

Programming PIC Microcontrollers in PicBasic Pro – Lesson 2 Cornerstone Electronics Technology and Robotics II

- **Administration:**
 - Prayer
- **PicBasic Pro Programs Used in This Lesson:**
 - General PicBasic Pro Program Listing:
<http://www.cornerstonerobotics.org/picbasic.php>
 - Lab 1 blink2 as .pdf file:
<http://www.cornerstonerobotics.org/code/blink2.pdf>
 - Lab 1 blink3 as .pdf file:
<http://www.cornerstonerobotics.org/code/blink3.pdf>
- **Programming PIC Microcontrollers:**
 - **PicBasic Pro Basics:**
 - **Comments:**
 - A PBP (PicBasic Pro) comment starts with either the **REM** keyword, the single quote (') or the semi-colon (;). All the characters following on this line are ignored.
 - Examples:

REM Comments may be made after REM
PORTB.0 = 1 ' All of the characters after the ' are an in-line comment.
GOTO loop ; All of the characters after the ; are an in-line comment.

- **Variables:**
 - Variables are where temporary data is stored in PicBasic Pro
 - The format for declaring a variable is :

Name of variable VAR size {modifiers}

- VAR lets PicBasic Pro know that this line is establishing a variable. It can or cannot be capitalized.
- The name of the variable is case insensitive, that is, VALUE and value are treated the same.
- A variable name can have up to 32 characters.
- Size is the amount of RAM memory space the variable is going to take. It has to be a bit, byte or word. Examples follow.
 - x VAR BIT (1 bit w/ range 0 – 1)
 - COUNT VAR BYTE (8 bits w/ range 0- 255)
 - large VAR WORD (16 bits w/ range 0 – 65535)
- BIT, BYTE, and WORD variables are always positive numbers.
- Modifiers will not be covered at this time.
- The VAR command can be used to add another name to the same variable. In the following example, bmx and BIKE will refer to the same RAM location.

Bmx VAR BIKE

- A pin can be named using the VAR command. In this manner, the name can be used in any operation. For example:

```
LED VAR PORTB.0      ' Names PORTB.0 as LED

HIGH LED              ' Set LED (PORTB.0) HIGH
PAUSE 500

LOW LED               ' Set LED (PORTB.0) LOW
PAUSE 500
END
```

○ **New PicBasic Pro Commands:**

▪ **HIGH**

Format:

HIGH *Pin*

Explanation:

Make the specified *Pin* high. *Pin* is automatically made an output. *Pin* may be a constant, 0-15, or a variable that contains a number 0-15 (e.g. B0) or a pin name (e.g. PORTA.0).

Examples:

```
HIGH 0              ' Set PORTB.0 HIGH (+5 volts)

HIGH PORTA.0        ' Set PORTA.0 HIGH (+5 volts)

led VAR PORTB.0      ' Names PORTB.0 as led
HIGH led            ' Set led (PORTB.0) HIGH (+5 volts)
```

▪ **LOW:**

Format:

LOW *Pin*

Explanation:

Make the specified *Pin* low. *Pin* is automatically made an output. *Pin* may be a constant, 0-15, or a variable that contains a number 0-15 (e.g. B0) or a pin name (e.g. PORTA.0).

Examples:

```
LOW 0              ' Set PORTB.0 LOW (0 volts)

LOW PORTA.0        ' Set PORTA.0 LOW (0 volts)

led VAR PORTB.0      ' Names PORTB.0 as led
LOW led            ' Set led (PORTB.0) LOW (0 volts)
```

▪ **FOR..NEXT:**

Format:

```
FOR Count = Start TO End {STEP {-} Inc}  
{Body}  
NEXT {Count}
```

Explanation:

The **FOR..NEXT** loop allows programs to execute a number of statements (the *Body*) some number of times using a variable as a counter. Due to its complexity and versatility, **FOR..NEXT** is best described step by step:

- 1) The value of *Start* is assigned to the index variable, *Count*. *Count* can be a variable of any type.
- 2) The *Body* is executed. The *Body* is optional and can be omitted (perhaps for a delay loop).
- 3) The value of *Inc* is added to (or subtracted from if "-" is specified) *Count*. If no **STEP** clause is defined, *Count* is incremented by one.
- 4) If *Count* has not passed *End* or overflowed the variable type, execution returns to Step 2.

If the loop needs to *Count* to more than 255, a word-sized variable must be used.

