EE461 Microprocessor-based Digital Design

Assignment 3 Solutions

1. (a) List the I/O ports of the PIC16F874. For each port, state how many I/O pins that port has.

SOLUTION

Port	Pins
A	6
B	8
C	8
D	8
E	3

(b) Aside from the pins associated with its I/O ports, how many other pins does the DIP package of the PIC16F874 have? Name them and give the pin numbers associated with them.

SOLUTION

There are seven pins.They are $\overline{\text{MCLR}}$ (pin 1), OSC1/CLKIN (pin 13), OSC2/CLKOUT (pint 14), V_{SS} (pins 12 and 31), and V_{DD} (pins 11 and 32.)

(c) What are the pin numbers for the bits of Port E in the DIP package?

SOLUTION

Pins 8, 9, and 10.

2. (a) How many pages of program memory are implemented in the PIC 16F874?

SOLUTION

There are two pages, pages 0 and 1.

(b) How many program words are there in each page (give your answer in decimal with no rounding.)

SOLUTION

Both pages have $800_{16} = 2048_{10}$ words in them. However, location 0 of page 0 is always the reset vector and location 4 of page 0 is always the interrupt vector (if interrupts are in use), so you might regard page 0 as having only 2046 words. Furthermore, there are three words in between these, so you might even say there are only 2043 words in page 0 if you can't think of a way to use these locations.

3. To access bank 1 in the data memory (that is, the register file), which bits in which register must be set to what value?

SOLUTION

Either put a 0 in the IRP bit (bit 7) of the STATUS register and a 1 in the most significant bit of the FSR register or put the value 01 into the RP1:RP0 bits (bits 6 and 5) of the STATUS register.

4. Define Harvard Architecture and explain the benefit of Pipelining.

SOLUTION

In a Harvard Architecture, the accessing of the data and instruction information is split onto two separate buses. Pipelining permits a faster clock since operations are divided into smaller tasks. Yet, instructions still finish at the rate of one per clock cycle.

5. Suppose the STATUS register contains the binary value 11011001, the FSR register contains the binary value 11011100, and your program reads data from the INDF register. From what file address is data actually read? Explain your answer.

SOLUTION

Reading from the INDF register (register 0) implies that the actual address is formed by taking the IRP bit (bit 7) of the status register and the eight bits of the FSR register (resgister 4) to obtain the nine bits of the address.In this case the nine-bit address is, therefore, 1 1101 1100 or $1DC_{hexadecimal}$. However, the PIC16F874 lacks memory at this address. Instead, memory whose initial address bit is 0 is addressed. Therefore, the actual address read is 0 11011100 or $0DC_{hexadecimal}$, an address located in the general purpose register section of Bank 1.

6. The instruction **`addlw 1`** will increment the contents of the Working register.

To decrement the byte in W in the absence of a Subtract instruction we can add h'FF' (which is the 2's complement of one); i.e. **`addlw h'FF'`**. For example if W were h'26' then:

```
  0010 0110
+1111 1111
  0010 0101 (or h'25')
```

An assembler would also allow us to use the syntax **`addlw -1`**.