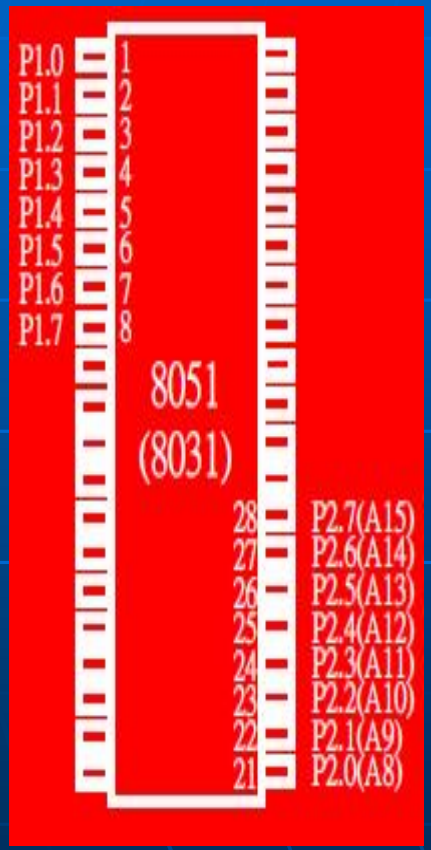
Port 0

- Port 0 is **also** designated as **AD0-AD7**.
- When connecting an 8051 to an external memory, port 0 provides both address and data.
- The 8051 multiplexes address and data through port 0 to save pins.



- **ALE** indicates if P0 has address or data.
  - *When ALE=0, it provides data D0-D7*
  - *When ALE=1, it has address A0-A7*

Port 1 and Port 2



- In 8051-based systems **with no external memory connection**:
  - Both P1 and P2 are used as simple I/O.
- In 8051-based systems **with external memory connections**:
  - Port 2 must be used along with P0 to provide the 16-bit address for the external memory.
  - P0 provides the lower 8 bits via A0 – A7.
  - P2 is used for the upper 8 bits of the 16-bit address, designated as A8 – A15, and it cannot be used for I/O.

Port 3

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

Serial communications

External interrupts

Timers

Read/Write signals of external memories

Pin Description Summary

PIN	TYPE	NAME AND FUNCTION
Vss	I	**Ground:** 0 V reference.
Vcc	I	**Power Supply:** This is the power supply voltage for normal, idle, and power-down operation.
P0.0 - P0.7	I/O	**Port 0:** Port 0 is an open-drain, bi-directional I/O port. Port 0 is also the multiplexed low-order address and data bus during accesses to external program and data memory.
P1.0 - P1.7	I/O	**Port 1:** Port I is an 8-bit bi-directional I/O port.
P2.0 - P2.7	I/O	**Port 2:** Port 2 is an 8-bit bidirectional I/O. Port 2 emits the high order address byte during fetches from external program memory and during accesses to external data memory that use 16 bit addresses.
P3.0 - P3.7	I/O	**Port 3:** Port 3 is an 8 bit bidirectional I/O port. Port 3 also serves special features as explained.

Pin Description Summary

PIN	TYPE	NAME AND FUNCTION
RST	I	**Reset:** A high on this pin for two machine cycles while the oscillator is running, resets the device.
ALE	O	**Address Latch Enable:** Output pulse for latching the low byte of the address during an access to external memory.
PSEN*	O	**Program Store Enable:** The read strobe to external program memory. When executing code from the external program memory, PSEN* is activated twice each machine cycle, except that two PSEN* activations are skipped during each access to external data memory.
EA*/VPP	I	**External Access Enable/Programming Supply Voltage:** EA* must be externally held low to enable the device to fetch code from external program memory locations. If EA* Is held high, the device executes from internal program memory. This pin also receives the programming supply voltage Vpp during Flash programming. (applies for 89c5x MCU's)