18004 MCC

PIC24 LAB Manual

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Tools Used In This Class

- **Explorer 16 Board**
  - Part Number: DM240001
- ***PIC24FJ128GA310 (MA240029)***
- **MCP2200 USB to RS232 Demo Board and cable**
- **Speech Playback PICtail™ Plus Daughter Board (AC164125)**

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Tools Used In This Class
(continued)

- **I²C EEPROM**
  - Part number AC243003

- **MPLAB® REAL ICE™ In-circuit emulator**
  - Part number DV244005

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Installing the MCC Plugin

- **The MPLAB® X IDE Code Configurator Plugin should already be installed for this MASTERs class**

- **To install the MCC Plugin refer to the Appendix at the end of this manual for Instructions**

PIC24 Lab 1:
Timer based LED Toggle

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PIC24 Lab 1 Objectives

- Start up MCC in MPLAB® X IDE
- Setup the configuration registers and oscillator
- Generate code to toggle an LED based on the Timer module.

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PIC24 Lab 1 Overview

- Connect the hardware
- Open MPLAB® X IDE
- Open project named ‘lab1_16bit’
  - C:\MASTERs\18004\labs\lab1\lab1_16bit.X
- Open MPLAB® Code Configurator
- Configure RA7 pin as GPIO
- Configure TMR1 period for 1s with Prescaler 1:64

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PIC24 Lab 1

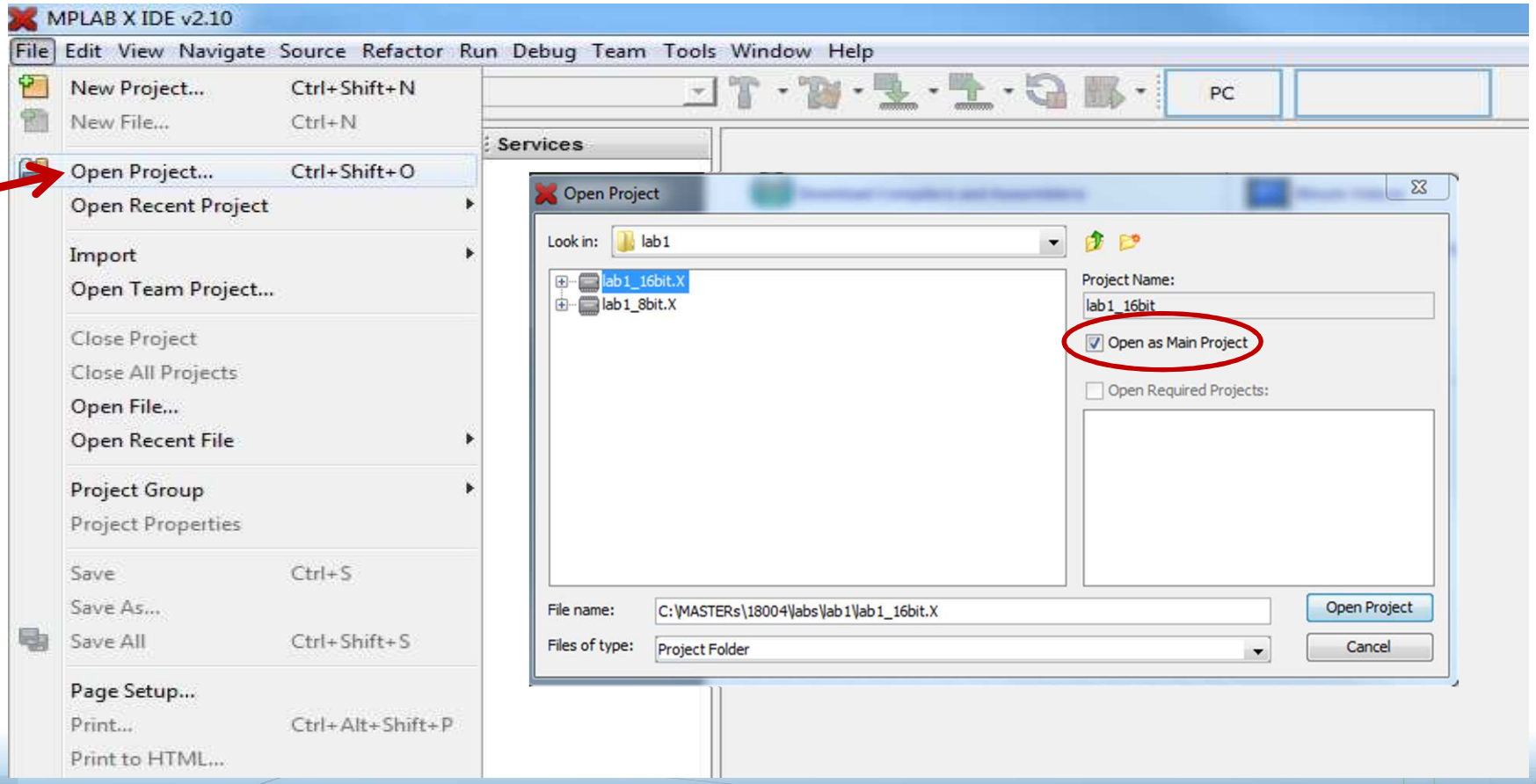
Connecting the hardware

- Connect the power supply to the Explorer 16 Board
- Connect the MPLAB® REAL ICE™ to the Explorer 16 Board
- Connect the USB cable between the MPLAB® REAL ICE™ and the Computer

PIC24 Lab 1

Setting up the Project

- **In MPLAB® X IDE, click on Open Project and select lab1_16bit.X**



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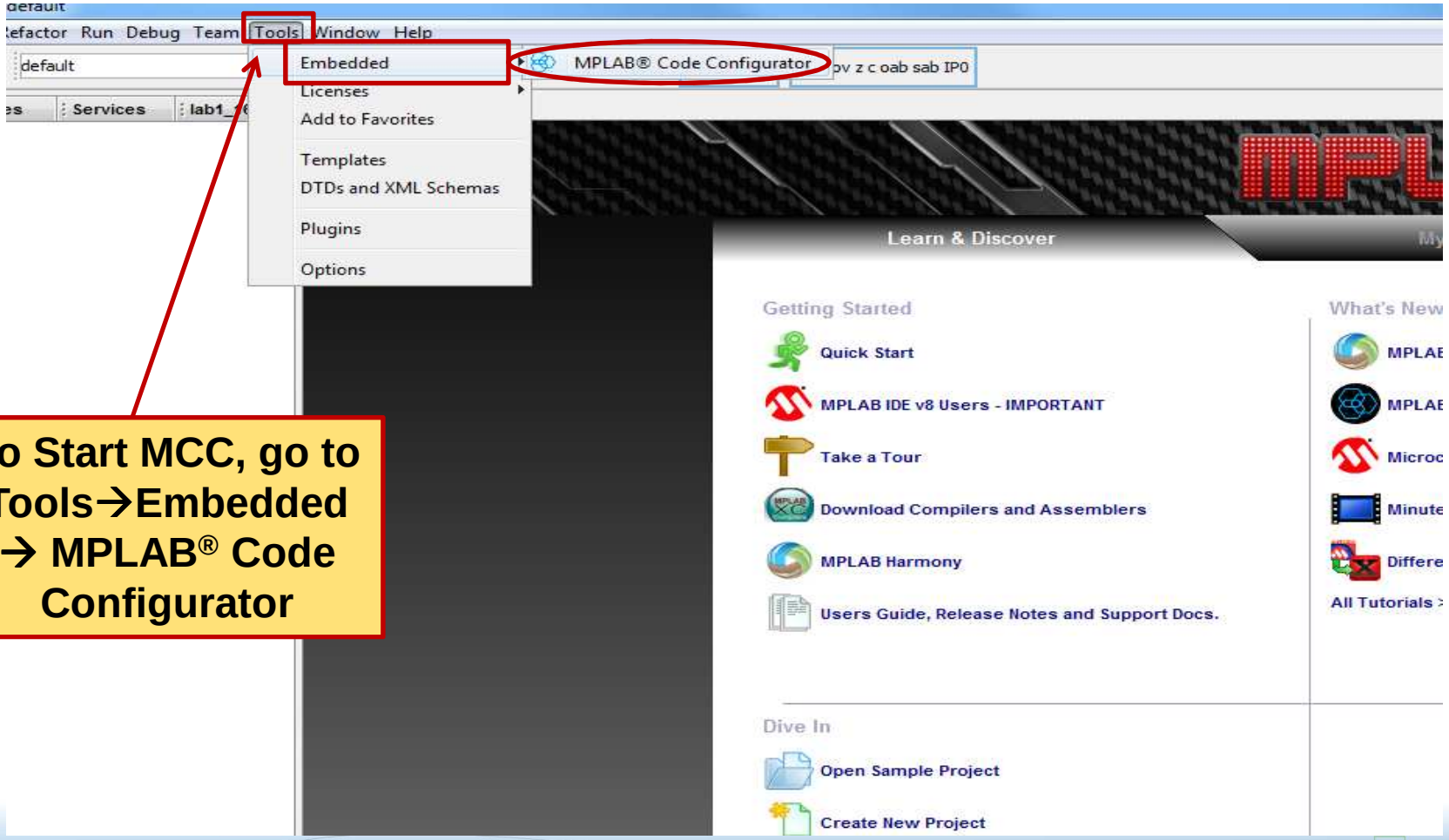
PIC24 Lab 1

- **Start MPLAB® Code Configurator**



To Start MCC, go to Tools→Embedded → MPLAB® Code Configurator

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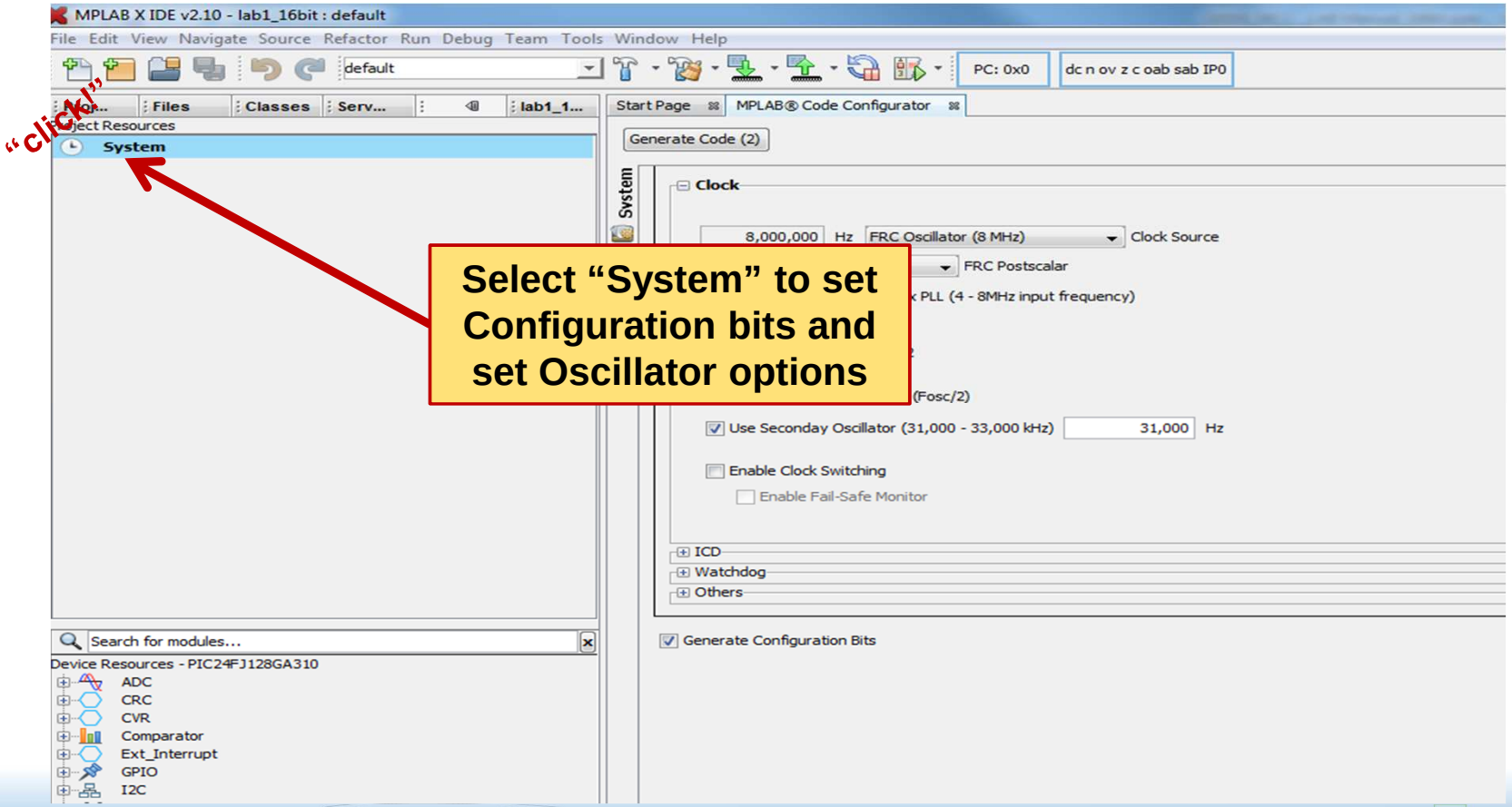
PIC24 Lab 1

- **Select System to setup Configuration bits and the Oscillator**



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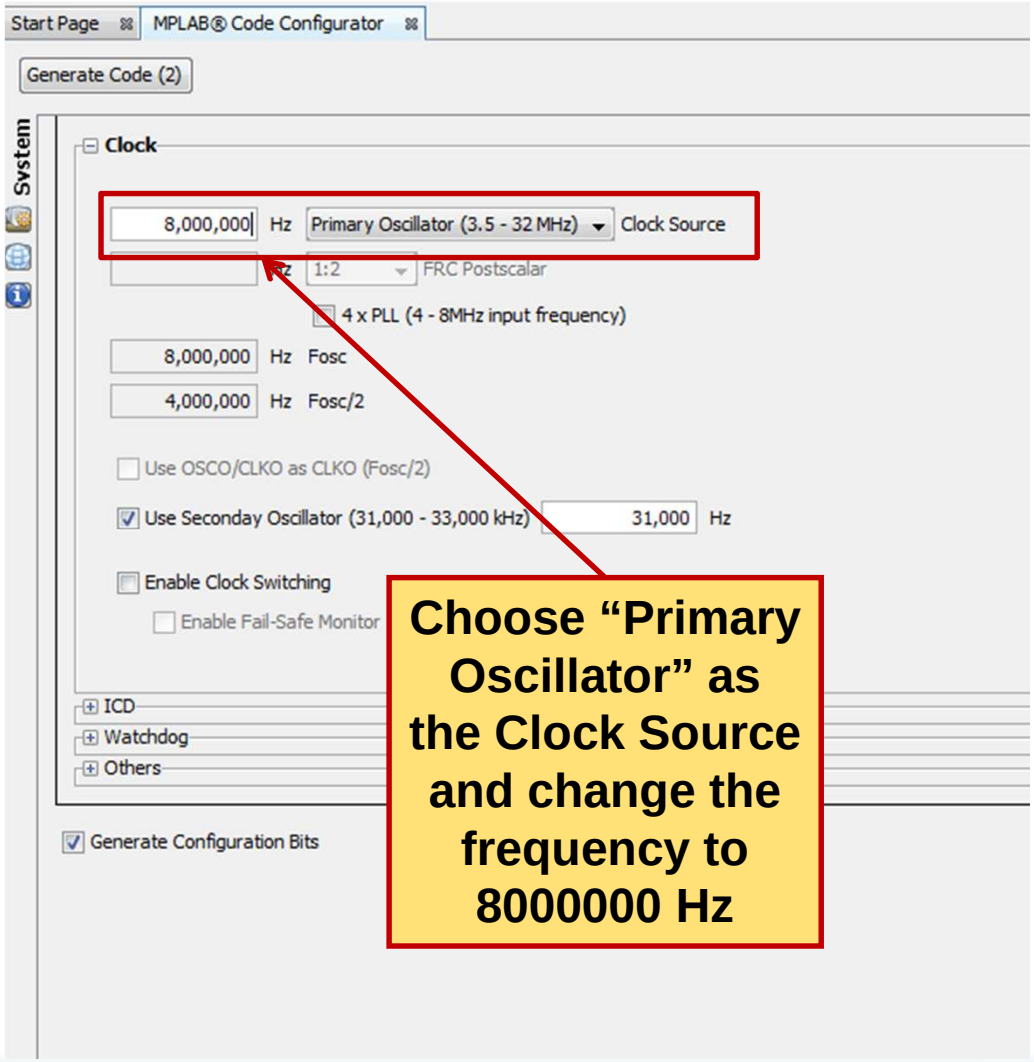
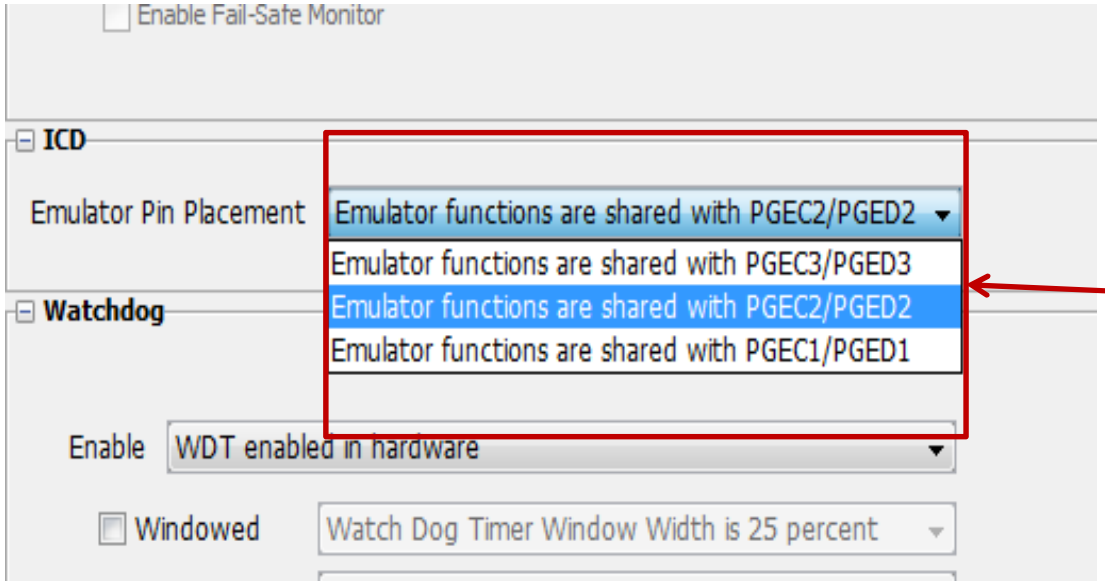
PIC24 Lab 1

