Ch.8
Hardware Connection

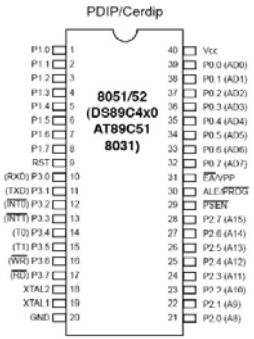
Yongjun Park
Hanyang University

Outline

- Pin Description
- DS89C4x0 Trainer
- Intel HEX file

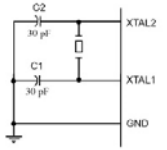
PIN: Layout

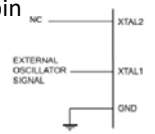
- **Pin Layout**
  - A total of 40 pins
  - 32 pins are used for I/O ports (8 pins/port, 4 ports)
  - The remaining 8 pins
    - VCC, GND, XTAL1, XTAL2, RST, $\overline{EA}$, $\overline{PSEN}$, ALE
- **VCC**
  - Pin 40
    - Provide supply voltage to the chip
  - Voltage source is +5V
- **GND**
  - Pin 20
    - Ground



PIN: XTAL1 and XTAL2

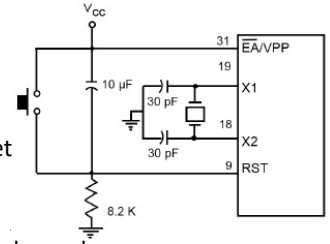
- **Pin Layout**
  - Provide external clock to 8051 (input pins)
  - Configuration 1 (most common):
    - Connect to a quartz crystal oscillator
    - Crystal oscillator can generate square waveform at a fixed frequency (e.g. 11.0592MHz)
    - Different 8051 chips have different speed ratings
      - E.g. a 12MHz chip can only be connected to a crystal oscillator with frequency 12MHz or lower
    - We can observe the clock with an oscilloscope on XTAL2 pin
  - Configuration 2:
    - Connect it to an external TTL oscillator (e.g. a clock signal generated by a function generator)
    - Only XTAL1 is used, XTAL2 is left unconnected (NC: not connected)





PIN: RST

- **RST (Reset, input pin)**
  - Active high: upon applying a high pulse to the pin, the uC will reset and terminate all activities
    - Normally it's value is low so uC can work normally
    - In order for it too be effective, the high pulse must be high for a minimum of 2 machine cycles
  - Reset by switch
    - When SW is open, RST is low
      When SW is closed, RST is high
    - When SW is released, RST is low → reset
  - Power on reset
    - At the instant of power on, RST is high
      After a while, the capacitor will be fully charged
    - In steady state, RST is low

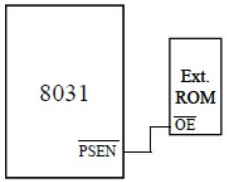


PIN: $\overline{EA}$, $\overline{PSN}$, and ALE

- **8031**
  - A simplified version of 8051, it doesn't have built-in ROM or RAM
  - Needs to be connected to external ROM and RAM through $\overline{EA}$, $\overline{PSN}$, and ALE
- **$\overline{EA}$**
  - External access (input pin): indicates whether there is external ROM
  - Active low: it's effective when the voltage is low
  - If it is connected to ground, there is external ROM
  - If it is connected to VCC, there is no external ROM

PIN: $\overline{EA}$, $\overline{PSN}$, and ALE

- **$\overline{PSEN}$**
  - Program store enable (output pin)
  - If external ROM is connected to the uC, this pin is connected to the OE (output enable) pin of the ROM to enable the output of the ROM



- **ALE**
  - Address latch enable (output pin)
  - Port 0 is used as both address and data bus for external RAM
  - If it is high, then P0 is used as address bus; if it is low, then P0 is used as data bus

PIN: Default Values

- **The default value of some 8051 registers upon reset**

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

- **Machine cycle and crystal frequency**

Chip (Maker)	Clocks per Machine Cycle
AT89C51/52 (Atmel)	12
P89C54X2 (Phillips)	6
DS5000 (Dallas Semiconductor)	4
DS89C4x0 (Dallas Semiconductor)	1

