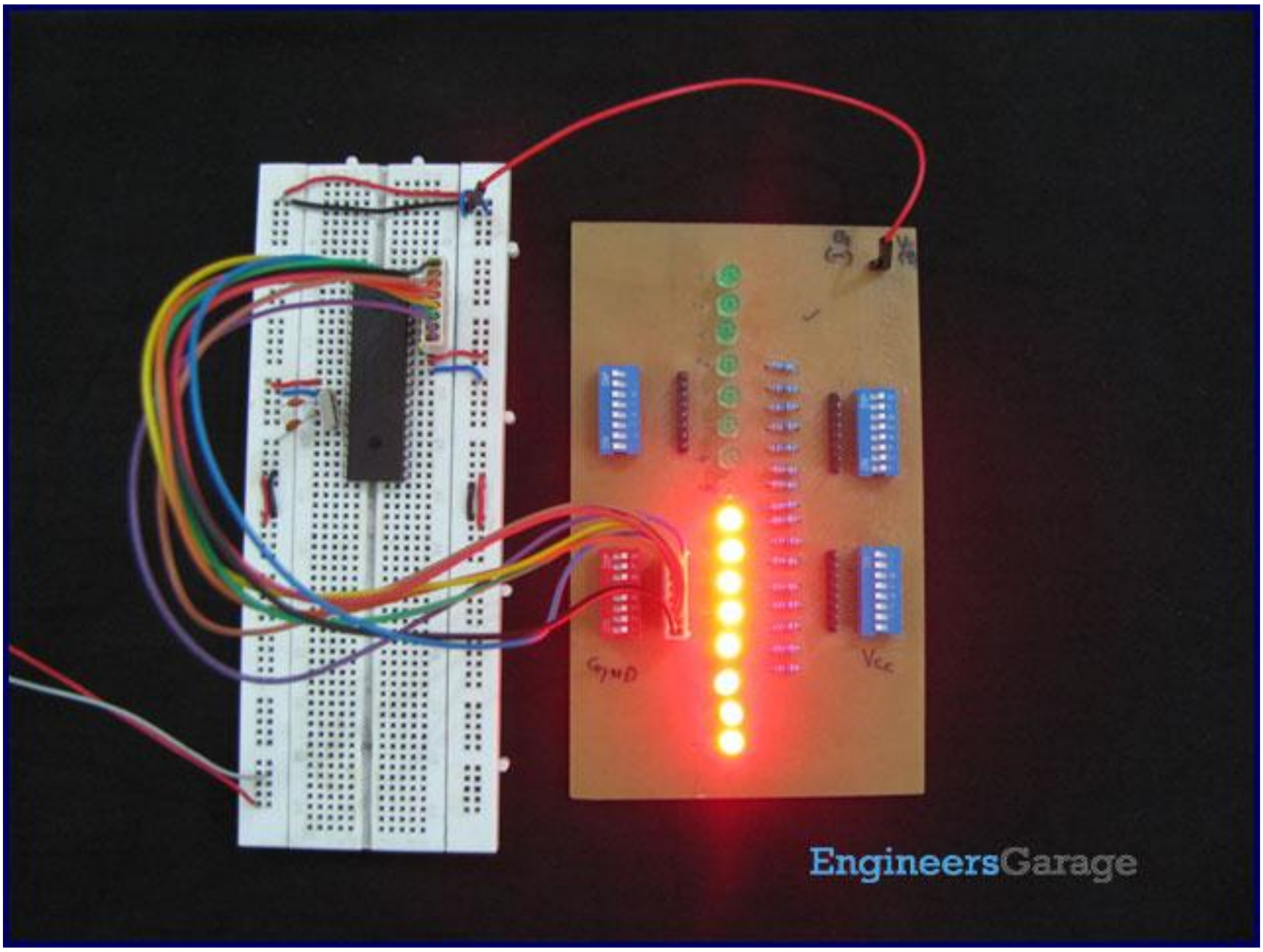
Interface LEDs with PIC Microcontroller (PIC18F4550)

Summary

It is necessary to understand basic I/O operations of PIC18F4550 before dealing with its complexities. This article presents a way to take simple output from a PIC microcontroller. This learning would also help in interfacing of external devices with the controller. Here the output from the microcontroller is taken on a set of LEDs which are made to blink in an alternate fashion.



Description

PIC18F4550 has a total of 35 I/O (input-output) pins which are distributed among 5 Ports. The following table shows the names and numbers of I/O pins of these 5 ports:

Port Name	Number of Pins	Pins
PORTA	7	RA0-RA6
PORTB	8	RB0-RB7
PORTC	7	RC0-RC2, RC4-RC7

PORTD	8	RD0-RD7
PORTE	4	RE0-RE3

As opposed to a basic 8051 microcontroller like AT89C51 which has most of the port pins serving single function, the port pins of a PIC microcontroller are multiplexed to serve more than one purpose.

