PIC Microcontroller and Embedded Systems
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Chapter 1: The PIC Microcontrollers: History and Features

- Microcontroller and Embedded Processors
- Overview of the PIC18 Family
Objective

- Compare and contrast uP and uC
- Describe the advantages of uC
- Explain the concept of ES
- Describe criteria for considering a uC
- Compare and contrast the various of the PIC Family
- Compare the PIC with uC offered by others
Microcontroller and Embedded Processors

- Microcontroller VS General purpose uP
- uC for embedded systems
- X86 PC Embedded Application
Figure 1-1. Microprocessor System Contrasted With Microcontroller System
Choosing a uController

- The major 8-bit
  - Freescale Semiconductor’s (formerly Motorola) 68HC08/68HC11
  - Intel’s 8051
  - Atmel’s AVR
  - Zilog’s Z8
  - PIC from Microchip Technology
Criteria for Choosing uController

1. Meeting the computing needs of the task at hand efficiently and cost effectively

2. Availability of SW and HW development tools
   - Compilers
   - Assemblers
   - Debuggers
   - Emulators

3. Wide availability and reliable source
Criteria for Choosing uController

- Meeting the computing needs of the task at hand efficiently and cost effectively
  - Determine its type, 8-bit, 16-bit or 32-bit
  - Speed
  - Packaging (40-Pin or QFP)
  - Power consumption
  - The amount of RAM and ROM
  - The number of I/O pins and the timer
  - Cost per unit
  - Ease of upgrade.
uC Data width

- 8-bit Microcontrollers
  - PIC10, PIC12, PIC14
  - PIC16, PIC17, PIC18
- 16-bit Microcontrollers
  - PIC24F, PIC24H
- 32-bit Microcontrollers
  - PIC32
- 16-bit Digital Signal Controllers
  - dsPIC30, dsPIC33F
Overview of the PIC18 Family

- An 8-bit uController called PIC is introduced in 1989 by Microchip Technology Corporation
- It includes
  - Small Data Ram
  - Few bytes of Rom
  - One timer
  - I/O ports
PIC 18 Feathers

- RISC Architecture
- On-chip program, Code, ROM
- Data EEPROM
- Timers
- ADC
- USART
- I/O Ports
Figure 1-2. Simplified View of a PIC Microcontroller
PIC18 Features

- RISC Architecture
- On chip Code ROM and Data RAM, Data EEPROM
- Timers
- ADC
- USART
- I/O ports
Figure 1-3. PIC18 Block Diagram
Figure 1-3. PIC18 Block Diagram (continued)

Note 1: Many of the general purpose I/O pins are multiplexed with one or more peripheral module functions. The multiplexing combinations are device dependent.
Figure 1-4. PIC16 Block Diagram
Figure 1-4. PIC16 Block Diagram (continued)

Note 1: The high order bit(s) of the Direct Address for the RAM are from the STATUS register.
2: Not all devices have this feature, please refer to device data sheet.
3: Many of the general purpose I/O pins are multiplexed with one or more peripheral module functions.
The multiplexing combinations are device dependent.
The PIC uCs
PIC uC program ROM

- PIC exists in terms of different speed and the amount of on-chip RAM/ROM
- Compatibility is restricted as far as the instructions are concerns.
PIC uC Program ROM

- PIC 18 can support up to 2MB
- Generally, they come with 4KB – 128KB
- Available in flash, OTP, UV-EPROM, and masked.
UV-EPROM

Figure 2: PIC16C5x SERIES BLOCK DIAGRAM

The PIC uCs
PIC18Fxxxx with flash

- Used for product development
PIC18Cxxxx and Masked PIC

- **OTP**
  - One time programmable
  - $C$ indicates the OTP RPM
  - Used for mass production
  - Cheaper

- **Masked**
  - Program will be burned into the PIC chip during the fabrication process
PIC uC data RAM and EEPROM

- Max. 4096 Bytes (4 kB) of data RAM space.
- Data RAM space has two components
  - Varied GPR, General Purpose RAM
    - For read/write and data manipulation
    - Divided into banks of 256 B
  - Fixed SFR, Special Function Registers
- Some of PICs have a small amount of EEPROM
  - Used for critical data storing
# PIC18 Microcontroller Family

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Abbreviation:  
- ADC = Analog-to-Digital Converter  
- CCP = Capture/Compare/PWM  
- FWM = Pulse Width Modulation  
- SPI = Serial Peripheral Interface  
- I²C = Inter-Integrated Circuit Bus  
- PMM = Power Managed Mode  
- USART = Universal Synchronous/Asynchronous Receiver/Transmitter
PIC uC peripherals

- CAN- (Controller Area Network),
- LIN- (Local Interconnect Network),
- USB- (Universal Serial Bus),
- I²C- (Inter-Integrated Circuit),
- SPI- (Serial Peripheral Interface),
- Serial or Ethernet Interface
- ADC - Analog Digital Converter
- USART- Universal Synchronous Asynchronous Receiver Transmitter
Chapter 1: Summary

- We have Compared between uP and uC
- We have described the advantages of uC
- We have given a simple introduction for PIC18

Next:
PIC Architecture and assembly language programming.