- Configuration bits are preset to allow development and debugging



PIC24 Lab 1

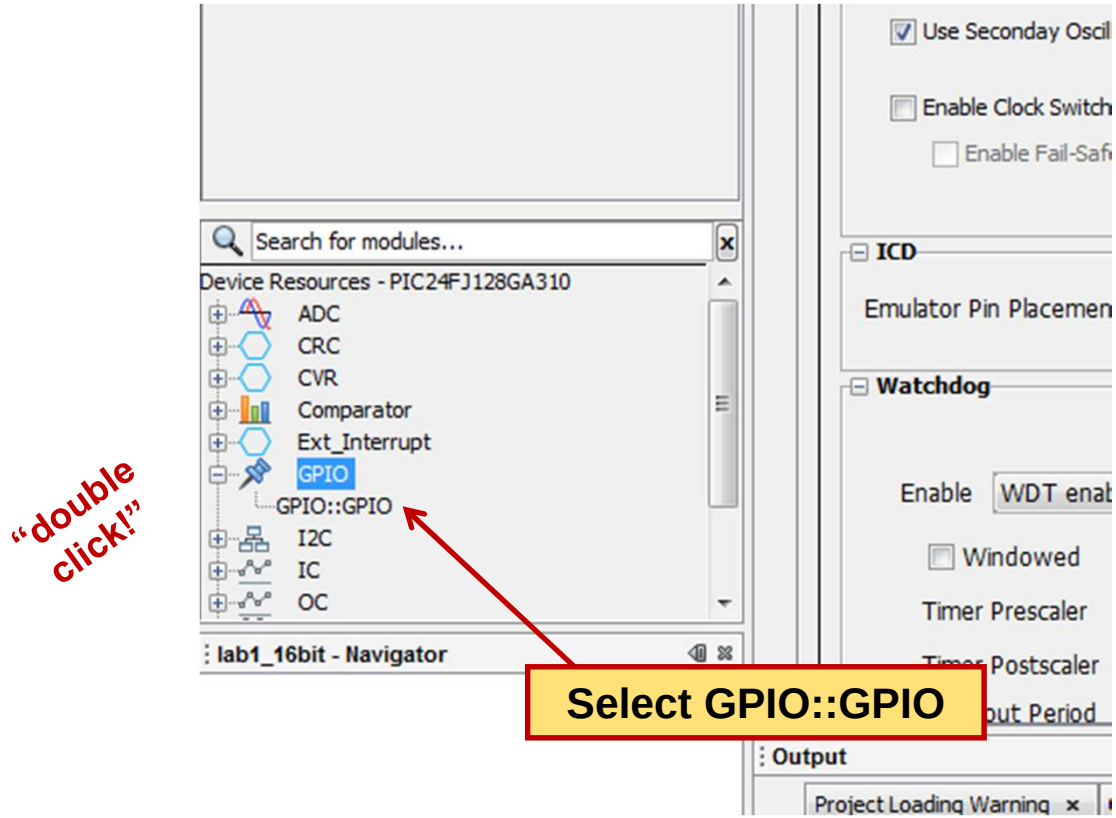
- **Change Emulator Pin Placement to PGEC2/PGED2**



Select "Emulator functions are shared with PGEC2/PGED2

PIC24 Lab 1

- **Double click on GPIO in Device Resources and then select GPIO::GPIO**



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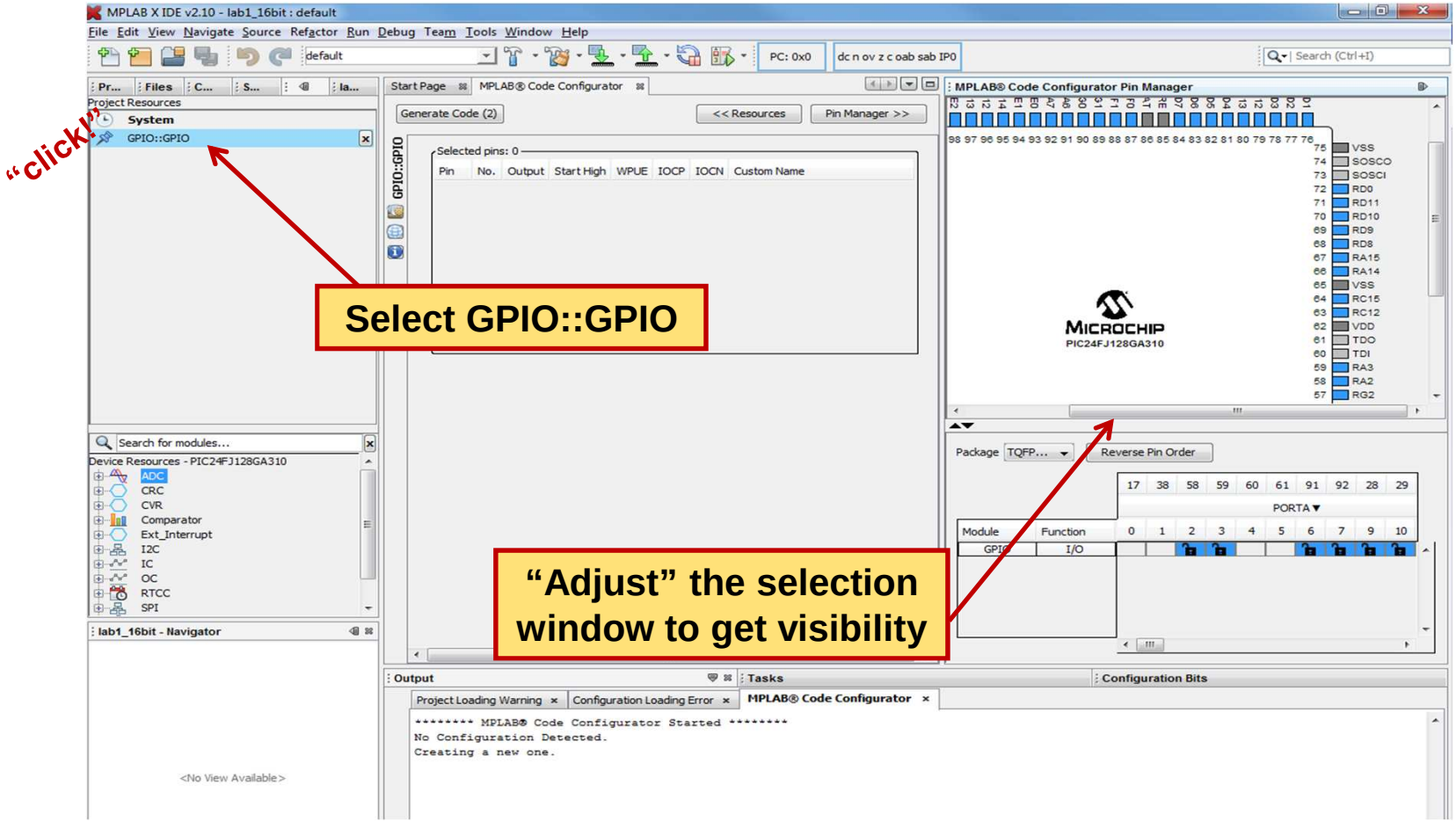
PIC24 Lab 1

- **Click on GPIO::GPIO**



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PIC24 Lab 1

- **Did you know …**

- **that you can configure whether or not MCC generates configuration bits for your project?**

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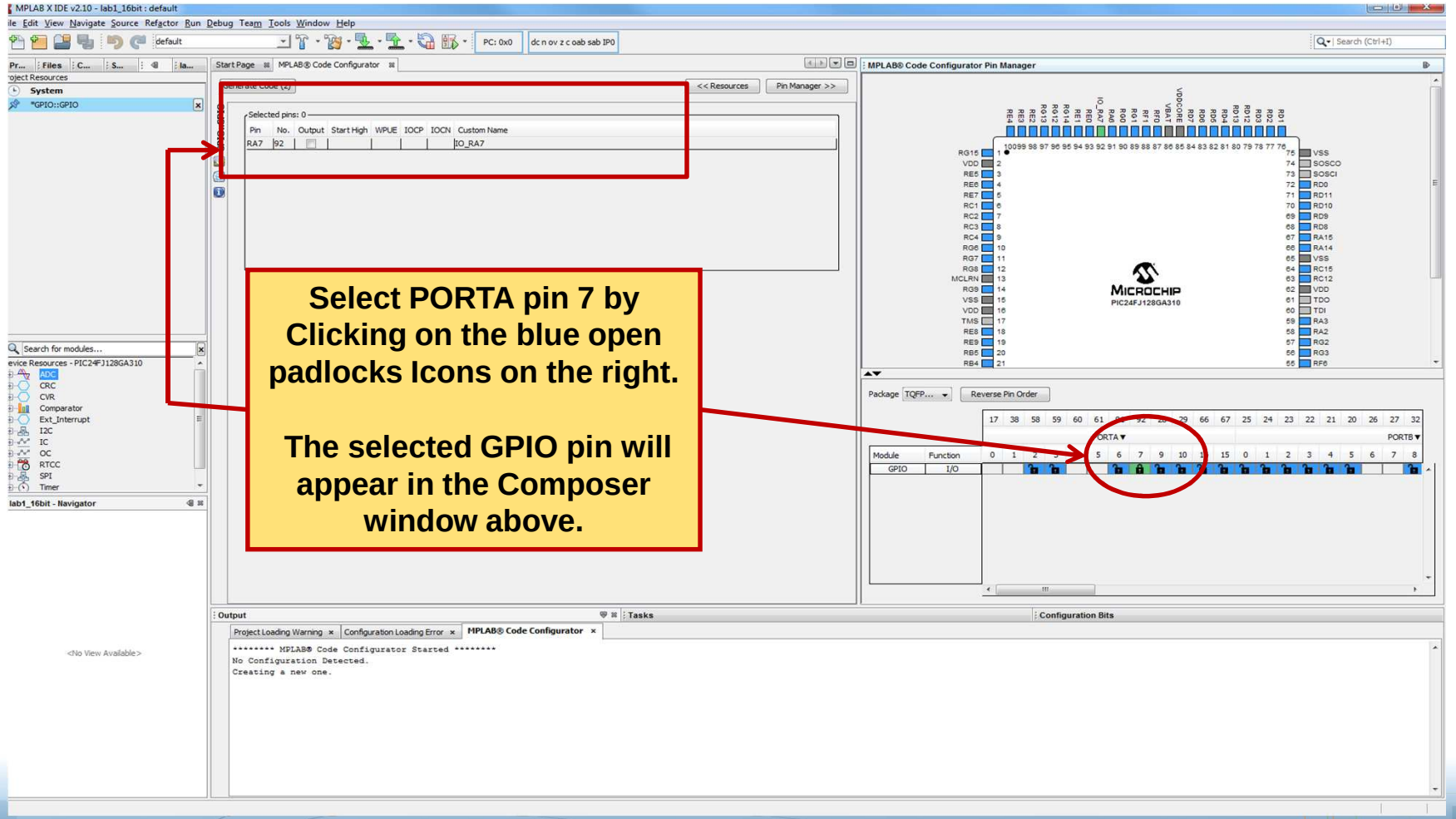
PIC24 Lab 1

- **Set up RA7 pin from the Pin Manager**



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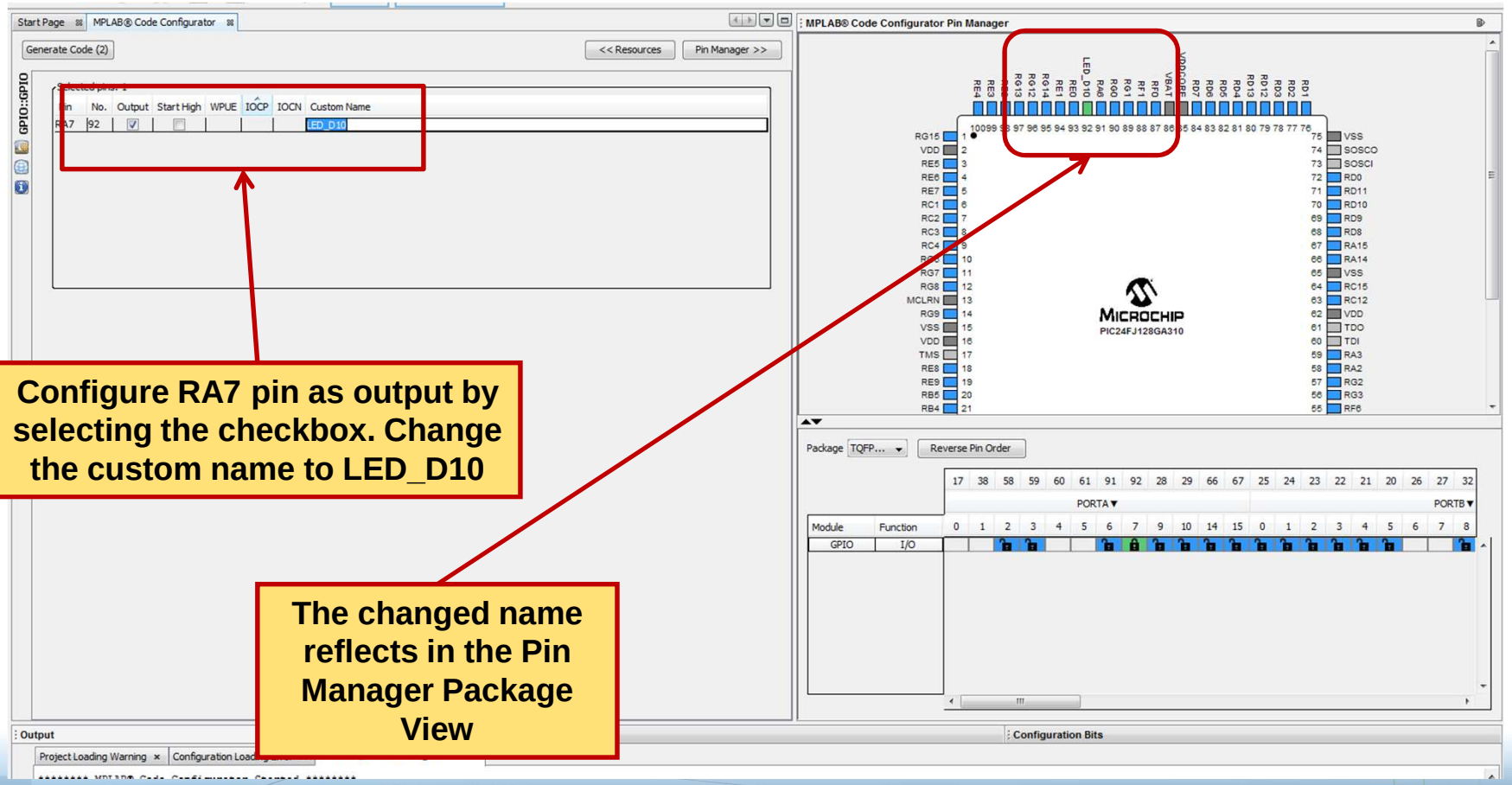
PIC24 Lab 1