The 35 I/O pins of PIC18F4550 are also multiplexed with one or more alternative functions of controller's various peripherals. Each Port of a PIC microcontroller corresponds to three 8-bit registers which should be configured to use the Port for general I/O purpose. These registers are:

1. **TRISx**: This is a data direction register which sets the direction of each port pin as input or output.
2. **PORTx**: This register stores the input level of pins (High or Low). When a pin configured as input, the input signal from external source is read from PORTx register.
3. **LATx**: This is output latch register. The data which has to be sent to external hardware as output is stored in LATx register.

Port Description:

PORTA:

PortA has 7 pins which can be used as both input as well as output pin. The 7th bit is missing from all the three registers. The input and output given to this port are of 8-bit but the 8th bit is internally masked.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
TRISA	-	TRISA6	TRISA5	TRISA4	TRISA3	TRISA2	TRISA1	TRISA0
PORTA	-	RA6	RA5	RA4	RA3	RA2	RA1	RA0
LATA	-	LATA6	LATA5	LATA4	LATA3	LATA2	LATA1	LATA0

PORTB:

PortB has 8 pins which can all be used for both input and output operation.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
TRISB	TRISB7	TRISB6	TRISB5	TRISB4	TRISB3	TRISB2	TRISB1	TRISB0
PORTB	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
LATB	LATB7	LATB6	LATB5	LATB4	LATB3	LATB2	LATB1	LATB0

PORTC:

PortC has 7 I/O pins. In PortC, Bit 3 is missing in hardware and Pins 4 & 5 can only be used as input pins. There are no 4th & 5th latch bits in LATC register, so these bits are internally masked during 8-bit write operation on PortC.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
TRISC	TRISC7	TRISC6	-	-	-	TRISC2	TRISC1	TRISC0
PORTC	RC7	RC6	RC5	RC4	-	RC2	RC1	RC0
LATC	LATC7	LATC6	-	-	-	LATC2	LATC1	LATC0

PORTD:

PortD has 8 pins which can all be used for both input and output operation.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
TRISD	TRISD7	TRISD6	TRISD5	TRISD4	TRISD3	TRISD2	TRISD1	TRISD0
PORTD	RD7	RD6	RD5	RD4	RD3	RD2	RD1	RD0
LATD	LATD7	LATD6	LATD5	LATD4	LATD3	LATD2	LATD1	LATD0

PORTE:

PortE has 4 I/O pins. Pin3 can be used as input pin only. RDPU bit is used to enable/disable internal pull-ups of PortD.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
TRISE	-	-	-	-	-	TRISE2	TRISE1	TRISE0
PORTE	RPDU	-	-	-	RE3	RE2	RE1	RE0
LATE	-	-	-	-	-	LATE2	LATE1	LATE0

I/O configuration:

The TRISx register is configured to set a pin as input or output. The High value (1) sets a pin as input pin and Low value (0) sets a pin as output. An easy way to remember this is to consider the resemblance of *1* with the letter *I* (for input) and *0* with the letter *O* (for output).

For example suppose a switch is connected at *RB0* and an LED is connected to *RB7* of PortB. Now the pins 0 & 7 have to be configured as input and output respectively. So the bit *TRISB0* is set to 1 to configure *RB0* as input pin & bit *TRISB7* is set to 0 to configure *RB7* as output pin.

TRISB	TRISB7	TRISB6	TRISB5	TRISB4	TRISB3	TRISB2	TRISB1	TRISB0
Value	0	…	…	…	…	…	…	1

The unused bits are set to 0.

TRISB	TRISB7	TRISB6	TRISB5	TRISB4	TRISB3	TRISB2	TRISB1	TRISB0
Value	0	0	0	0	0	0	0	1

So the overall value of TRISB register becomes:

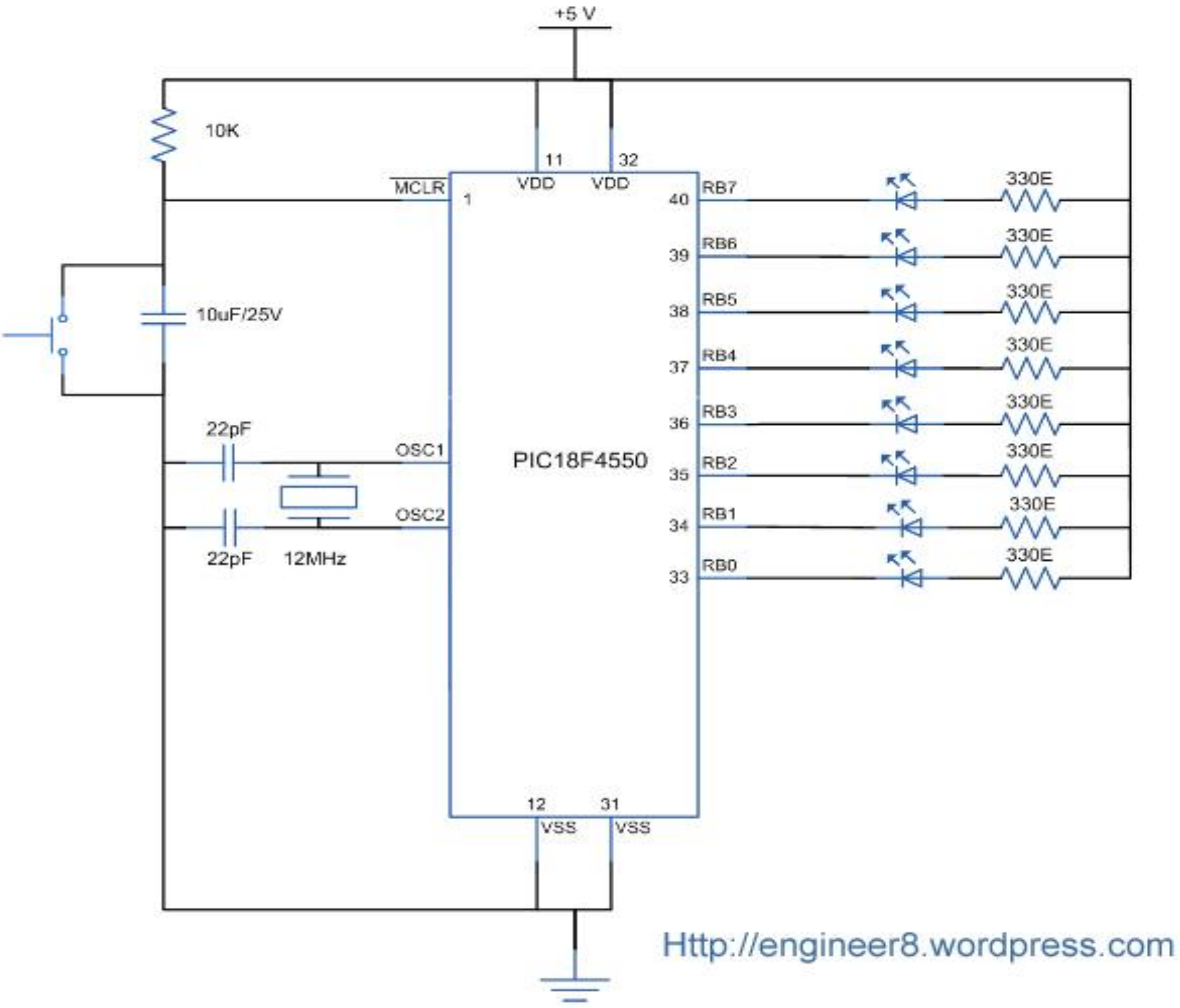
TRISB = 0000 0001 = 0x01

Using this knowledge, the objective of this article can be achieved which is to glow a set of LEDs in alternate blinking fashion. The LEDs here are connected to PORTB pins as shown in the circuit diagram.

Programming steps:

1. Configure the TRISB register to make PortB as output port.
2. Set all the bits of LATB register High (1) to glow all LEDs.
3. Provide some delay.
4. Set all the bits of LATB register Low (0) to turn off the LEDs.
5. Provide some delay.
6. Repeat the process from step 2.

Circuit Design



Code

```
// Program to Interface LED with PIC18F4550 Microcontroller

// Configuration bits
/* _CPUDIV_OSC1_PLL2_1L,  // Divide clock by 2
   _FOSC_HS_1H,           // Select High Speed (HS) oscillator
   _WDT_OFF_2H,           // Watchdog Timer off
   MCLRE_ON_3H            // Master Clear on
*/

void main()
{
      TRISB=0x00;               // Set PORTB as output PORT
      LATB=0xFF;                // Set PORTB high initially (All
LEDs on)
      while(1)
      {
             LATB = ~LATB;            // Toggle the value of PORTB
             Delay_ms(1000);          // Delay of 1 sec
      }
}
```

Components

A) **Light emitting diodes** (**LEDs**) are semiconductor light sources. The light emitted.

B) **PIC18F4550** is an 8-bit microcontroller of PIC18 family. PIC18F family is based on 16-bit instruction set architecture. PIC18F4550 consists of 32 KB flash memory, 2 KB SRAM...

References

http://www.engineersgarage.com/embedded/pic-microcontroller-projects/led-interface-circuit

http:// Engineer8.wordpress.com