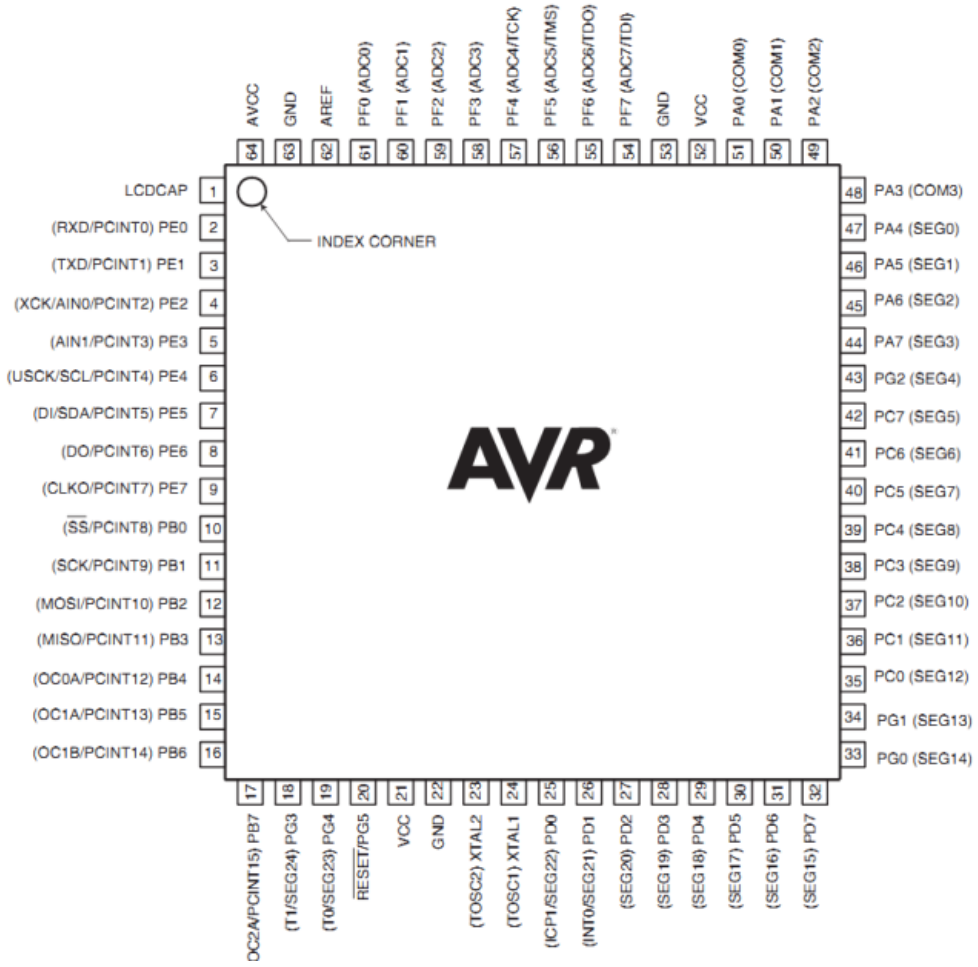
AVR IO Ports

General Purpose I/Os, Pull-Up Resistors, Programming IOs

Credit to Dr. Robucci for slide information

ATMega169P Chip



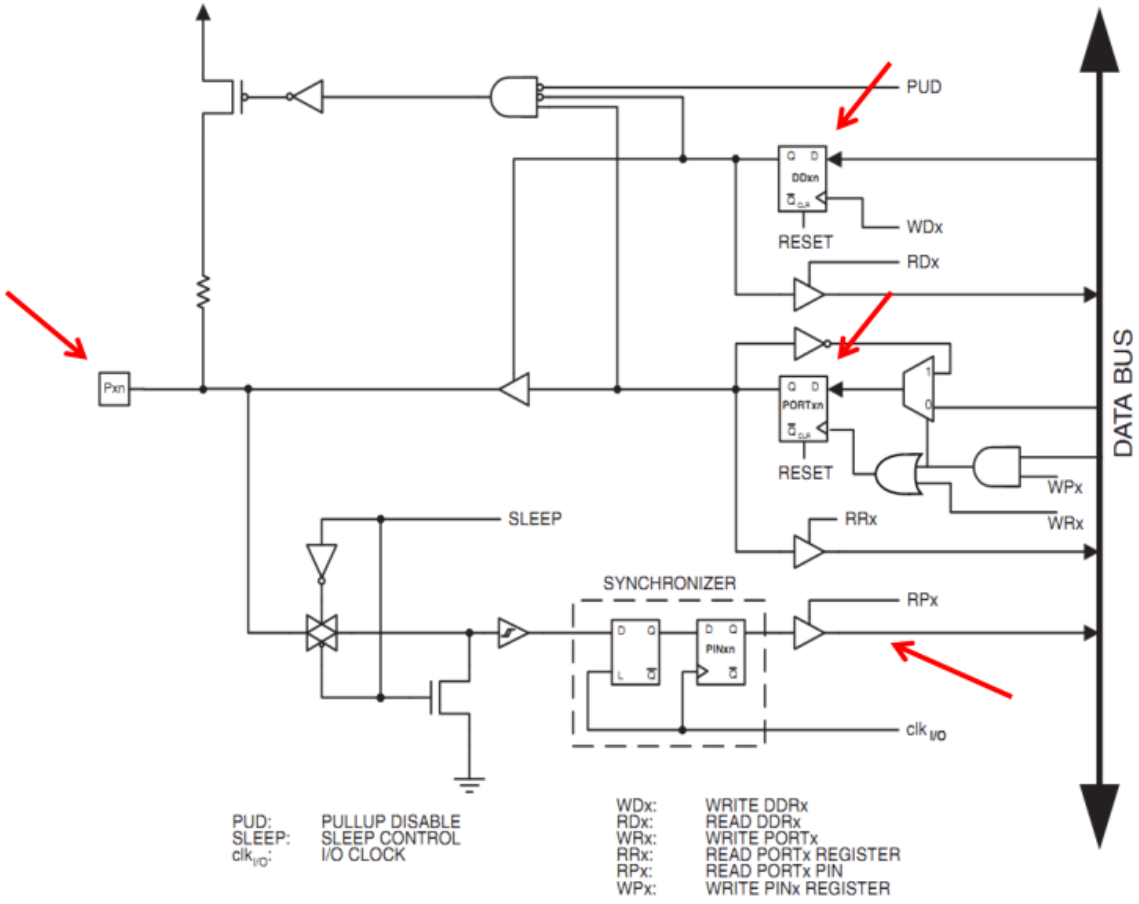
I/O Ports

- All AVR Ports have true Read-Modify-Write functionality
  - Each pin on a port can be modified without unintentionally modifying any other pin
- Three I/O memory address locations allocated for each port
  - Data Register – PORTx (Read/Write)
  - Data Direction Register – DDRx (Read/Write)
  - Port Input Pins – PINx (Read)