- **Set RA7 pin to output and change the name to LED_D10**



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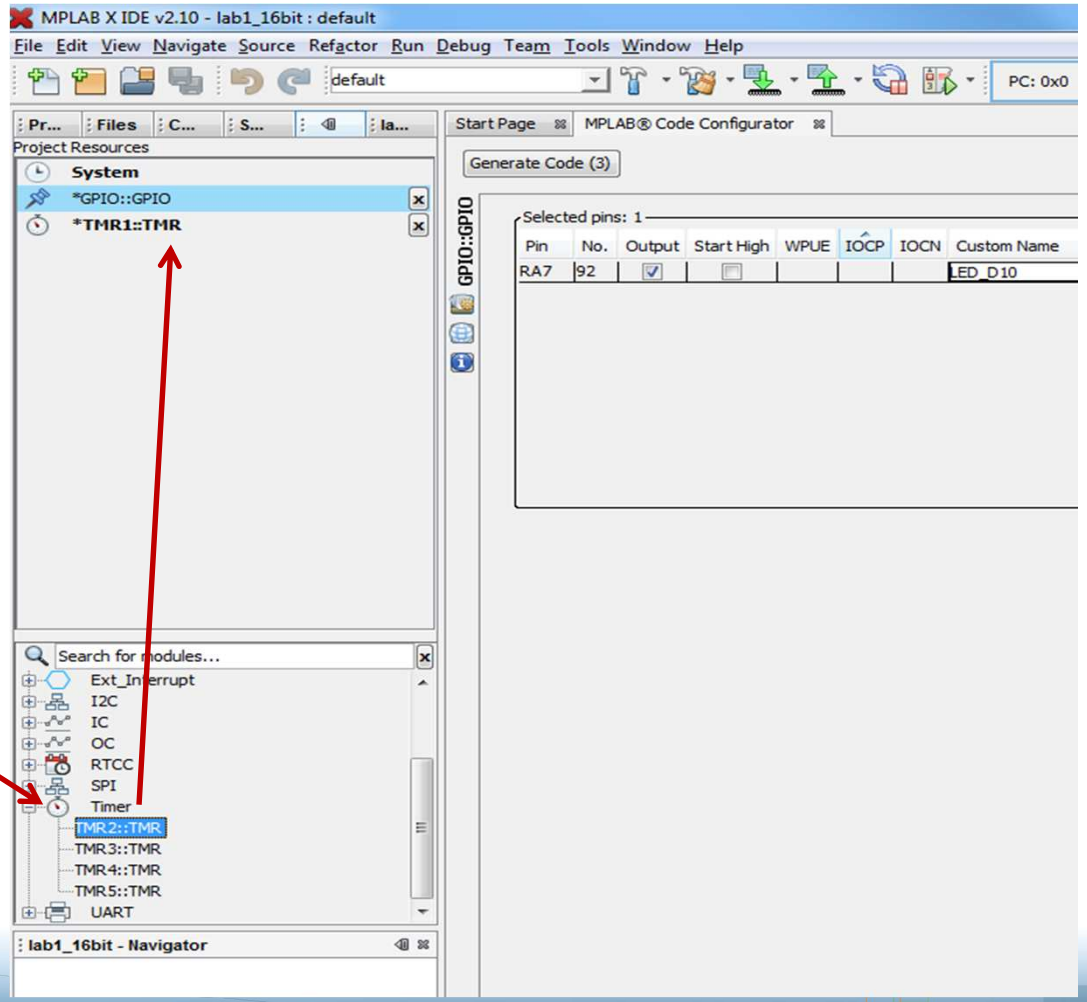
PIC24 Lab 1

- **Select TMR1 module**

Double click on "Timer" to see all instances of the module. Select TMR1::TMR to see it in the Project Resources



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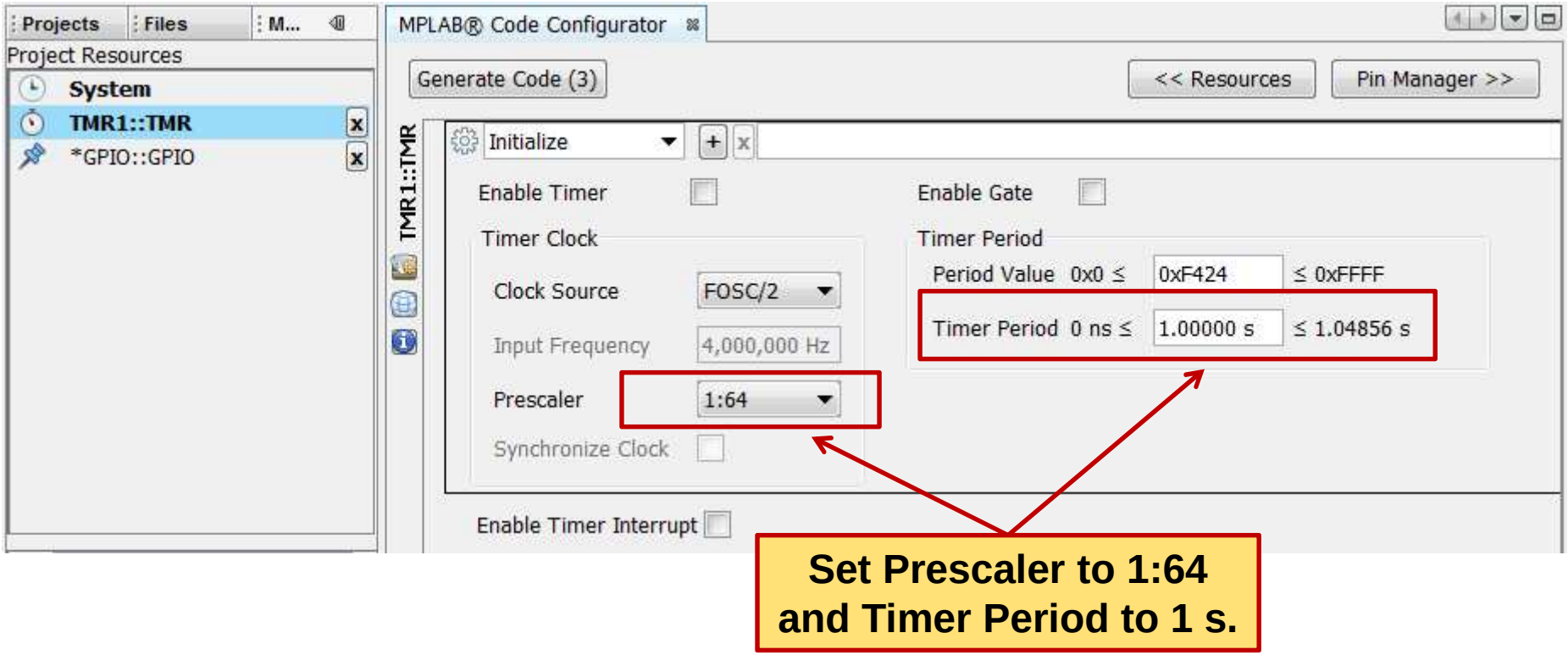
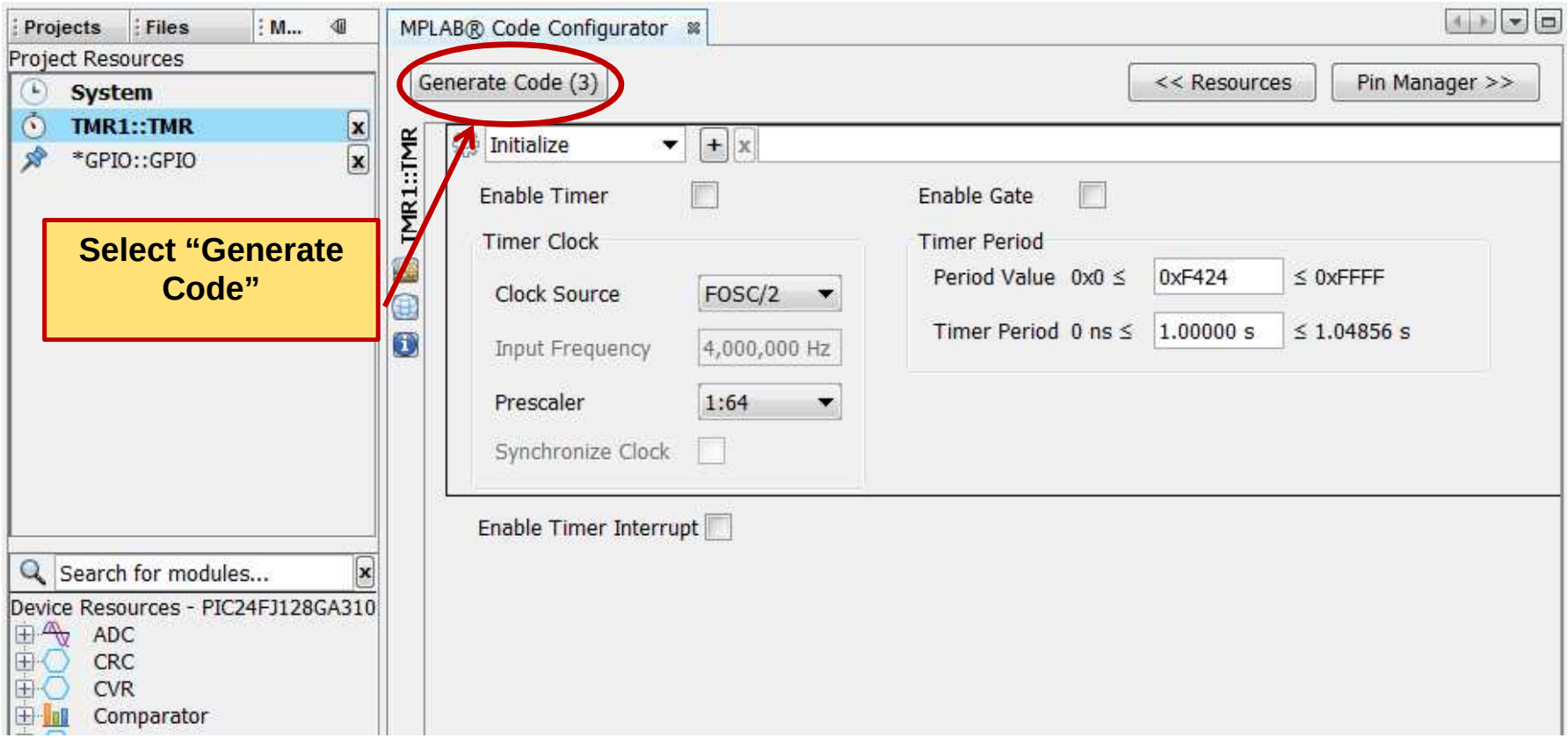
PIC24 Lab 1

- **Select TMR1 module**



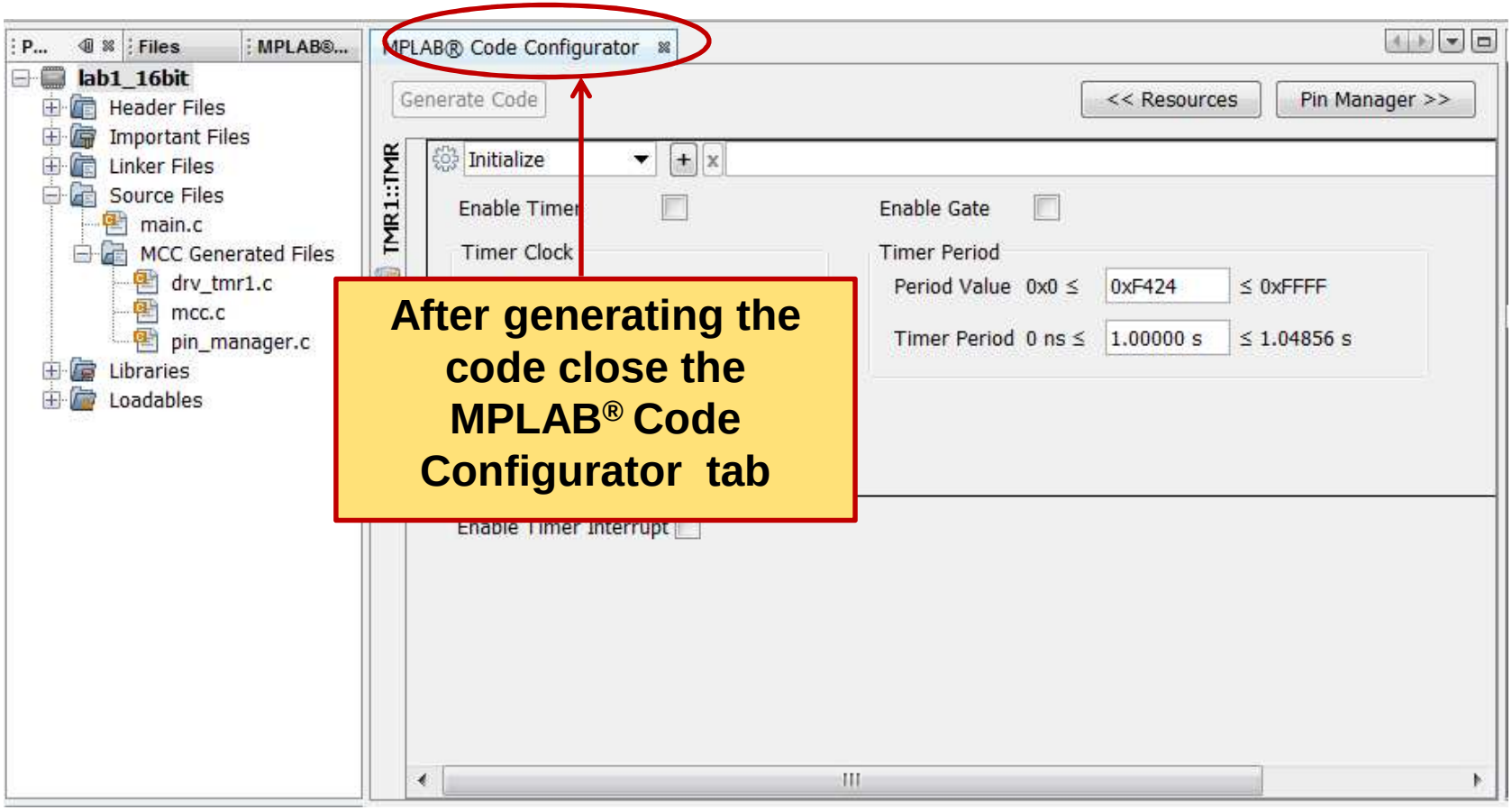
PIC24 Lab 1

- **Generate the code**



PIC24 Lab 1

- **Close MPLAB® Code Configurator**



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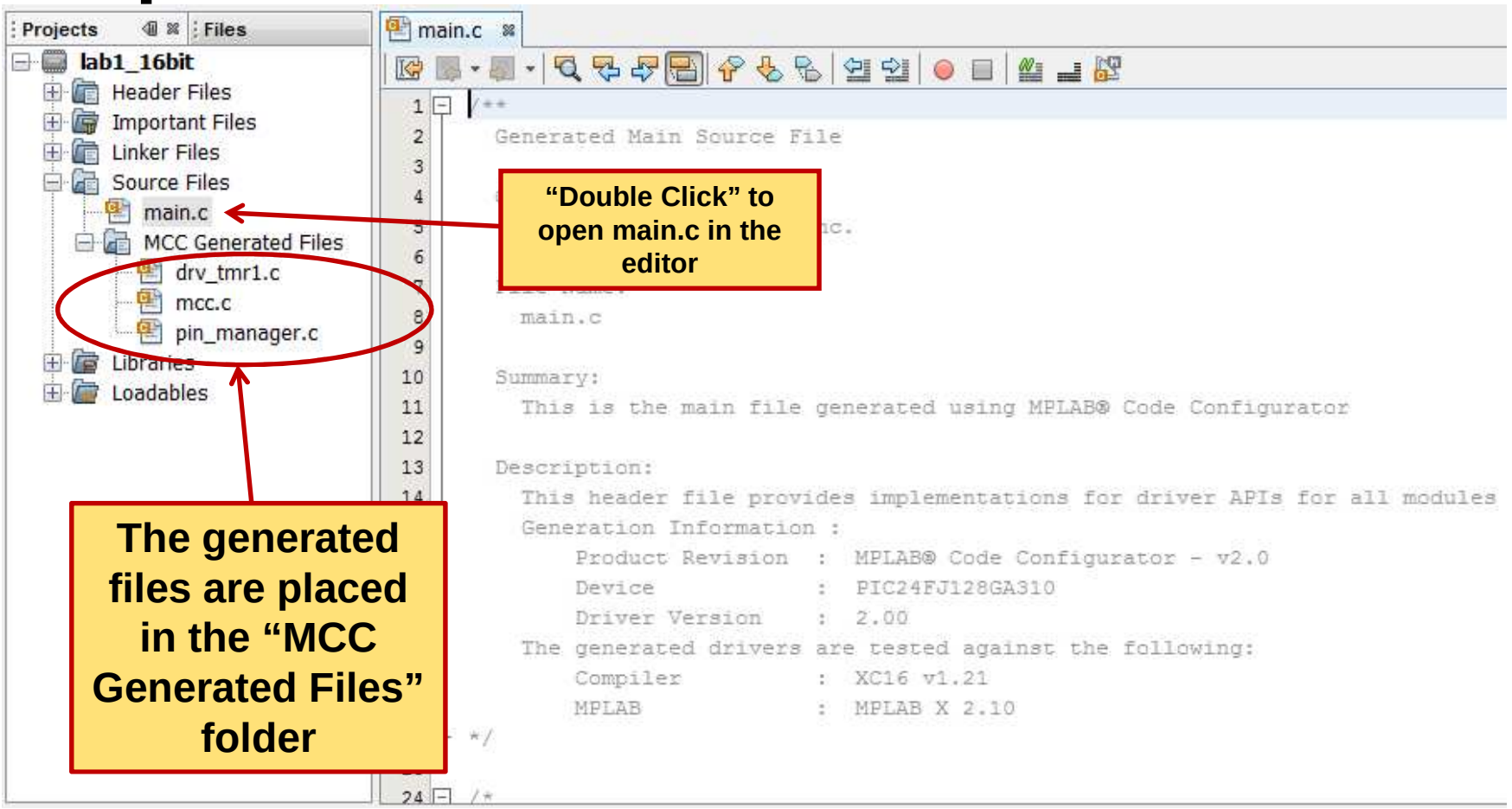
PIC24 Lab 1

