

PIC Microcontroller and Embedded Systems

PIC I/O Port Programming

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Objective

- ▶ List all the ports of the PIC18
- ▶ Describe the dual role of PIC18 pins
- ▶ Code Assembly to use ports for input or output
- ▶ Code PIC instructions for I/O handling
- ▶ Code I/O bit-manipulation Programs for PIC
- ▶ Explain the bit addressability of PIC ports

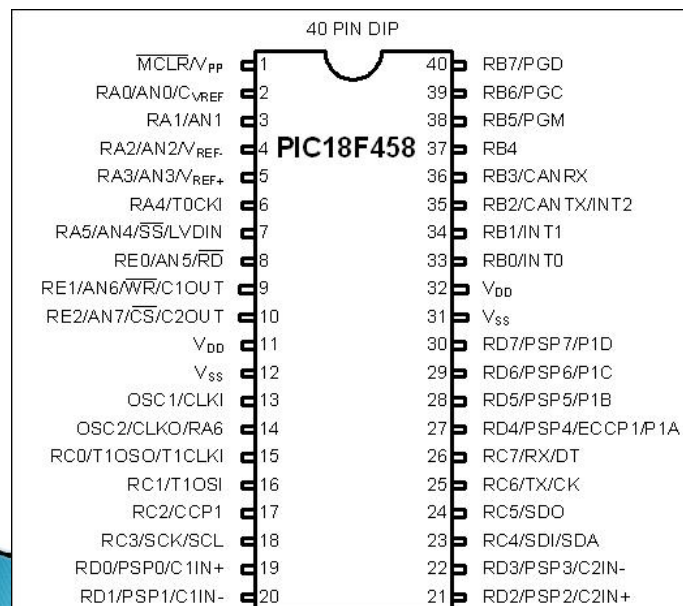
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I/O Port Programming in PIC18

- ▶ PIC18 has many ports
 - Depending on the family member
 - Depending on the number of pins on the chip
 - Each port can be configured as input or output.
 - Bidirectional port
 - Each port has some other functions
 - Such as timer , ADC, interrupts and serial communication
 - Some ports have 8 bits, while others have not

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PICF458 Pin Diagram



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Ports in PIC 18

Pins	Add	18-pin	28-pin	40-pin	64-pin	80-pin
Chip	PIC18F1220	PIC18F2220	PIC18F458	PIC18F6525	PIC18F8525	
PORT A F80H	X	X	X	X	X	X
PORT B F81H	X	X	X	X	X	X
PORT C F82H		X	X	X	X	X
PORT D F83H			X	X	X	X
PORT E F84H			X	X	X	X
PORT F F85H			X	X	X	X
PORT G F86H				X	X	X
PORT H				X	X	X
PORT J				X	X	X
PORT K					X	X
PORT L					X	X

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I/O SFR

- ▶ Each port has three registers for its operation:
 - ▶ TRIS register (Data Direction register)
 - If the corresponding bit is 0 Output
 - If the corresponding bit is 1 Input
 - ▶ PORT register (reads the levels on the pins of the device)
 - ▶ LAT register (output latch)
- ▶ The Data Latch (LAT) register is useful for read-modify-write operations on the I/O pins. It is the value that the I/O are driving.

