

# Chapter 13

## PIC Family Microcontroller

# Lesson 15

## **Instruction Set**

# Most instructions execution Time

- One instruction cycle
- If XTAL frequency = 20 MHz, then instruction cycle time is  $0.2\mu\text{s}$  or 200 ns ( $= 4/20 \text{ MHz}$ )
- When a test for a condition is true or PC changes in the operation for branching or call, then it takes two instruction cycles (440 ns for 20 MHz Xtal)

# PIC instructions in 16F877

- 35 Instructions
- 14-bit length
- Saved in program memory with 8 k addresses and 14-bit at each address
- Each instruction two parts
- *opcode* and
- one or two *operands*. An opcode specifies instruction type. The operands specify the operation bits, byte or register

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# Opcode and Operand

- opcode specifies instruction type
- The operands specify the bits, byte, registers using which the operations performed

# Instruction Types

- Byte-oriented operations on file register
- Bit-oriented operations on file register
- Literal operation
- Control operations Call/Branch (GOTO) instructions

# Byte-oriented operations

- The operations are on the bytes, for example,
- `WTEMP eq 0x70`
- `W_TEMP` defined an operand at address `0x70`
- `MOVWF W_TEMP`—move (copy) `W` into `W_TEMP`



# Bit-oriented operations

- The operations on the bits
- Bit clear or bit set

# Literal-oriented operations

- The operations on the literal
- An instruction can have 8-bit immediate value (operand) for the operation
- `ADDLW 0x7D` to add 0x7D into W-register
- Affects Z, C and DC in STATUS register

# Control operations

- The operation for control of the program or branch or call
- CLRWDT— clears watchdog timer and effects TO and PD flags in STATUS register

# MOV

- MOVF f ,
- dMOVWF
- fMOVLW k

# ArithmeticInstructions

- ADDWF f, d
- ADDLW k
- SUBWF f, d
- SUBLW k

# LogicOperation Instructions

- ANDWF f, d
- ANDLW kX
- ORWF f, d
- XORLW k
- IORWF f, d
- IORLW k

# COM,CLR,RL

- COMF f, d
- CLRW
- CLRF fSWAP f, d
- RLF f, d
- RLF R, d

# INC and DEC

- INCF f, d
- INCFSZ f, d(2-cycle instruction)
- DECF f, d
- DECFSZ f, d(two-cycle instruction)



# Bit Oriented Operations

- BCF f, b
- BSF f, b
- BTFSC f, b (two-cycle instruction)
- BTFSS f, b (two-cycle instruction)

# Control Instructions

- CLRWDT
- NOP
- CALL k' (two-cycle instruction)
- GOTO k' (two-cycle instruction)
- RETURN (two-cycle instruction)
- RETFIE
- RETLW k (two-cycle instruction)
- SLEEP

# Web-link for instruction set

- PIC datasheet for PIC 16F877 at the website <http://ww1.microchip.com/downloads/en/DeviceDoc/30292c.pdf>.

# Application Notes

- <http://www.microchip.com>.
- Code examples are at [http://www.microchip.com/stellent/idcplg?IdcService=SS\\_GET\\_PAGE&nodeId=2609](http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2609)
- The examples for the instructions and projects in Microcontroller Programming The Microchip PIC by Julio Sanchez and Maria P. Canton, CRC Press (Taylor and Francis Group), 2007

# Summary

# We learnt

- Instruction set has 35 instructions
- All instructions of same length— 14-bit length instructions
- Byte-oriented operations on file register
- Bit-oriented operations on file register
- Literal operation
- Control operations Call/Branch (GOTO) instructions

End of Lesson 15 on

**Instruction Set**