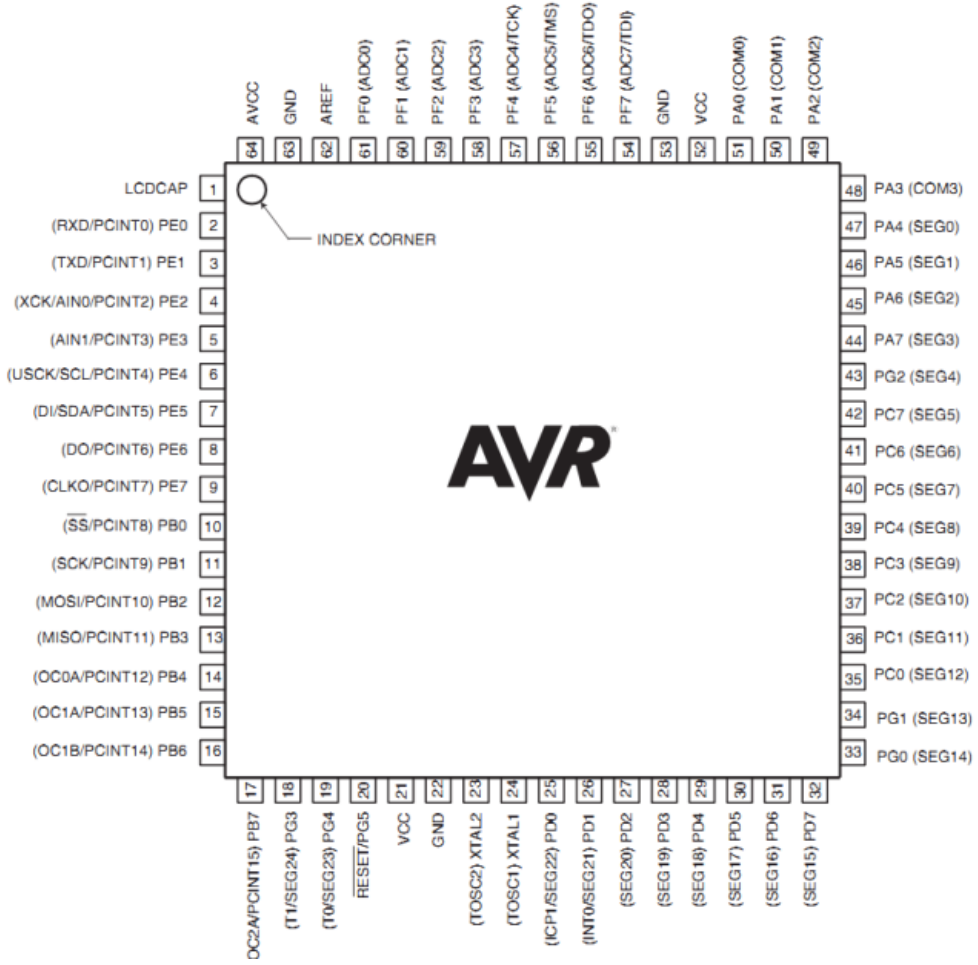
AVR IO Ports

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)

- All ATmega169P I/Os and peripherals are placed in the I/O space. All I/O locations may be accessed by the LD/LDS/LDD and ST/STS/STD instructions, transferring data between the 32 general purpose working registers and the I/O space. I/O Registers within the address range 0x00 - 0x1F are directly bit-accessible using the SBI and CBI instructions. In these registers, the value of single bits can be checked by using the SBIS and SBIC instructions.
- When using the I/O specific commands IN and OUT, the I/O addresses 0x00 - 0x3F must be used. When addressing I/O Registers as data space using LD and ST instructions, 0x20 must be added to these addresses.

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 (can be used only in C)
- 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

Programming I/O Ports - Registers

- Each port is controlled by 3 8-bit registers that control specific functionality of that port.
- **DDRx** – Controls the Data Direction flow of the port.
- **PORTx** – Controls the output value of an output pin as well pull-up resistor status of input pin.
- **PINx** – Can be read in to see the value of any pin on a port.

I/O PORT

DDRx Reg.

Controls the direction of data flow in both modes.

1	Output
0	Input

PORTx Reg.

Input Mode		Output Mode	
Controls the pull up resistor connected to pin.		Controls output value of pin.	
0	Off	0	Low
1	On	1	High

PINx Reg.

Can be read to see the value at any of the 8 pins on the port.