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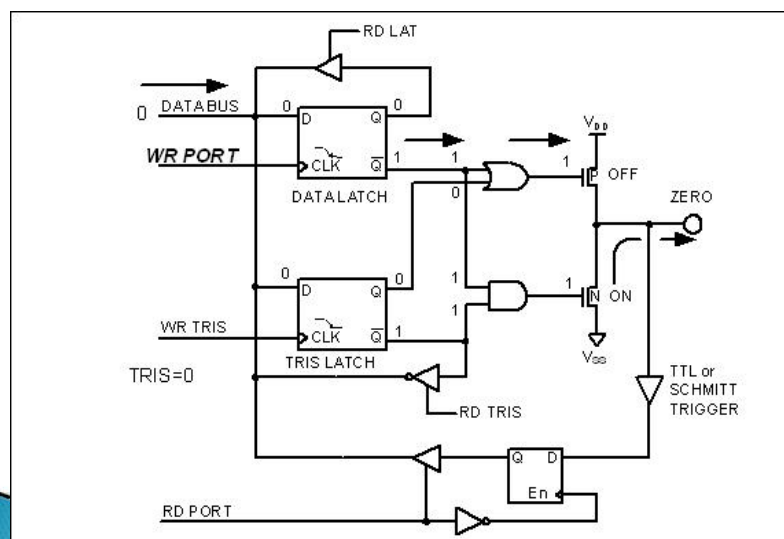
I/O SFR

- ▶ PIC18F458 has 5 ports
- ▶ Upon reset, all ports are configured as input
- ▶ TRISx register has 0FFH

Pins	Address
PORT A	F80H
PORT B	F81H
PORT C	F82H
PORT D	F83H
PORT E	F84H
LATA	F89H
LATB	F8AH
LATC	F8BH
LATD	F8CH
LATE	F8DH
TRISA	F92H
TRISB	F93H
TRISC	F94H
TRISD	F95H
TRISE	F96H

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Internal Architecture of Port Pin



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Port A

- ▶ PORTA is a 7-bit wide, bidirectional port.
- ▶ Sometimes A6 is not available.
- ▶ The corresponding Data Direction register is TRISA.
- ▶ Setting a TRISA bit (= 1) will make the corresponding PORTA pin an input
- ▶ Clearing a TRISA bit (= 0) will make the corresponding PORTA pin an output
- ▶ On a Power-on Reset, these pins are configured as inputs and read as '0' 0 .

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Example1 (TRIS register)

```

MOV LW B'00000000'
MOV WF TRISA
BACK  MOV LW 0x55
      MOV WF PORTA
      CALL DELAY
      MOV LW 0xAA
      MOV WF PORTA
      CALL DELAY
      GOTO BACK

```

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Example 2

```
MYREG EQU 0x20  
MOVLW B'1111111'  
MOVWF TRISA  
MOVF PORTA, w  
MOVWF MYREG
```

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PORT B

- ▶ PORTB occupies a total of 8 pins
- ▶ To use the pins of PORT B as both input and output.
- ▶ Each bit must be connected externally to a pin by enabling the bits of of register TRISB.

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Alternate Function of Port A & Port B

Table 4-3: Port A Alternate Functions

Bit	Function
RA0	AN0/CVREF
RA1	AN1
RA2	AN2/VREF-
RA3	AN3/VREF+
RA4	T0CKI
RA5	AN4/SS/LVDIN
RA6	OSC2/CLKO

Table 4-4: Port B Alternate Functions

Bit	Function
RB0	INT0
RB1	INT1
RB2	INT2/CANTX
RB3	CANRX
RB4	
RB5	PGM
RB6	PGC
RB7	PGD

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PORT C and PORT D

- ▶ PORTC is 8 pins
- ▶ PORTD is 8 pins
- ▶ Alternate Function of Port C & Port D

Table 4-5: Port C Alternate Functions

Bit	Function
RC0	T1OSO/T1CKI
RC1	T1OSI
RC2	CCP1
RC3	SCK/SCL
RC4	SDI/SDA
RC5	SDO
RC6	TX/CK
RC7	RX/DT

Table 4-6: Port D Alternate Functions

Bit	Function
RD0	PSP0/C1IN+
RD1	PSP1/C1IN-
RD2	PSP2/C2IN+
RD3	PSP3/C2IN-
RD4	PSP4/ECCP1/PIA
RD5	PSP5/P1B
RD6	PSP6/P1C
RD7	PSP7/P1D

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Port E

- ▶ It occupies a total 3 pins in PIC 18F458.
- ▶ It is used for 3 additional analog inputs or simple I/O.