- **Open main.c**



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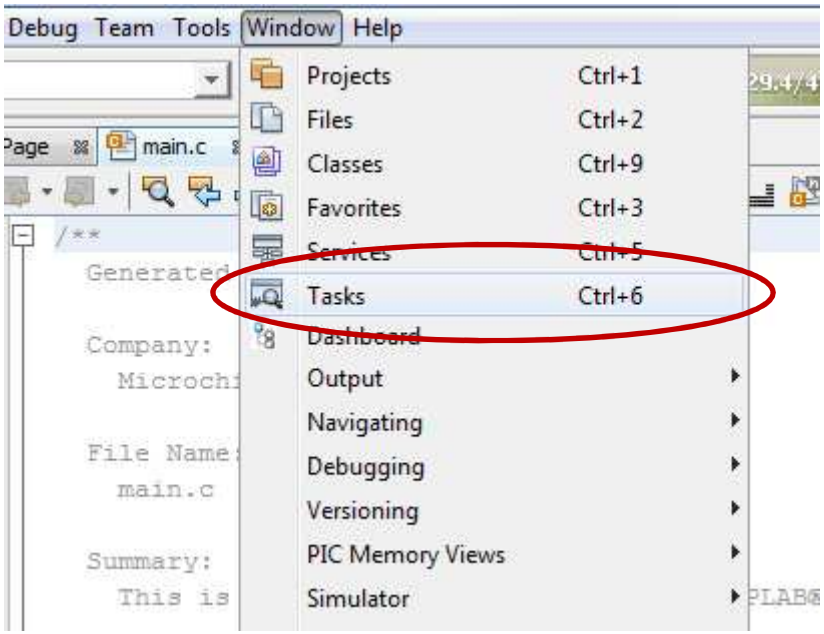
PIC24 Lab 1

- **Open the MPLAB X Tasks window to see a list of TODOs for Lab 1**



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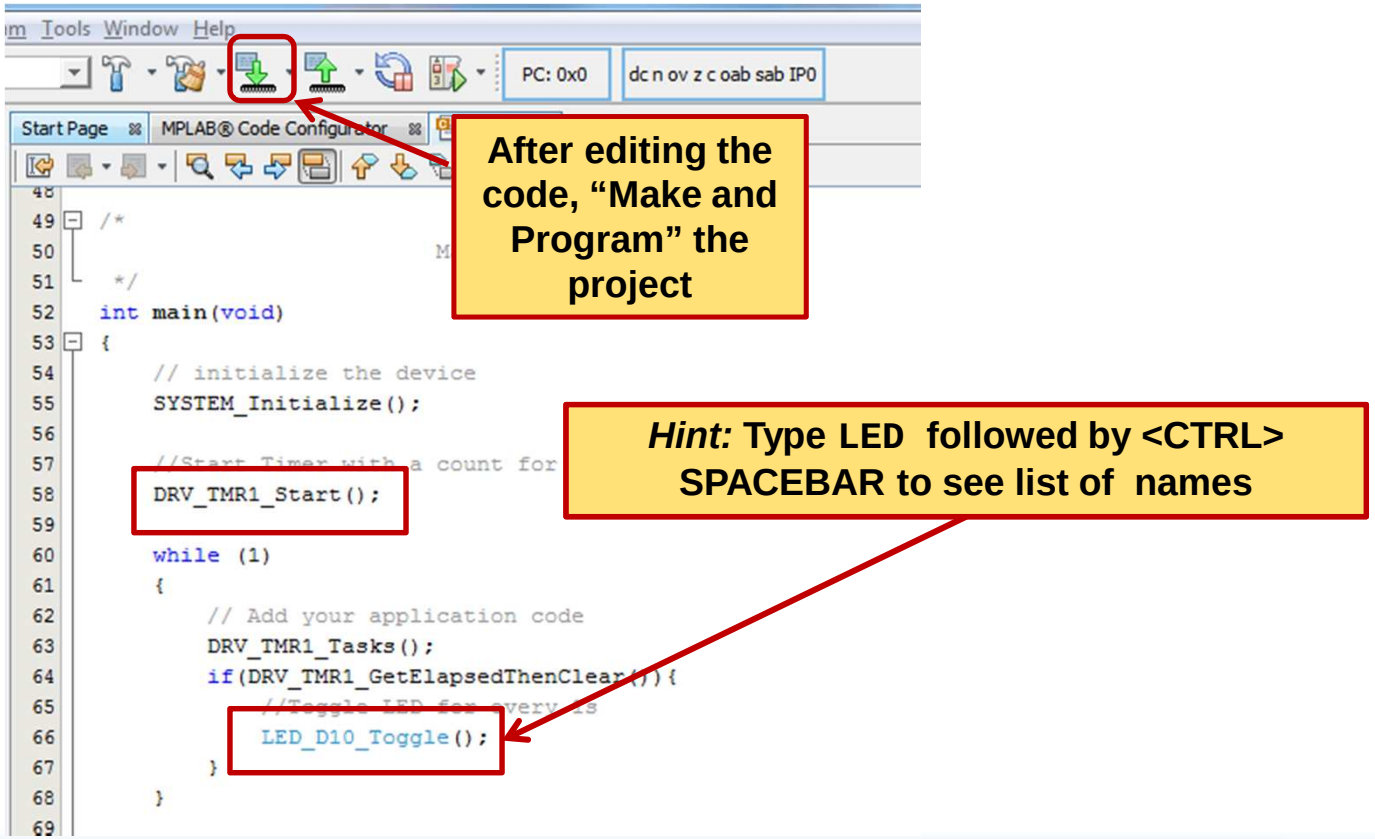
PIC24 Lab 1

- **Add the line of code to turn on LED1 then “Make and Program” the project**



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PIC24 Lab 1

- Did you know …

- that MCC can generate a main.c file for you if one does not exist in the project the 1st time you generate code?

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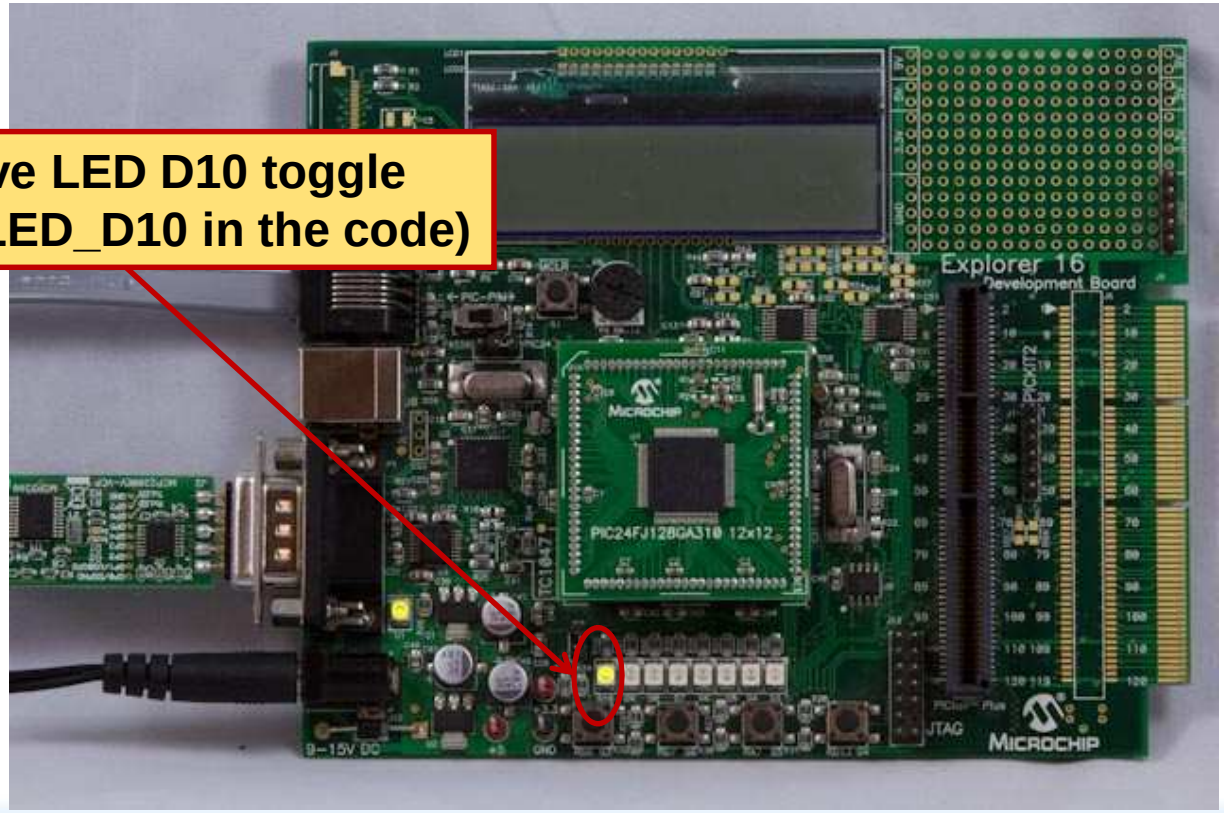
PIC24 Lab 1

- The LED marked D10 should be toggling every second



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PIC24 Lab 1 Summary

- We quickly set up GPIO to control an LED
- We quickly set up a timer to blink an LED
- We quickly created an application for toggling an LED

PIC24 Lab 2:
Timer based LED Toggle and display ADC value on UART

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PIC24 Lab 2 Objectives

- **Set up the ADC to read the potentiometer voltage**
- **Set up the UART to output potentiometer value.**

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PIC24 Lab 2 Overview

- Close any files open in the editor, and close all MPLAB® X IDE Projects
- Open lab2_16bit.X
- Configure ADC1 for Channel AN5 for auto sampling auto conversion mode
- Configure UART2 for transmission with 9600 Baud, Parity None and 1 Stop Bit

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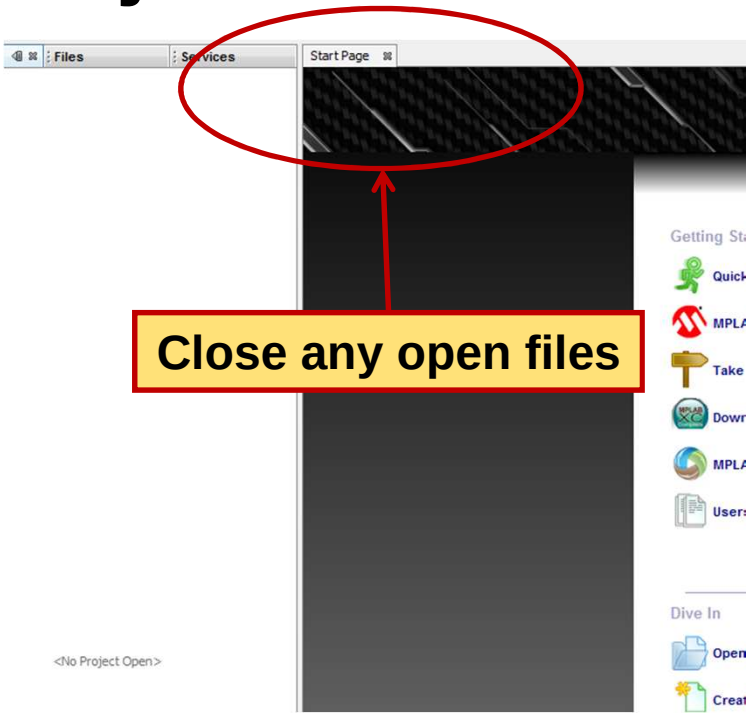
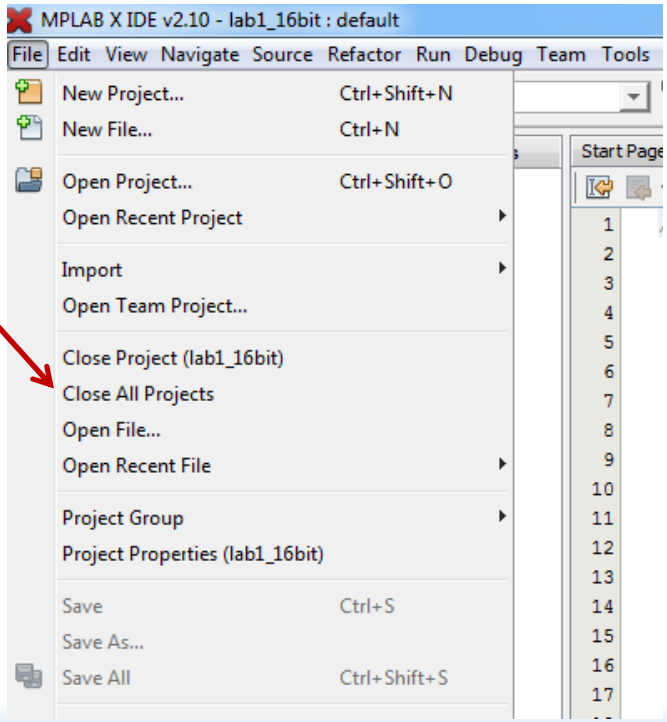
PIC24 Lab 2

- **Close any open files in the editor window, and all open MPLAB® X IDE projects**





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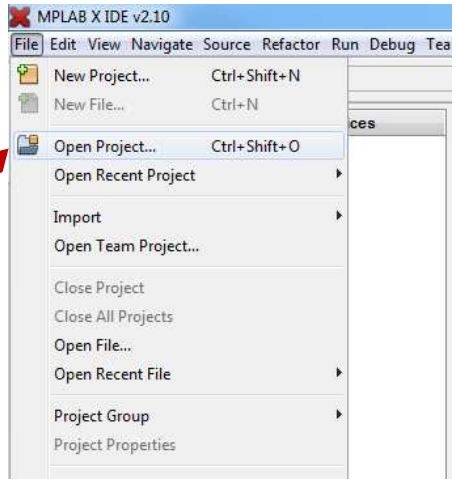
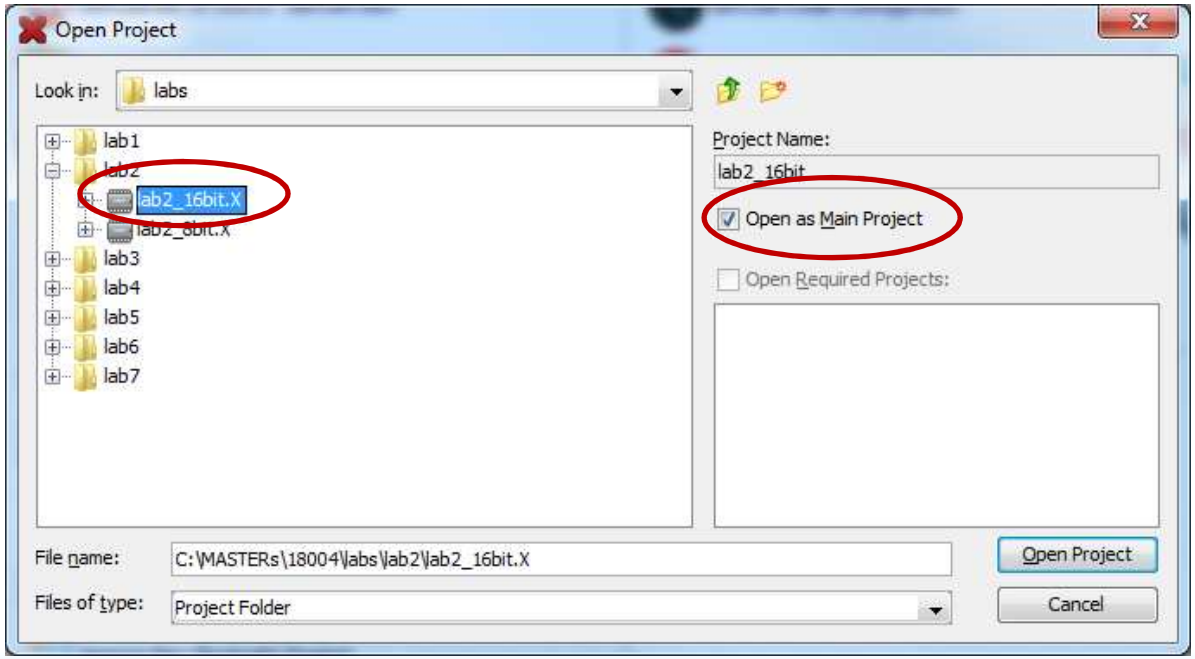
PIC24 Lab 2