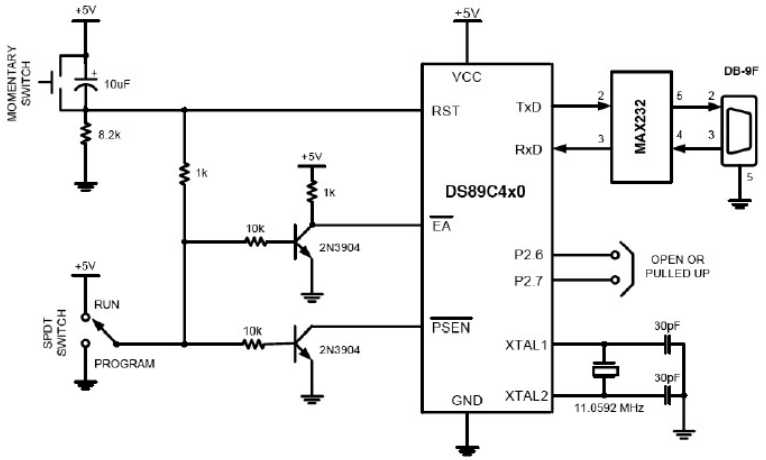
Outline

- Pin Description
- **DS89C4x0 Trainer**
- Intel HEX file

Hardware: Key Features

- **Key Features of DS89C4x0**
  - On-chip flash ROM
    - DS89C420/30: 16kB
    - DS89C440: 32kB
    - DS89C450: 64kB
  - High speed
    - 1 clock per machine cycle
    - DC to 33MHz operation
      (it can be connected to a crystal with frequency 33KMHz)
  - 256 bytes RAM, Two full duplex serial ports
  - 13 interrupt sources(6 external) with 5 levels of interrupt priority
  - Programmable watchdog timer

Hardware

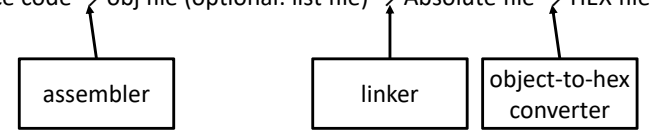


Outline

- Pin Description
- DS89C4x0 Trainer
- **Intel HEX file**

Intel HEX File

- **Intel HEX file**
  - A widely used file format designed to standardize the loading of executable machine code into a ROM chip
  - Review:
    - Source code → obj file (optional: list file) → Absolute file → HEX file



Intel HEX File

- **Format of HEX file**

```
:10000000758055759055 75A0557DFA111C7580AA9F
:100010007590AA75A0AA7DFA111C80E47C237B4F01
:07002000DBFEDCFADDF62235
:00000001FF
```

  - It can be open by using any text editor
  - Each line can be decomposed into 4 fields

```
:CC  AAAA TT  DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD  SS
:10  0000 00  75805575905575A0557DFA111C7580AA   9F
:10  0010 00  7590AA75A0AA7DFA111C80E47C237B4F   01
:07  0020 00  DBFEDCFADDF622                     35
:00  0000 01  FF                                 
```


Intel HEX File

- **Format of Intel HEX file**
  - Each line starts with a colon
  - Details
    - CC: the number of bytes in this line, the maximum value of 10H
    - AAAA: a 16-bit address indicating where the contents of the line should be stored in ROM
    - TT: type. if TT = 00, then this is not the last line, if TT = 01, then this is the last line
    - DD…DDD: the real data or code to be stored in ROM
    - SS: checksum for everything in the line to make sure there is no error
  - It always ends with FF

```
:CC  AAAA TT  DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD  SS
:10  0000 00  75805575905575A0557DFA111C7580AA   9F
:10  0010 00  7590AA75A0AA7DFA111C80E47C237B4F   01
:07  0020 00  DBFEDCFADDF622                     35
:00  0000 01  FF                                 
```


Intel HEX File

List file

```
LOC  OBJ       LINE
0000           1          ORG 0H
0000 758055    2    MAIN: MOV P0, #55H
0003 759055    3          MOV P1, #55H
0006 75A055    4          MOV P2, #55H
0009 7DFA      5          MOV R5, #250
000B 111C      6          ACALL MSDELAY
000D 7580AA    7          MOV P0, #0AAH
0010 7590AA    8          MOV P1, #0AAH
0013 75A0AA    9          MOV P2, #0AAH
0016 7DFA      10         MOV R5, #250
0018 111C      11         ACALL MSDELAY
001A 80E4      12         SJMP MAIN
               13 ;--- THE 250 MILLISECOND DELAY.
               14   MSDELAY:
001C 7C23      15   HERE3:  MOV R4, #35
001E 7B4F      16   HERE2:  MOV R3,#79
0020 DBFE      17   HERE1:  DJNZ R3, HERE1
0022 DCFA      18           DJNZ R4, HERE2
0024 DDF6      19           DJNZ R5, HERE3
0026 22        20           RET
               21           END
```

Hex file

```
:CC  AAAA TT  DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD  SS
:10  0000 00  75805575905575A0557DFA111C7580AA   9F
:10  0010 00  7590AA75A0AA7DFA111C80E47C237B4F   01
:07  0020 00  DBFEDCFADDF622                     35
:00  0000 01  FF                                 
```