

EE-222: Microprocessor Systems

AVR Microcontroller: I/O Ports Bit Manipulation

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Examples: DIY

Example

- Write a program to create a square wave of 50% duty cycle on bit 0 of Port C.

```
LDI    R20, HIGH(RAMEND)
OUT     SPH, R20
LDI    R20, LOW(RAMEND)
OUT     SPL, R20      ;initialize stack pointer

SBI     DDRC, 0        ;set bit 0 of DDRC (PC0 = out)
HERE:   SBI     PORTC, 0 ;set to HIGH PC0 (PC0 = 1)
CALL    DELAY          ;call the delay subroutine
CBI     PORTC, 0        ;PC0 = 0
CALL    DELAY
RJMP    HERE           ;keep doing it
```

Example

- Write a program to perform the following:
 - Keep monitoring the PB2 bit until it becomes HIGH
 - When PB2 becomes HIGH, write the value \$45 to Port C and also send a HIGH-to-LOW pulse to PD3

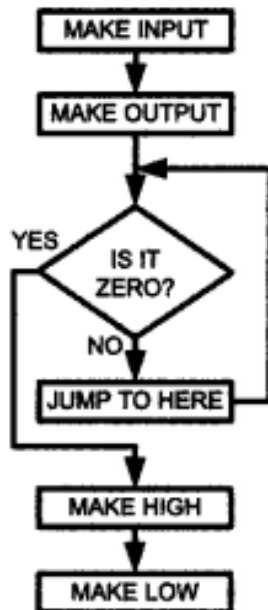
```
                CBI    DDRB, 2      ;make PB2 an input
                LDI     R16, 0xFF
                OUT     DDRC, R16    ;make Port C an output port
                SBI     DDRD, 3      ;make PD3 an output
AGAIN:          SBIS    PINB, 2      ;skip if Bit PB2 is HIGH
                RJMP    AGAIN        ;keep checking if LOW
                LDI     R16, 0x45
                OUT     PORTC, R16   ;write 0x45 to port C
                SBI     PORTD, 3     ;set bit PD3 (H-to-L)
                CBI     PORTD, 3     ;clear bit PD3
                HERE:    RJMP    HERE
```

Class Activity

- Assume that bit PB3 is an input and represents the condition of a door alarm.
 - If it goes LOW, it means that the door is open
 - Monitor the bit continuously
 - Whenever it goes LOW, send a HIGH-to-LOW pulse to port PC5 to turn on a buzzer

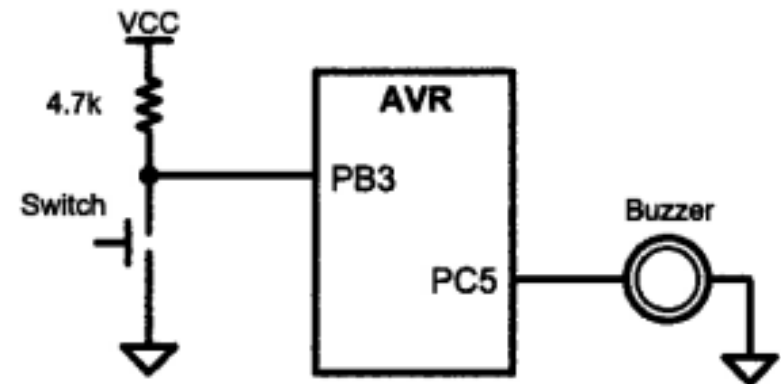
Class Activity: Solution

```
CBI    DDRB, 3    ;make PB3 an input
SBI    DDRC, 5    ;make PC5 an output
HERE:  SBIC  PINB, 3    ;keep monitoring PB3 for HIGH
RJMP   HERE      ;stay in the loop
SBI    PORTC, 5    ;make PC5 HIGH
CBI    PORTC, 5    ;make PC5 LOW for H-to-L
RJMP   HERE
```



INSTRUCTIONS

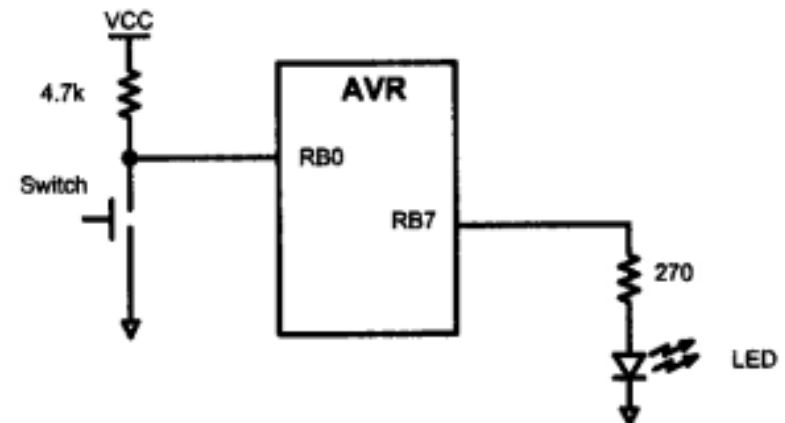
```
CBI DDRB, 3
SBI DDRC, 5
HERE: SBIC PINB, 3
RJMP HERE
SBI PORTC, 5
CBI PORTC, 5
```



Class Activity

- A switch is connected to pin PB0 and an LED to pin PB7. Write a program to get the status of SW and send it to the LED.

```
        CBI    DDRB, 0        ;make PB0 an input
        SBI    DDRB, 7        ;make PB7 an output
AGAIN:   SBIC   PINB, 0        ;skip next if PB0 is clear
        RJMP   OVER          ;(JMP is OK too)
        CBI    PORTB, 7
        RJMP   AGAIN          ;we can use JMP too
OVER:    SBI    PORTB, 7
        RJMP   AGAIN          ;we can use JMP too
```



Reading

- The AVR Microcontroller and Embedded Systems: Using Assembly and C by Mazidi et al., Prentice Hall
 - Chapter-4: Complete
 - Go through all the examples carefully and make sure you run them on Atmel Studio for firm understanding.
- Also perform the left-over class activities

THANK YOU