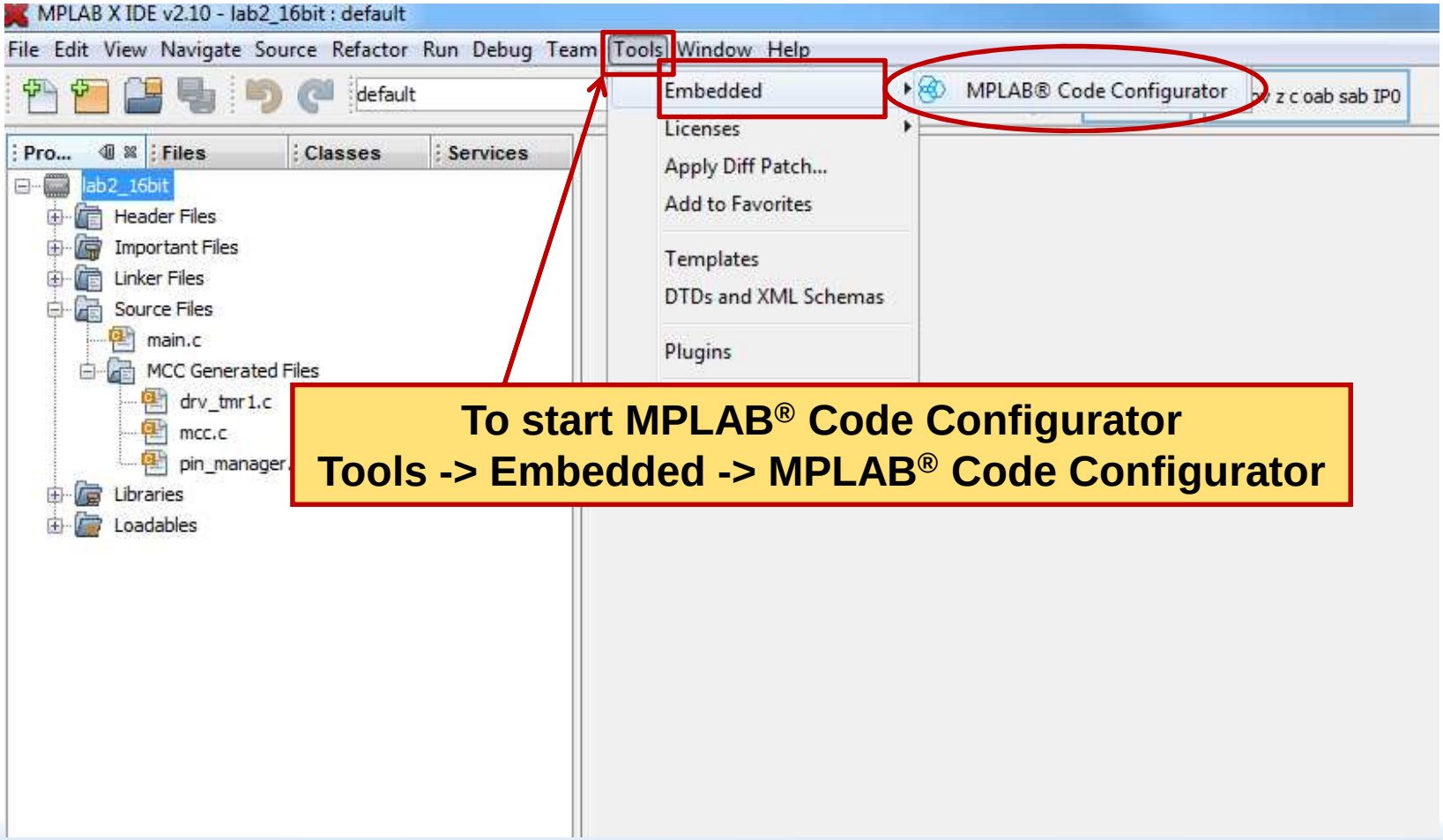
- **Open lab2_16bit.X**





PIC24 Lab 2

- **Start MPLAB® Code Configurator**



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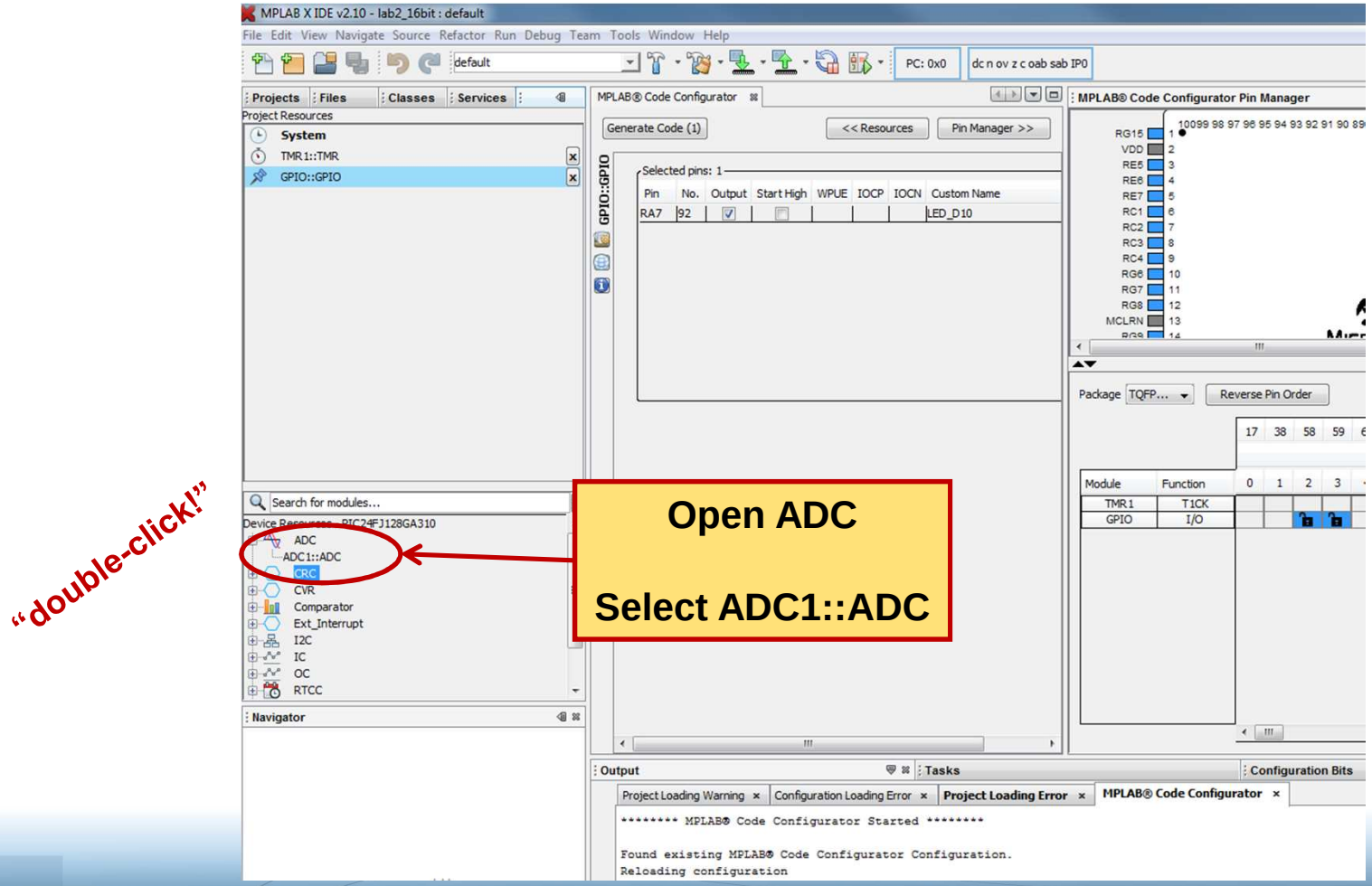
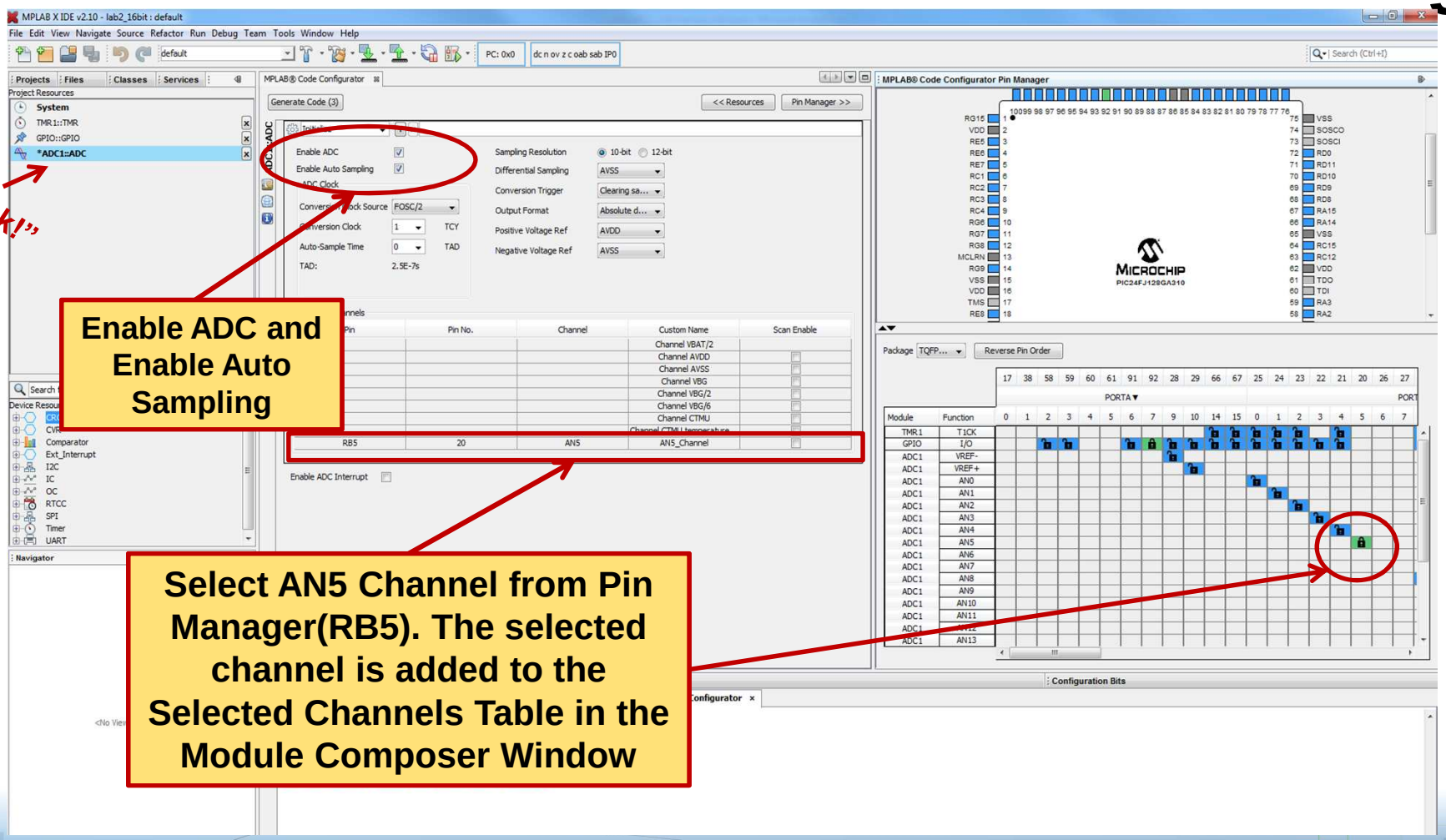
PIC24 Lab 2