Examples:

```
FOR i = 1 TO 10      ' Count from 1 to 10  
N = N+1  
NEXT i                ' Go back to and do next count  
  
FOR B2 = 200 TO 100 STEP -1 ' Count from 200 to 100 by -1  
PULSOUT 2,B2           ' Send position signal to servo  
PAUSE 20              ' Pause 20 msec  
NEXT B2               ' Go back to and do next count
```

Nesting:

A **For..Next** loop can be placed inside another **FOR..NEXT** loop; this is called nesting. Nesting is embedding one object (one **FOR..NEXT** loop) in another object of the same type (another **FOR..NEXT** loop).

```
FOR i = 1 TO 2  
  FOR j = 1 TO 10  
    HIGH 0  
    LOW 1  
    PAUSE 500  
    LOW 0  
    HIGH 1  
    PAUSE 500  
  NEXT j  
  HIGH 2  
  PAUSE 500  
  LOW 2  
NEXT i
```

Note: The FOR...NEXT j loop must be nested entirely within the FOR...NEXT i loop.

Referring to Pins by a Number 0 – 15:

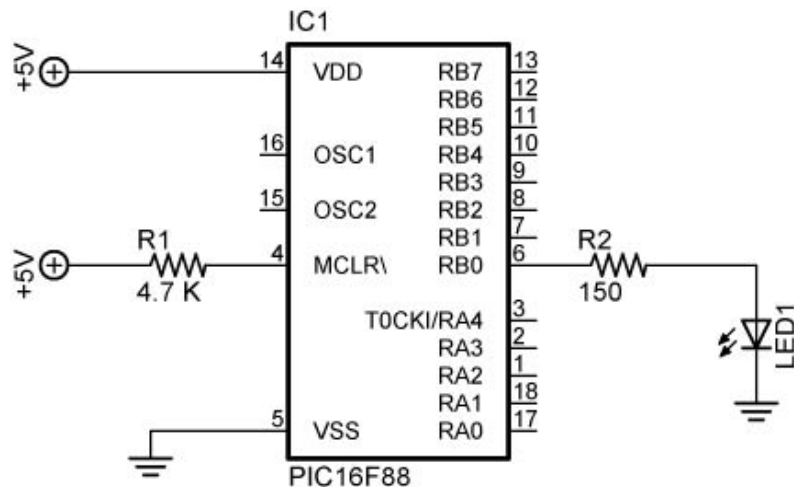
- PicBasic Pro Compiler commands can also refer to PORT name and bit number by a simple number. See following list for an 18 pin PIC16F88 microcontroller:

PORT Name.Bit#	Number
PORTB.0	0
PORTB.1	1
PORTB.2	2
PORTB.3	3
PORTB.4	4
PORTB.5	5
PORTB.6	6
PORTB.7	7
PORTA.0	8
PORTA.1	9
PORTA.2	10
PORTA.3	11
PORTA.4	12
PORTA.5	13
PORTA.6	14
PORTA.7	15

- Perform PIC Microcontrollers Programming 2 LAB 1 – blink2:

Cornerstone Electronics Technology and Robotics II PIC Microcontrollers Programming 2 LAB 1 – blink2

- **Purpose:** The purpose of this lab is to acquaint the student with the PicBasic Pro commands: HIGH, LOW, and FOR..NEXT.
- **Apparatus and Materials:**
 - 1 – Analog/Digital Trainer
 - 1 – Breadboard with 9 V Supply
 - 1 – 150 Ohm, ½ Watt Resistors
 - 2 – 470 Ohm, ½ Watt Resistors
 - 1 – 1K, ½ Watt Resistor
 - 1 – LED
 - 2 – DC Motors
 - 2 – 2N2222A NPN Transistors
 - 1 – 78L05 Voltage Regulator
 - 1 – 0.1 uF Capacitor
- **Procedure:**
 - Open **blink2.pbp** and download to your chip. Wire your digital trainer or robotic car for blink2.
 - Change the pin location and blinking times.



blink2 and blink3

- Open **blink3.pbp** and download to your chip.
- Change the number of times the LED blinks.

Cornerstone Electronics Technology and Robotics II
PIC Microcontrollers Programming 2 LAB 1 – blink2 continued

- **Challenges:**
 - **LED Flashing:** Write a program using the **FOR..NEXT** command to make an LED connected to PORTB.7 flash on 4 times and then turn off. Have the LED turn on for 0.2 seconds and off for 0.8 seconds each time. Save the program as **flash1.pbp**.
 - **Piezo Buzzer:** Write a program that makes an LED blink every second (on 500 ms and off 500 ms) and a buzzer to sound on every fifth LED blink. The buzzer is to sound twice then the LED and buzzer are to turn off. Save the program as **buzz1.pbp**.
 - **Knight Rider:** Write a program to make the 8 LED's scroll back and forth. Utilize a 100 ohm DIP resistor package. Save the program as **knight1.pbp**.
 - **Duplicate Laps:** Write a program so that your robotic car will navigate the rectangular track twice. The instructions for the first lap must be identical to the second lap, i.e., use a **FOR...NEXT** command. After the second lap is completed, activate Knight Rider. Save the program as **indy1.pbp**.