Programming I/O Ports - Assembly

- **;Using CBI and SBI to write to ports**
- SBI DDRB, 1 ;make bit 1 as output bit on PORTB //SBI DDRB, ob00000001
- 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, ob00010000
- OUT DDRB, R18 ;make bit 4 as output bit on PORTB
- LDI R18, ob00000000
- OUT PORTB, R18 ;make PORTB bit 4 as "0"
- LDI R18, ob00010000
- OUT PORTB, R18 ;make PORTB bit 4 as "1“

Programming I/O Ports - Assembly

- **;INPUT EXAMPLE**
- IN R18,PINB //Reads all 8bits, For example, reading Push button value
- **;set pin 4 of B port as output**
- **; without affecting other bits**
- IN R18,DDRB //reading DDRB register value and storing in R18 can be any other register like R20
- ORI R18, 0b00010000
- OUT DDRB, R18

- We don't need to use R18 for all three cases. Basically you can use any register for each of these three examples

- **;set pin 4 of B port to 1**
- **; without affecting other bits**
- IN R18,PORTB
- ORI R18, 0b00100000
- OUT PORTB, R18 //Since in previous example this bit was as output through DDRB , then this line means that we are making pin 4 port 4 to be one. For example, truing n LED On (or off)

Programming I/O Ports - Assembly

- **;clear pin 4 of B port to 0**
- **; without affecting other bits**
- IN R18,PORTB
- ANDI R18, 0b11101111
- OUT PORTB, R18 //In this example if we don't set the bit4 direction as output then this value doesn't get set to the output port

- **;set pin 7,3 of B port to 1 at same time**
- **; without affecting other bits**
- IN R18,PORTB
- ORI R18, 0b10001000
- OUT PORTB, 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 //Inverts Pin 1 by Xoring it or inverting it

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

Ports on Butterfly Board

Figure 3-1. Connectors

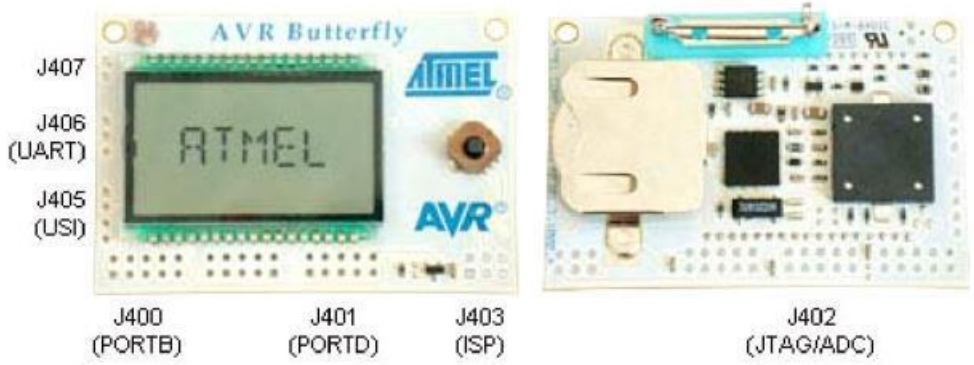
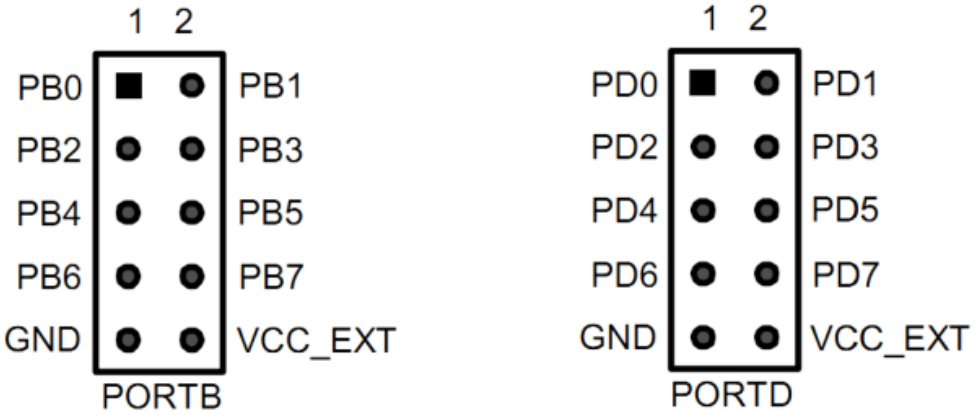


Figure 3-7. PORT B and PORT D



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