- **Open the ADC module and select ADC1::ADC**



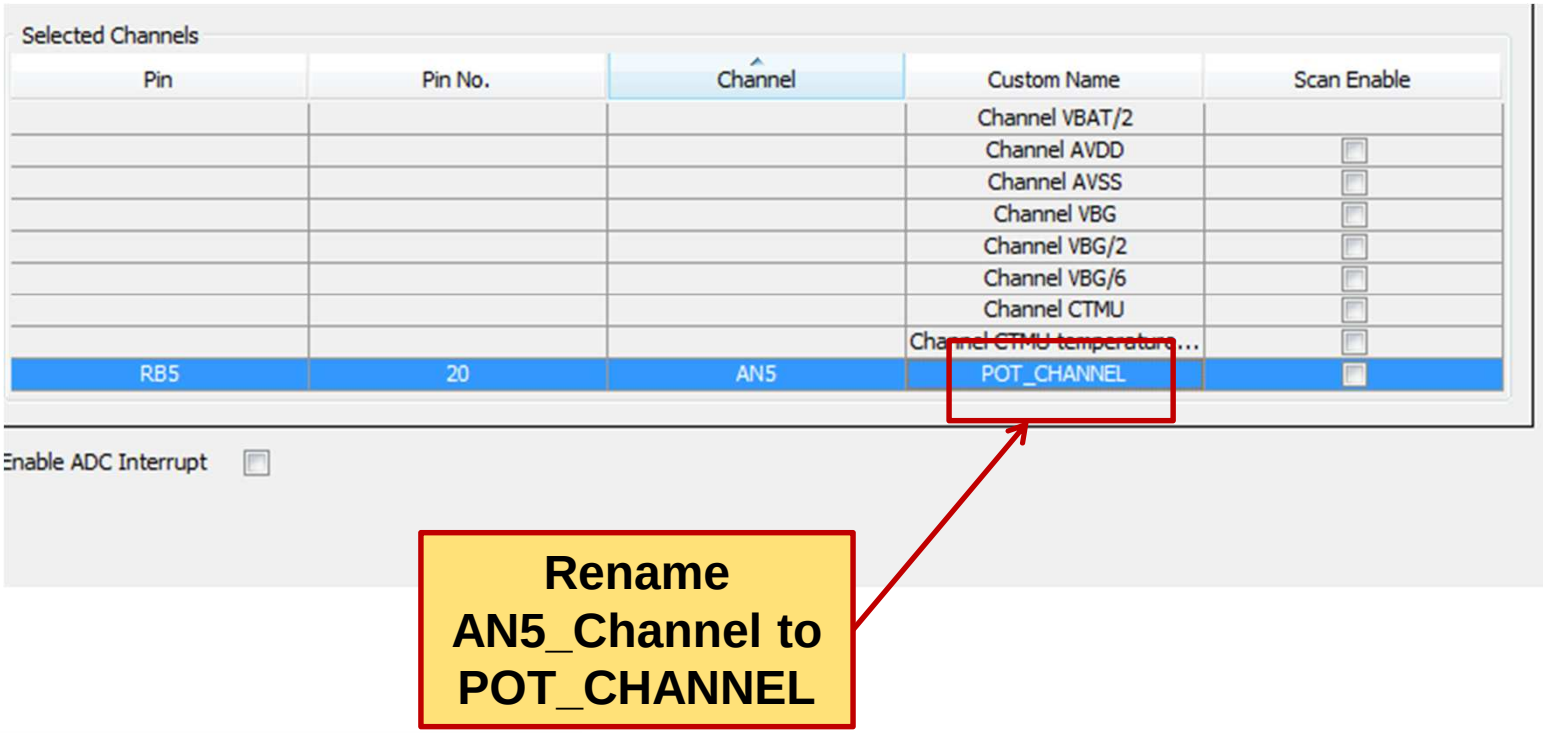
PIC24 Lab 2

- **Select ADC1::ADC and do the following**



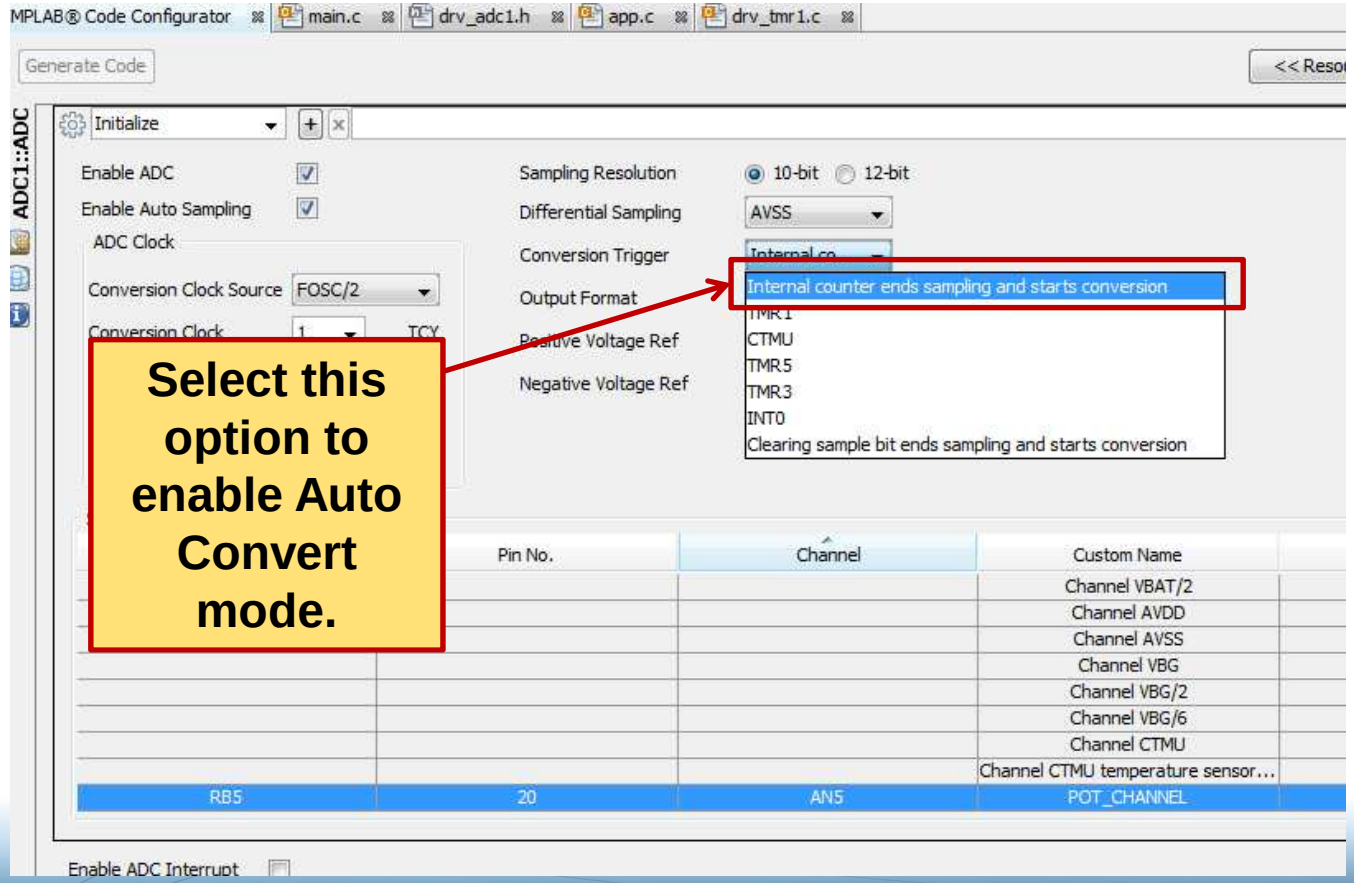
PIC24 Lab 2

- **Rename AN5_Channel to POT_CHANNEL**



PIC24 Lab 2

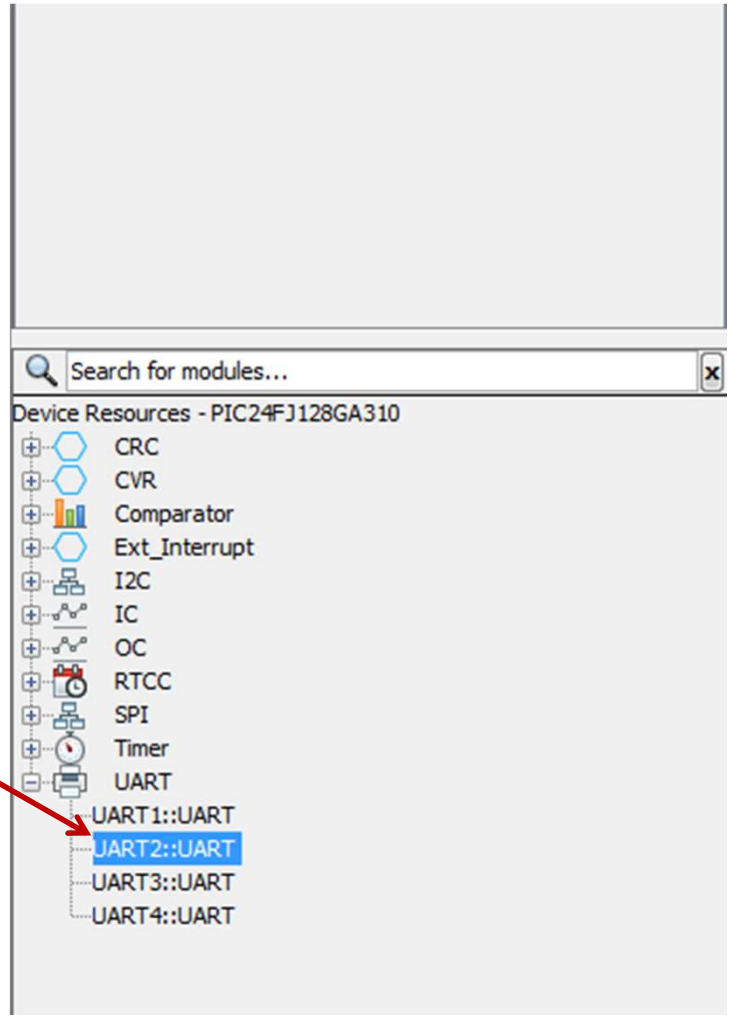
- **Select Conversion Trigger to “Internal counter ends sampling and starts conversion”**



PIC24 Lab 2

- **Open UART and select UART2::UART**

Open UART module in the Device Resources and select UART2::UART



"double-click!"

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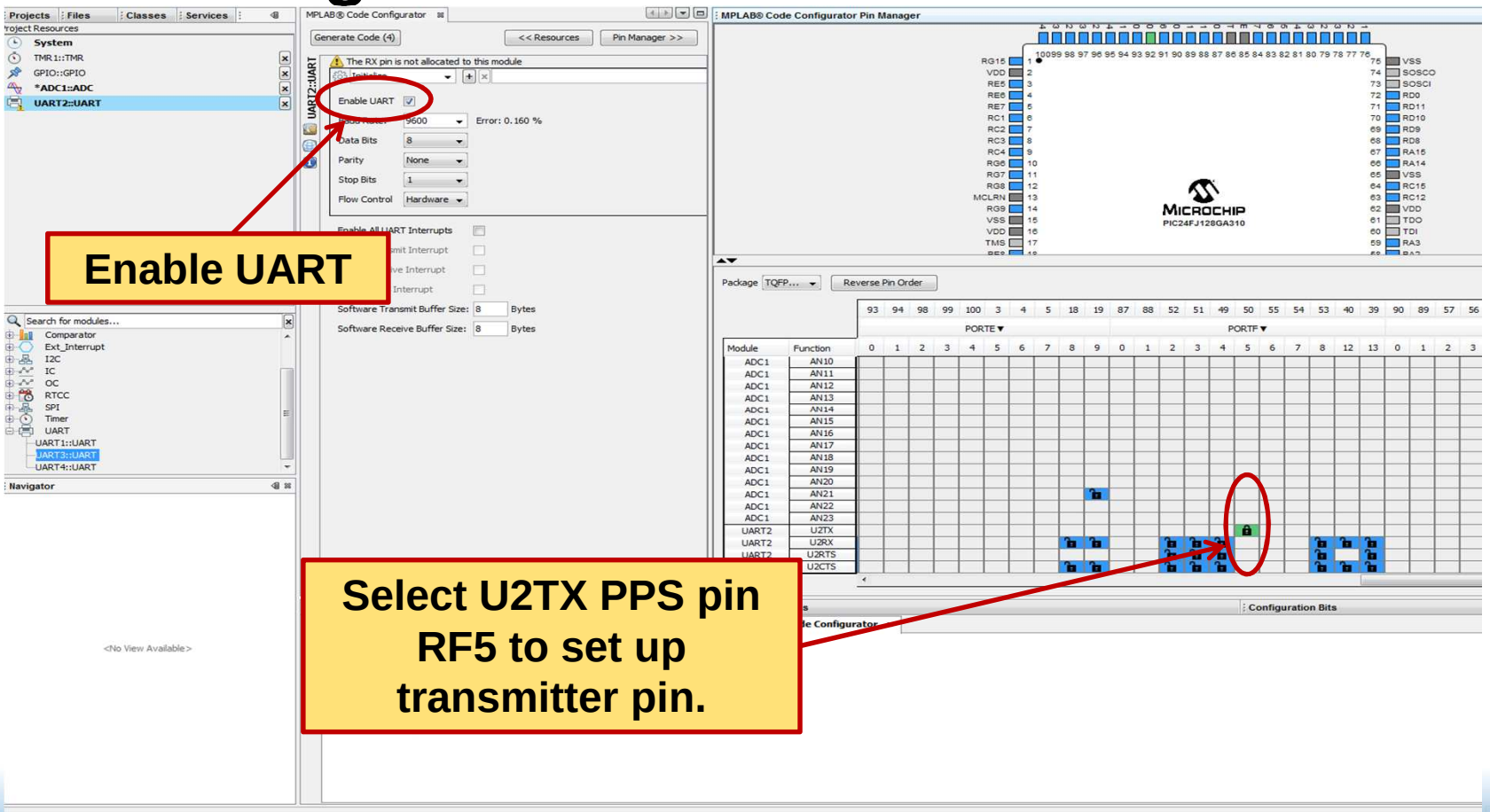
PIC24 Lab 2

- **Select UART2::UART and make the following selections**



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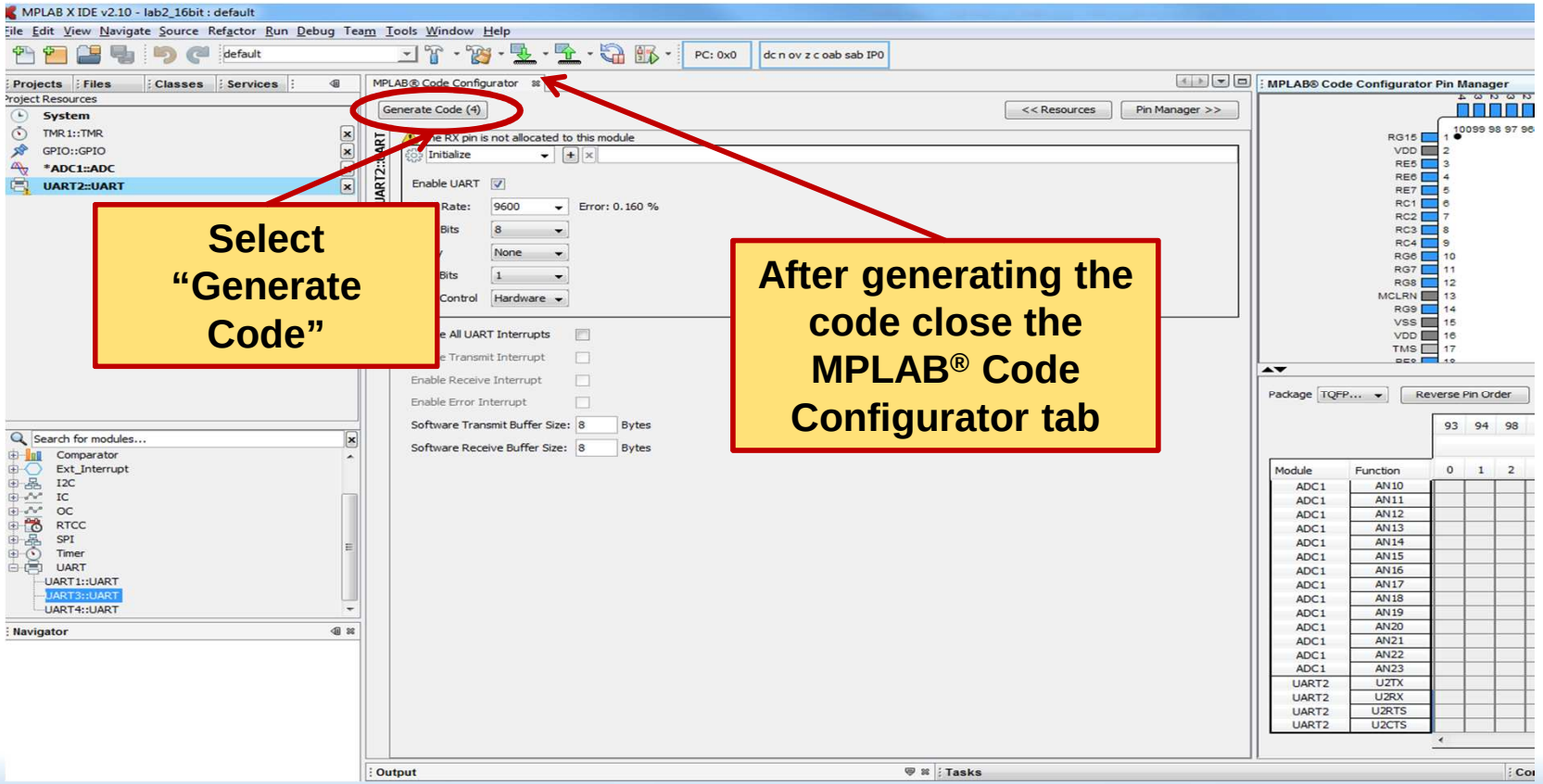
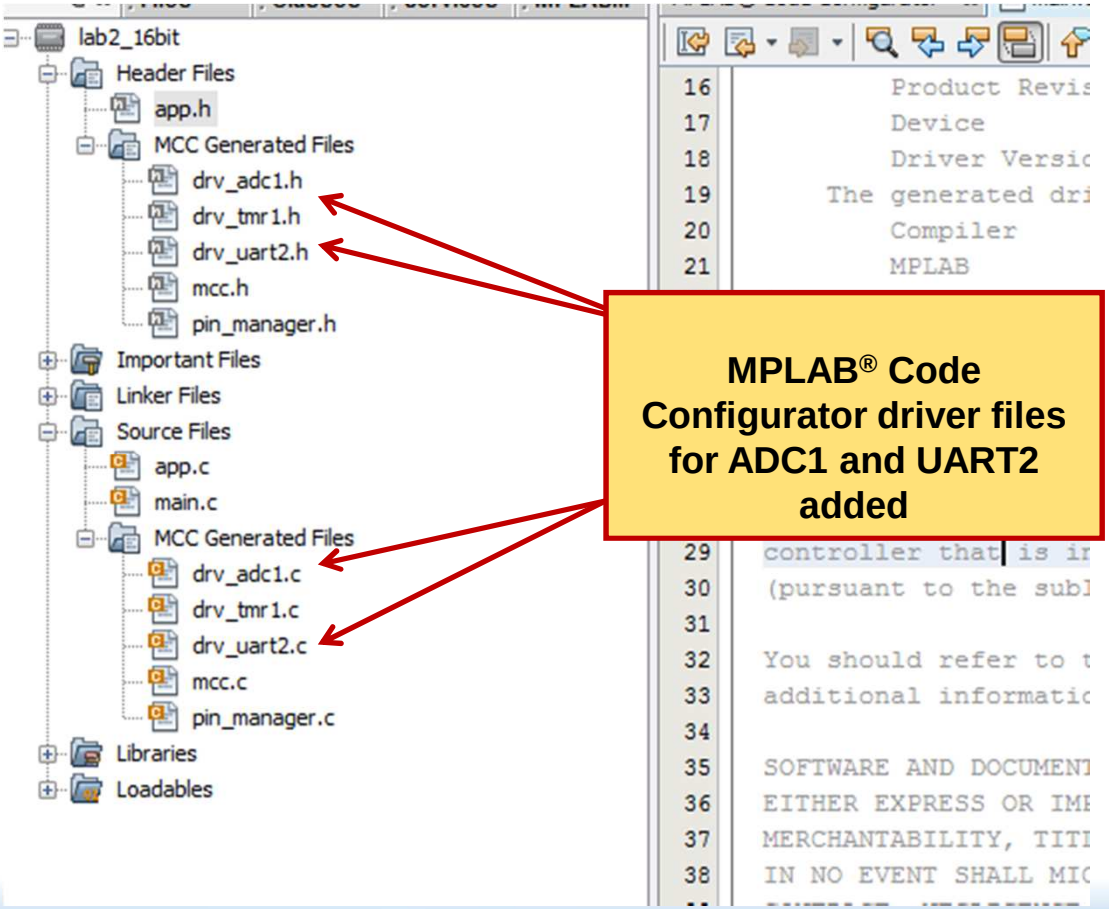
PIC24 Lab 2