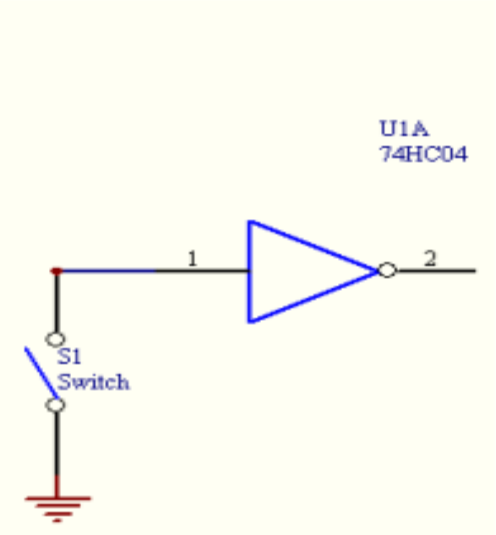
I/O Ports

- ATMega 169P has 7 ports
  - A,B,C,D,E,F,G
- Pxn represents nth bit in Port x
  - E.g. PA6 == 6th bit of Port A
- If DDxn is a:
  - 1 – Pxn is configured to be an output pin
  - 0 – Pxn is configured to be an input pin
- If DDxn is configured as output and PORTxn is:
  - 1 – Pxn is driven high (1)
  - 0 – Pxn is driven low (0)
- Note: "writing" a logic 1 to a bit in the PINx Register will *toggle* the corresponding bit in the data

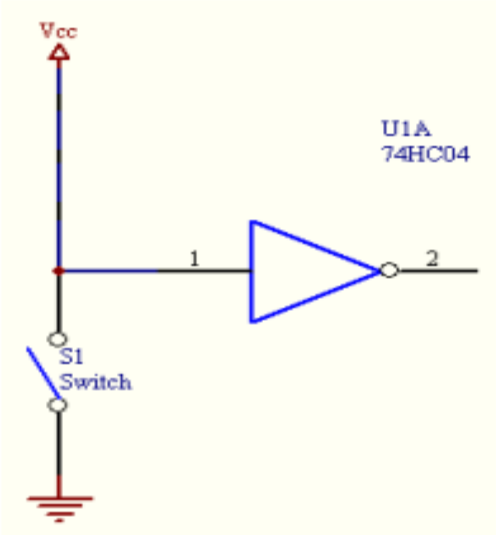
General Digital I/O



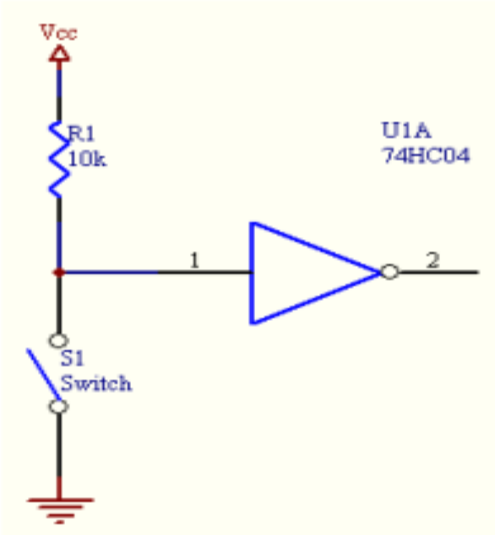
Pull-Up Resistor



S1 = 0 – High Impedance
S1 = 1 – VCC
BAD



S1 = 0 – GND
S1 = 1 – VCC
BAD
Why?



S1 = 0 – GND
S1 = 1 - VCC
Good
Why?

Pull-Up Resistor

- With a pull-up resistor, the input pin reads high state when switch is open, low when switch is closed
- AVR has internal pull-up
  - No need to implement outside
- This is what allows you to toggle the pin's output

Programming I/O Ports - Assembly

- **;Using CBI and SBI to write to ports**
- SBI DDRB, 1 ;make bit 1 as output bit on PORTB
- CBI PORTB, 1 ;make PORTB bit 1 as "0"
- SBI PORTB, 1 ;make PORTB bit 1 as "1"

- **;Using OUT instruction to write to ports**
- LDI R18, 0b00010000
- OUT DDRB, R18 ;make bit 1 as output bit on PORTB
- LDI R18, 0b00000000
- OUT PORTB, R18 ;make PORTB bit 1 as "0"
- LDI R18, 0b00010000
- OUT PORTB, R18 ;make PORTB bit 1 as "1“

Programming I/O Ports - Assembly

- **;INPUT EXAMPLE**
- IN R18,PINB
- **;set pin 5 of B port as output**
- **; without affecting other bits**
- IN R18,DDRB
- ORI R18, 0b00010000
- OUT DDRB, R18