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Read followed by write operation

- ▶ Be careful
- ▶ Don't have a two I/O operations one right after the other.
- ▶ Data Dependency
A NOP is needed to make that data is written into WREG before it read for outputting to PortB.

```

CLRF    TRISB
SETF    TRISC
L4 MOVF  PORTC,W
MOVWF   PORTB
BRA    L4

```

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Example 4-1

Write a test program for the PIC18 chip to toggle all the bits of PORTB, PORTC and PORTD and every 0.25 of a second. Suppose that there is a 4Mhz.

```

R1 equ 0x07
R2 equ 0x08
ORG 0
CLRF TRISB
CLRF TRISC
CLRF TRISD
MOVLW 0x55
MOVWF PORTB
MOVWF PORTC
MOVWF PORTZ
L3 COMF PORTB,F
  COMF PORTC,F
  COMF PORTD,F
  CALL QDELAY
  BRA L3
QDELAY
  MOVLW D'200'
  MOVWF R1
D1 MOVLW D'250'
  MOVWF R2
D2 NOP
  NOP
  DECF R2,F
  BNZ D2
  DECF R1,F
  BNZ D1
  RETURN
  END

```

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I/O Bit Manipulation Programming

- ▶ I/O ports and bit-addressability
- ▶ Monitoring a single bit
- ▶ Reading a single bit

PORT A	PORT B	PORT C	PORT D	PORT E	PORT Bit
RA0	RB0	RC0	RD0	RE0	D0
RA1	RB1	RC1	RD1	RE1	D1
RA2	RB2	RC2	RD2	RE2	D2
RA3	RB3	RC3	RD3		D3
RA4	RB4	RC4	RD4		D4
RA5	RB5	RC5	RD5		D5
	RB6	RC6	RD6		D6
	RB7	RC7	RD7		D7

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Bit Oriented Instruction for PIC18

Instruction		Function
BSF	fileReg, bit	Bit Set File Register
BCF	fileReg, bit	Bit Clear File Register
BTG	fileReg, bit	Bit Togg1 File Register
BTFSC	fileReg, bit	Bit Test File Register, skip if clear
BTFSS	fileReg, bit	Bit Test File Register, skip if set

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Example 4-2

- ▶ A LED is connected to each pin of port D. Write a program to turn on each Led from pin D0 to D4.

```

CLRF    TRISD
BSF    PORTD,0
CALL   DELAY
BSF    PORTD,1
CALL   DELAY
BSF    PORTD,2
CALL   DELAY
BSF    PORTD,3
CALL   DELAY
BSF    PORTD,4
CALL   DELAY

```

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Example 4-3

- Write the following Programs Create a square wave of 50% duty cycle on bit 0 of PortC

<pre> BCF TRISC 0 HERE BSF PORTC 0 CALL DELAY BCF PORTC,0 CALL DELAY BRA HERE </pre>		<pre> BCF TRISC,0 BACK BTF PORTC,0 CALL DELAY BRA BACK </pre>
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Example 4-4

- Write a program to perform the following
- Keep monitoring the RB2 bit until it becomes HIGH (1).
- When RB2 becomes HIGH, write value 45H to portC and send a HIGH to LOW plus to RD3

```

BSF TRISB,2
CLRF TRISC
BCF PORTD 3
MOVLW 0x45
AGAIN
BTFSS PORTB,2
BRA AGAIN
MOVWF PORTC
BSF PORTD,3
CALL DELAY
BCF PORTD,3

```

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Example 4-5

- ▶ A switch is connected to pin RB0 and a Led to pin RB7. Write a program to read the status of SW and send it to the Led.

```
BSF TRISB,0
```

```
BCF TRISB,7
```

```
AGAIN
```

```
BTFSS PORTB,0
```

```
GOTO OVER
```

```
BSF PORTB,7
```

```
GOTO AGAIN
```

```
OVER
```

```
BCF PORTB,7
```

```
GOTO AGAIN
```