- **Generate the code and close MPLAB® Code Configurator**



PIC24 Lab 2

- **Four more files added to the project**



PIC24 Lab 2

- **Open main.c and add the code shown**

```
68
69      /*Start the timer with Period 1s */
70      DRV_TMR1_Start();
71      /*Select the ADC channel to which Potentiometer is connected*/
72      DRV_ADC1_ChannelSelect(DRV_ADC1_POT_CHANNEL);
73      DRV_ADC1_Start();
74      while(1)
75      {
76          DRV_TMR1_Tasks();
77          if(DRV_TMR1_GetElapsedThenClear()){
78              //Toggle LED D10 every 1s
79              LED_D10_Toggle();
80
81              adcResult = DRV_ADC1_ConversionGet();//Digital value is read
82              ConvertADCVoltage(adcResult);//adc result value is converted to analog voltage
83              sprintf(bufferWrite, "Potentiometer Analog Voltage is = %d.%d%d V \r\n",adones, adten
84              Write2UART(bufferWrite, strlen(bufferWrite));//Analog voltage value is transmitted ov
85          }
```

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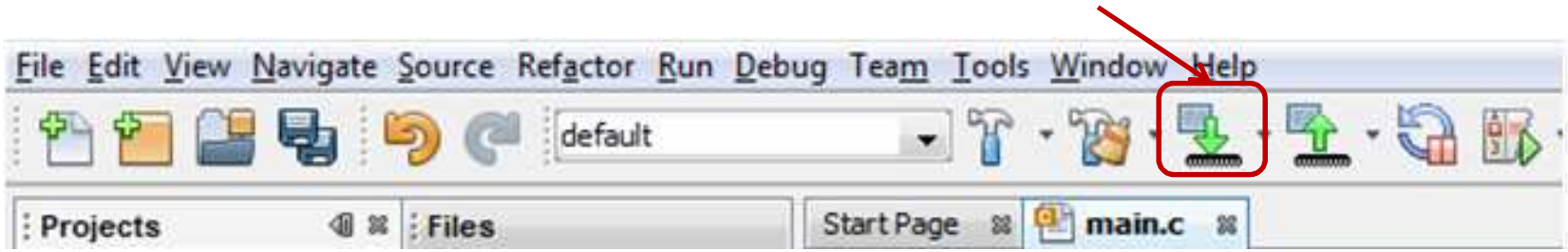
PIC24 Lab 2

- **“Make and Program” the project**



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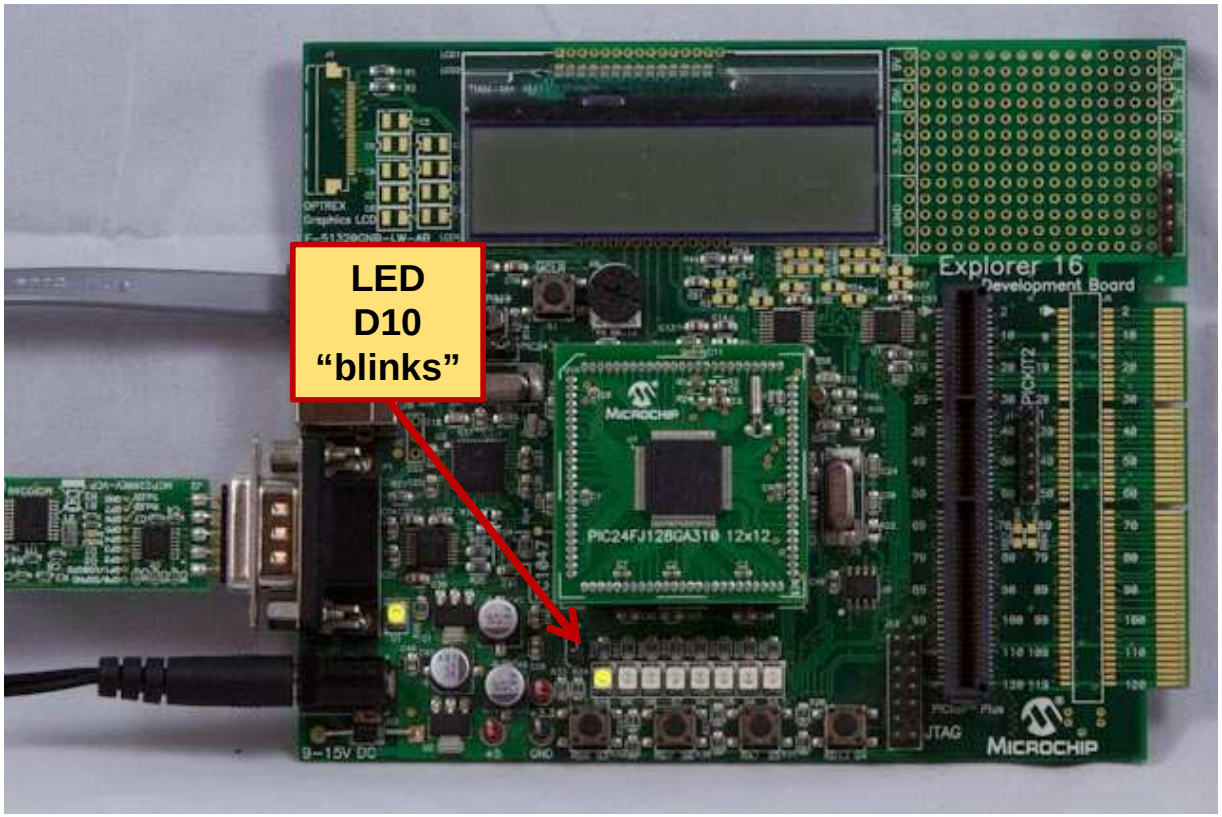
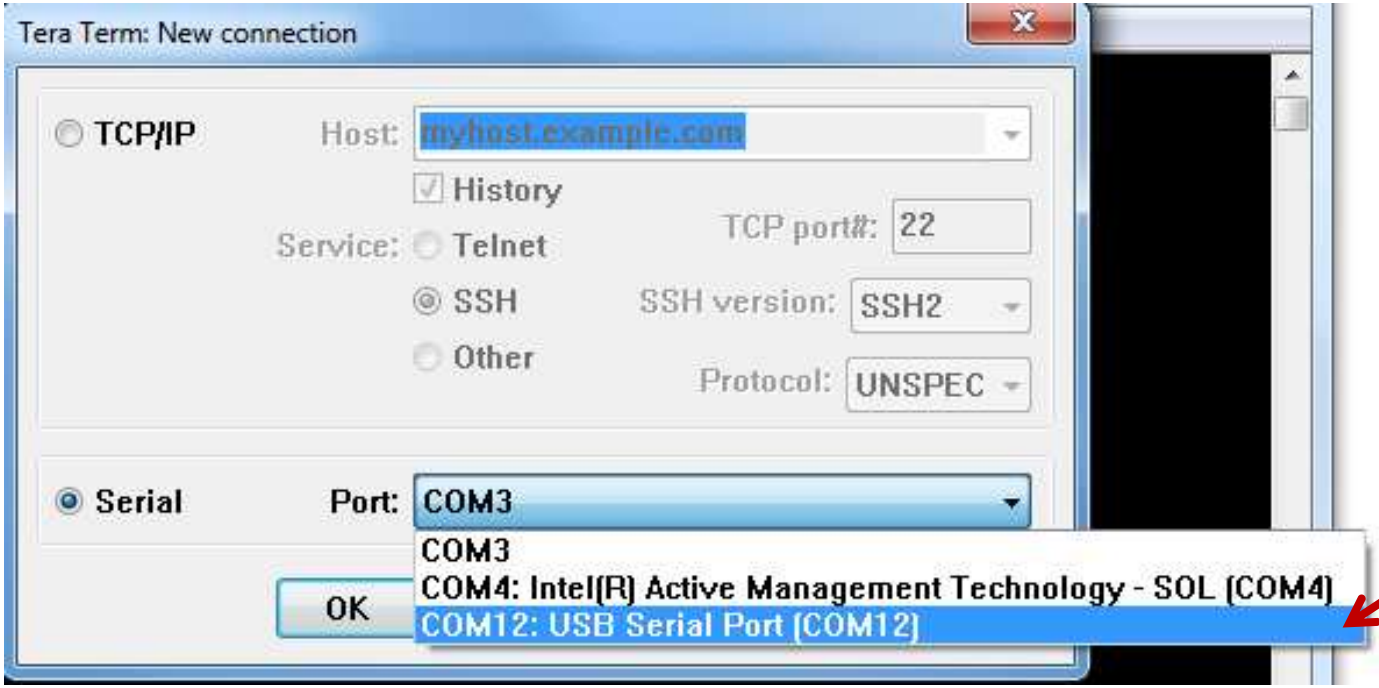
PIC24 Lab 2

- LED_D10 toggles every second



PIC24 Lab 2

- **Start Tera Term**
- **Select the USB Serial Port**

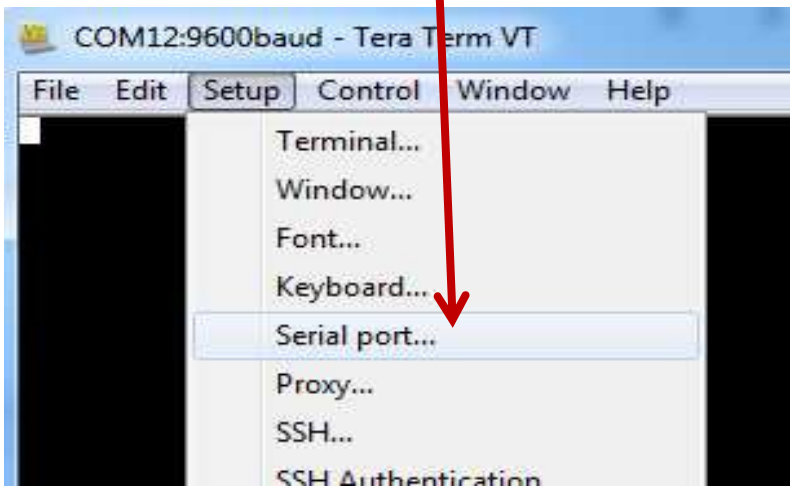


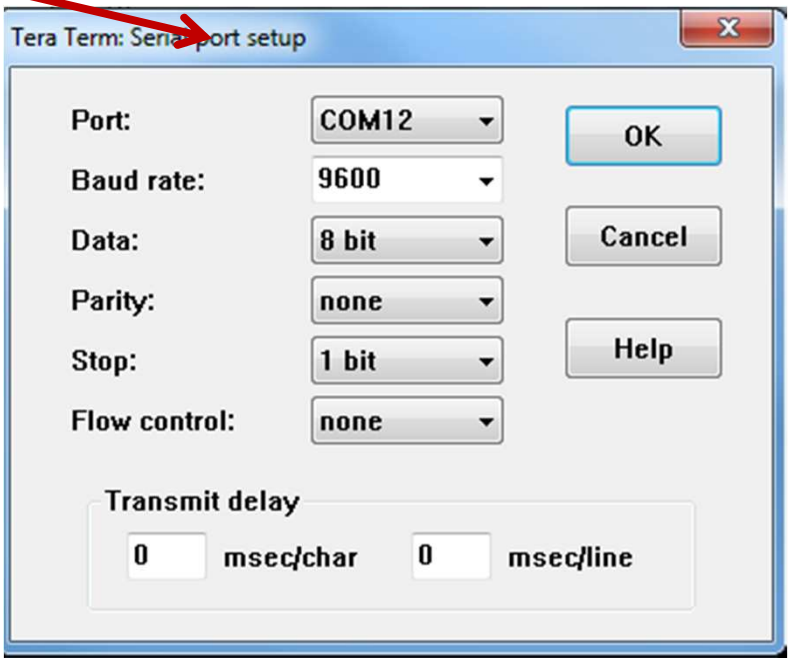
Open "Tera Term" from your desktop and set up a new connection. Choose the COMx: USB Serial Port

PIC24 Lab 2

- **Setup the Serial Port**

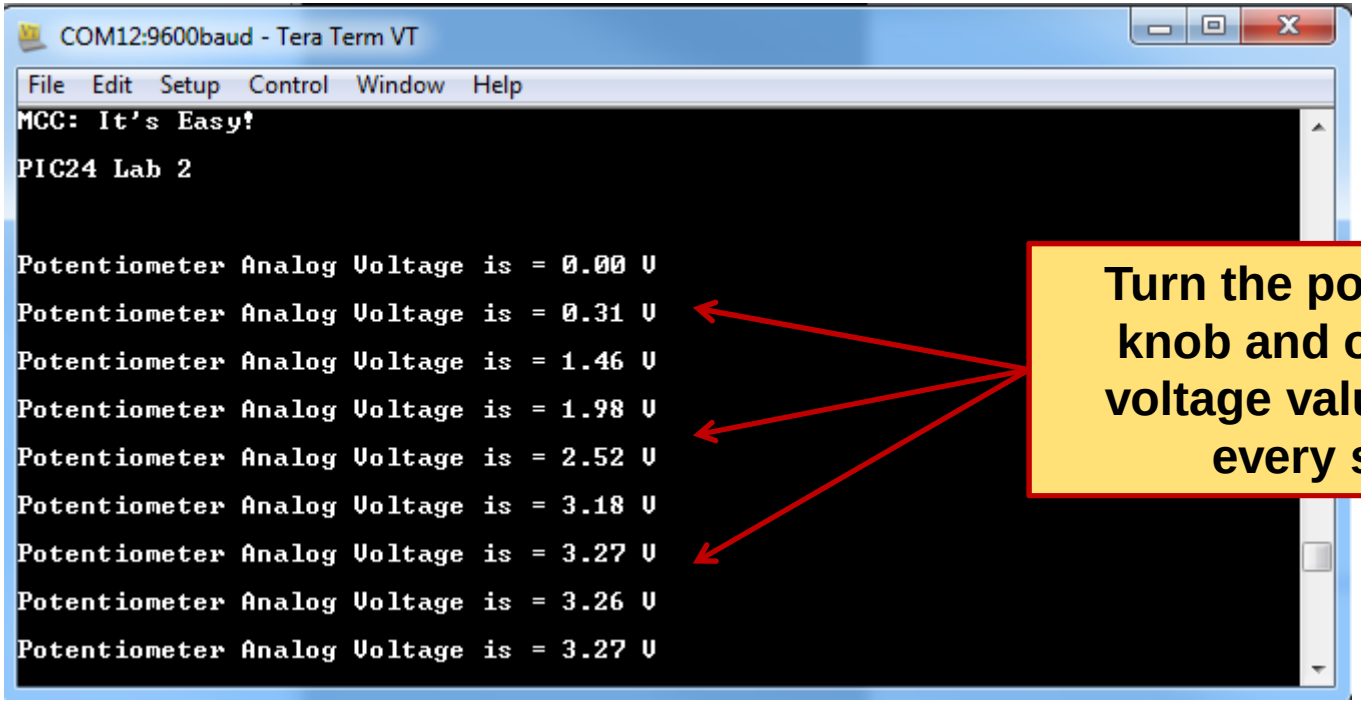
Choose Serial Port under "Setup" and configure the following settings





PIC24 Lab 2

- **Tera Term shows the potentiometer voltage updating every second**



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PIC24 Lab 2 Summary

- We configured ADC1 to sample the Potentiometer channel and convert it to a voltage.