- **;set pin 5 of B port to 1**
- **; without affecting other bits**
- IN R18,PORTB
- ORI R18, 0b00100000
- OUT PORTB, R18

Programming I/O Ports - Assembly

- **;clear pin 5 of B port to 0**
- **; without affecting other bits**
- IN R18,PORTB
- ANDI R18, 0b11101111
- OUT PORTB, R18

- **;set pin 7,3 of B port to 1 at same time**
- **; without affecting other bits**
- IN R18,PORTB
- ORI R18, 0b10001000
- OUT DDRB, R18

Programming I/O Ports - Assembly

- **;toggle pin 1 of B (no eori available)**
- **; without affecting other bits**
- IN R18,PORTB
- LDI R19,0b00000010
- EOR R18, R19
- OUT PORTB, R18

- **;toggle pin 1 of B using PINB "input write trick"**
- OUT PINB, 0b00000010

Ports on Butterfly Board

Figure 3-1. Connectors

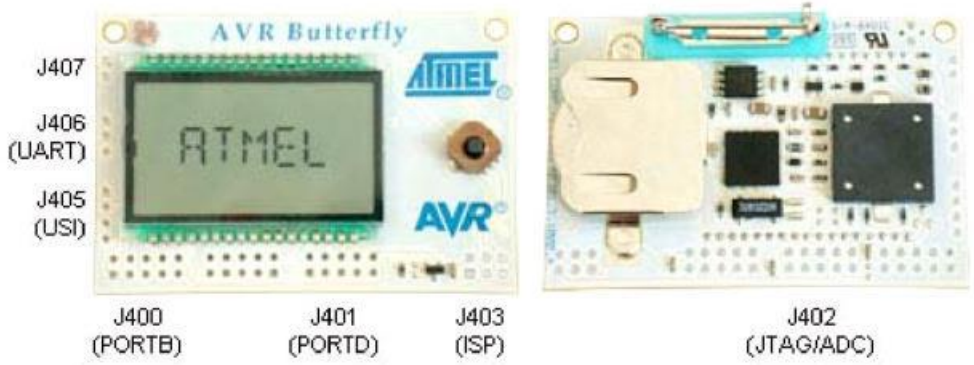
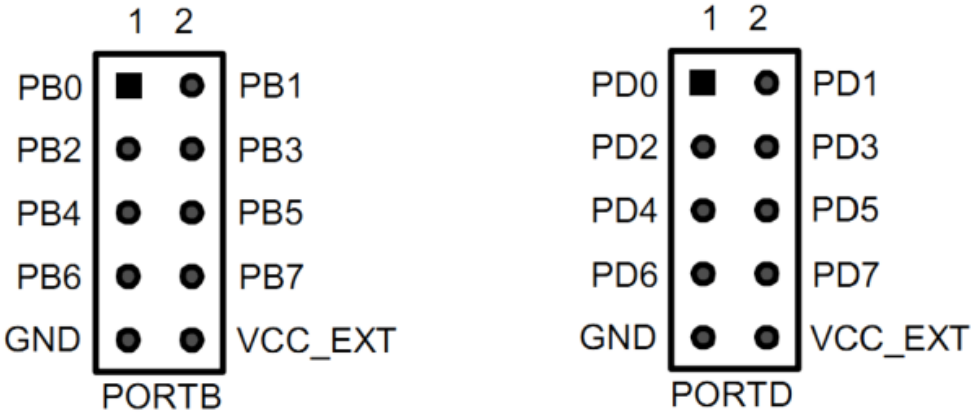


Figure 3-7. PORT B and PORT D



Review of Bit masking

- Controlling Port I/O makes bit masks invaluable
  - Allows control of single pins without affecting others
- Using OR as mask to bring up a pin
  - ORI A 0'b00000001
    - Only makes the LSB become 1, leaves others unaffected
- Using AND as mask to bring a pin down
  - ANDI A 0'b1111110
    - Only makes LSB become 0, leaves others unaffected