- We configured UART2 to transmit the converted potentiometer voltage onto Tera Term

PIC24 Lab 3:
Using Interrupts

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PIC24 Lab 3 Objectives

- Converting Lab 2 into an Interrupt Mode application

- Read potentiometer voltage using ADC and display it on serial port using UART and toggle an LED every second using a Timer

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PIC24 Lab 3 Overview

- Close any files open in the editor, and close all MPLAB® X IDE Projects
- Open lab3_16bit.X
- Configure TMR1 module period 1s in Interrupt Mode
- Configure UART2 for 9600 Baud, Parity None,1 Stop Bit and Interrupt Mode

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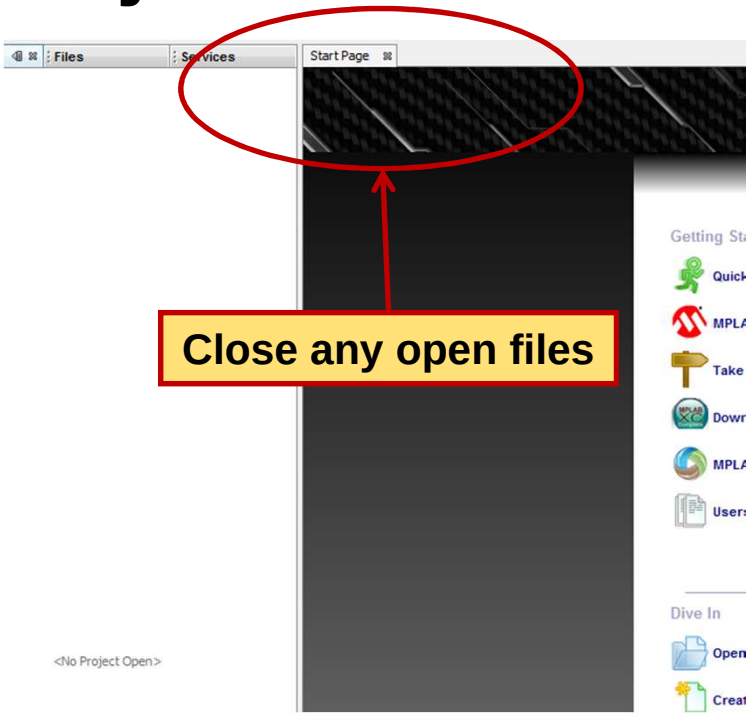
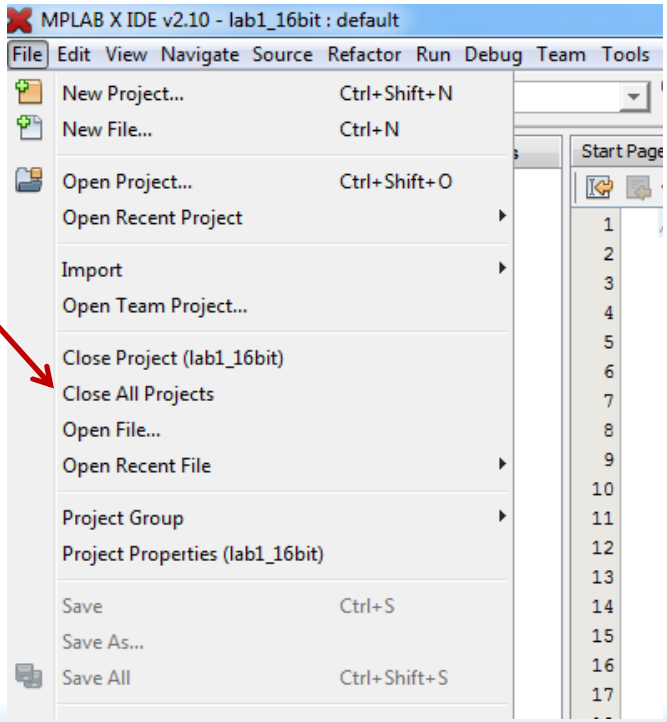
PIC24 Lab 3

- **Close any open files in the editor window, and all open MPLAB® X IDE projects**





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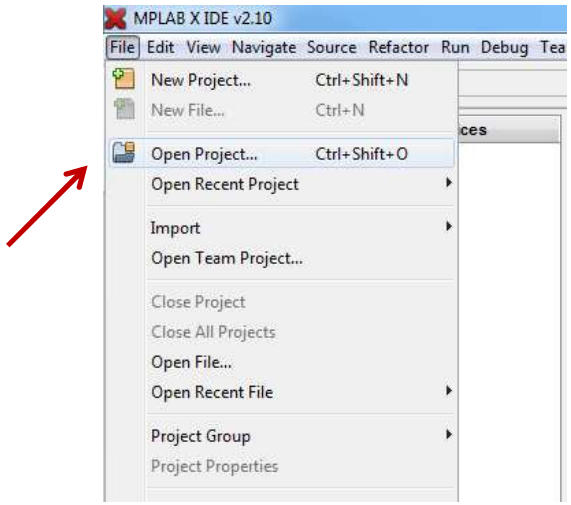
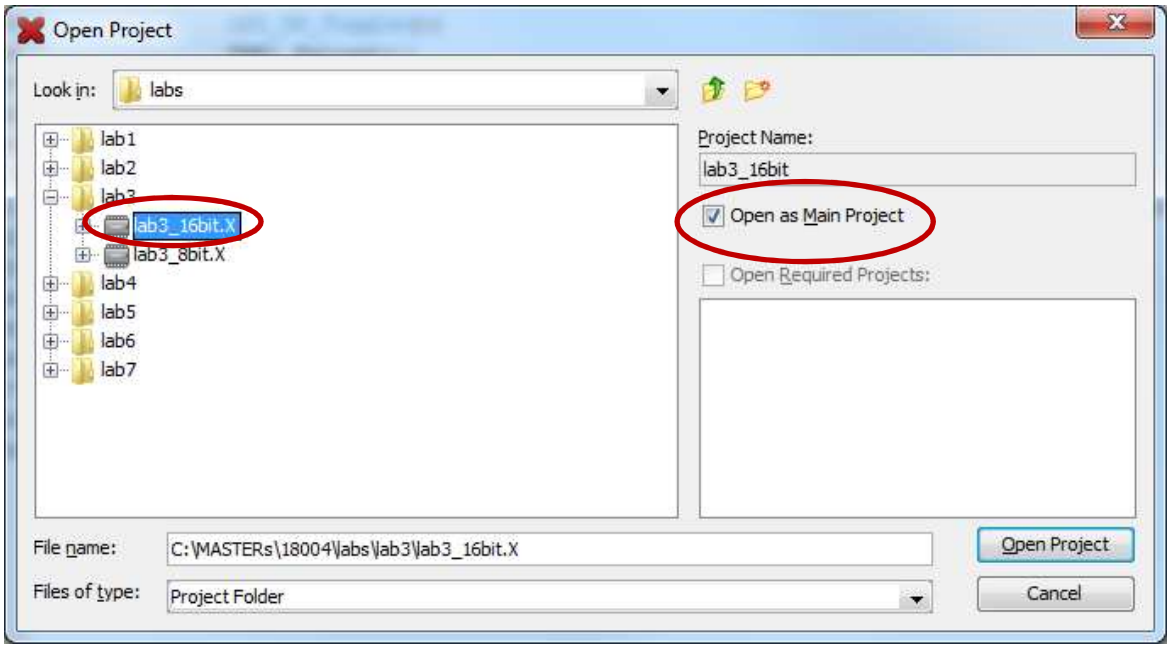
PIC24 Lab 3

- **Open lab3_16bit.X**





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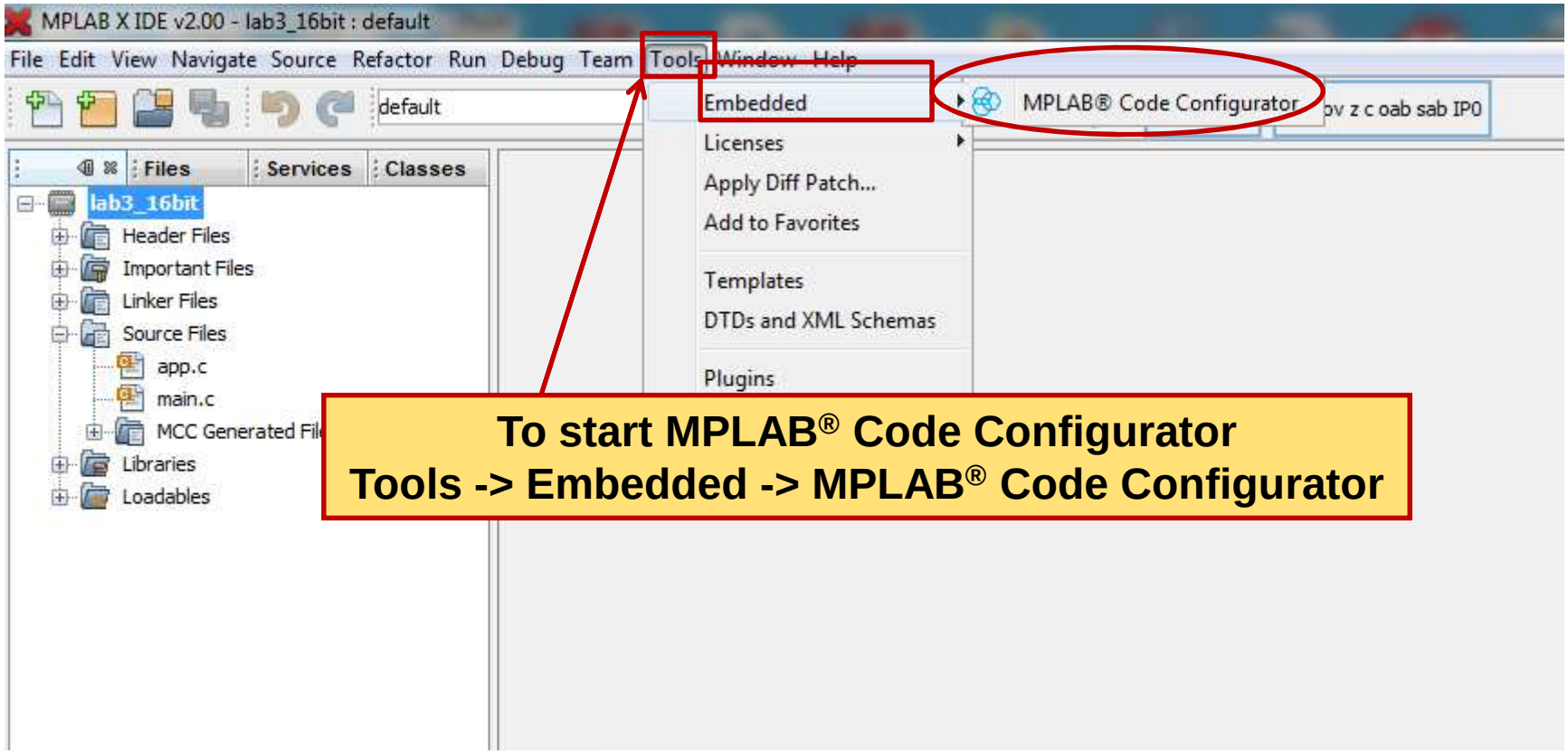
PIC24 Lab 3

- **Start MPLAB® Code Configurator**



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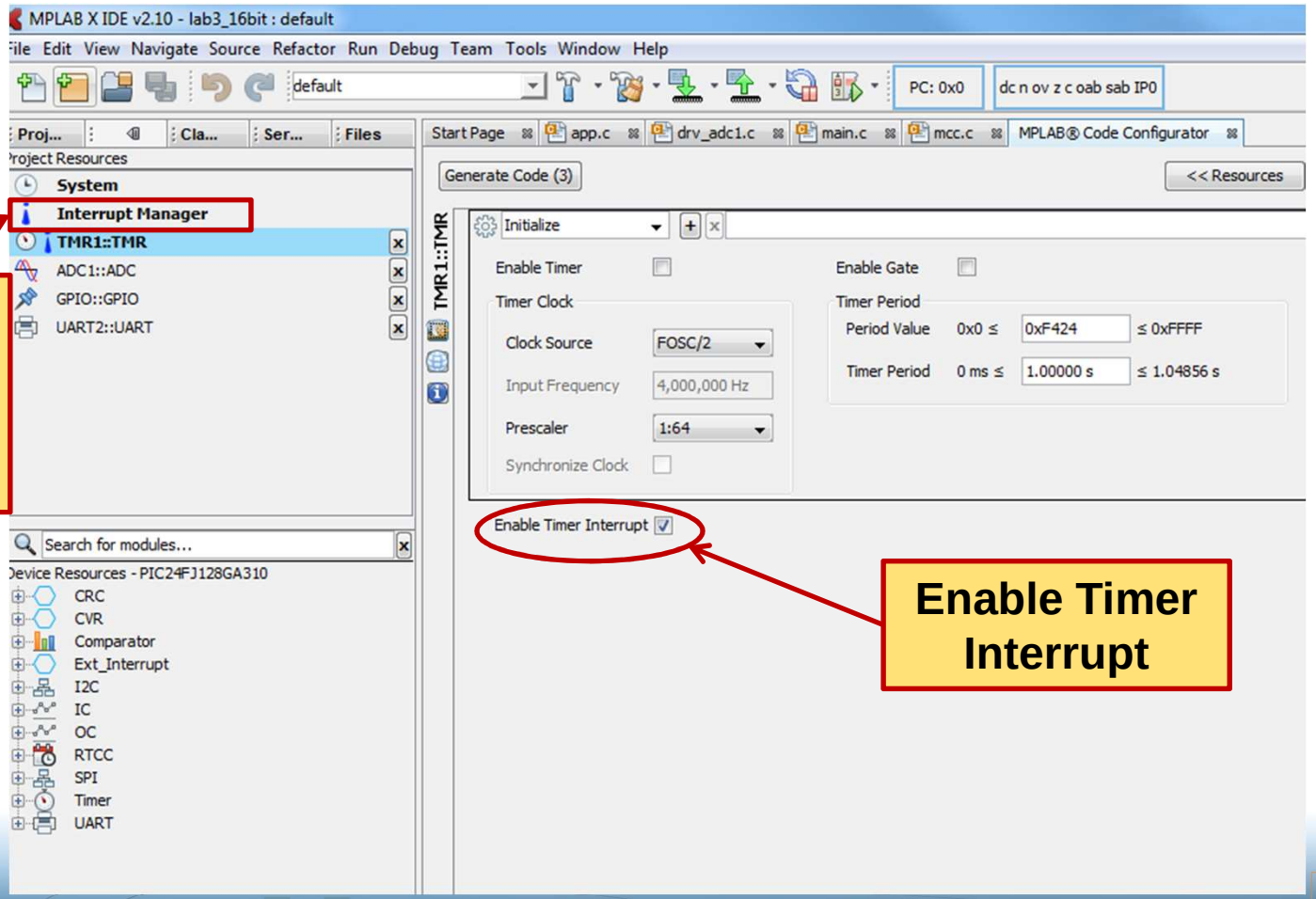
PIC24 Lab 3

- **Select Timer 1 from the Project Resources and Enable Timer Interrupt.**



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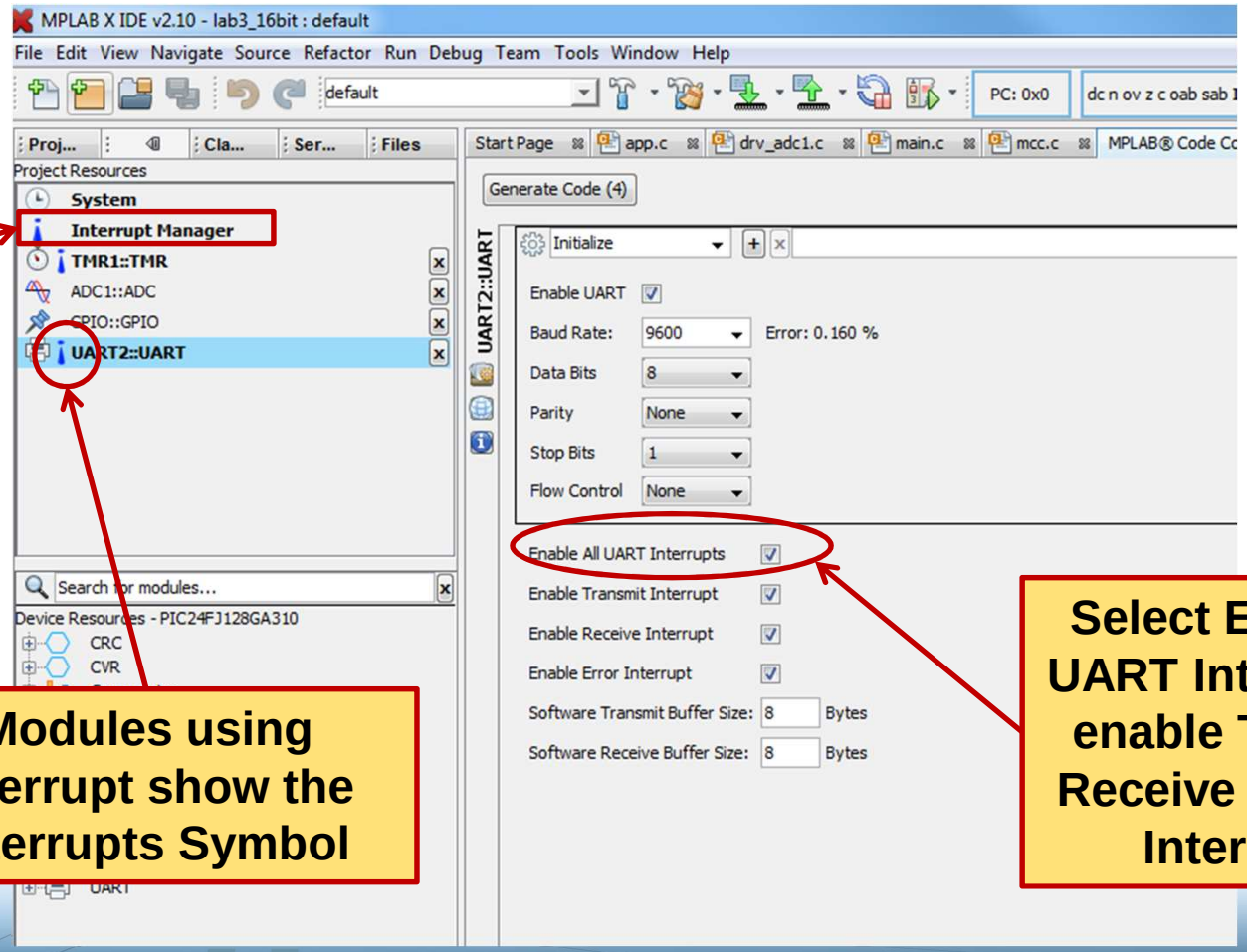
PIC24 Lab 3

- **Select UART2 and Enable All UART Interrupts.**



Interrupt Manager is invoked.

Modules using Interrupt show the Interrupts Symbol

Select Enable All UART Interrupts to enable Transmit, Receive and Error Interrupts.

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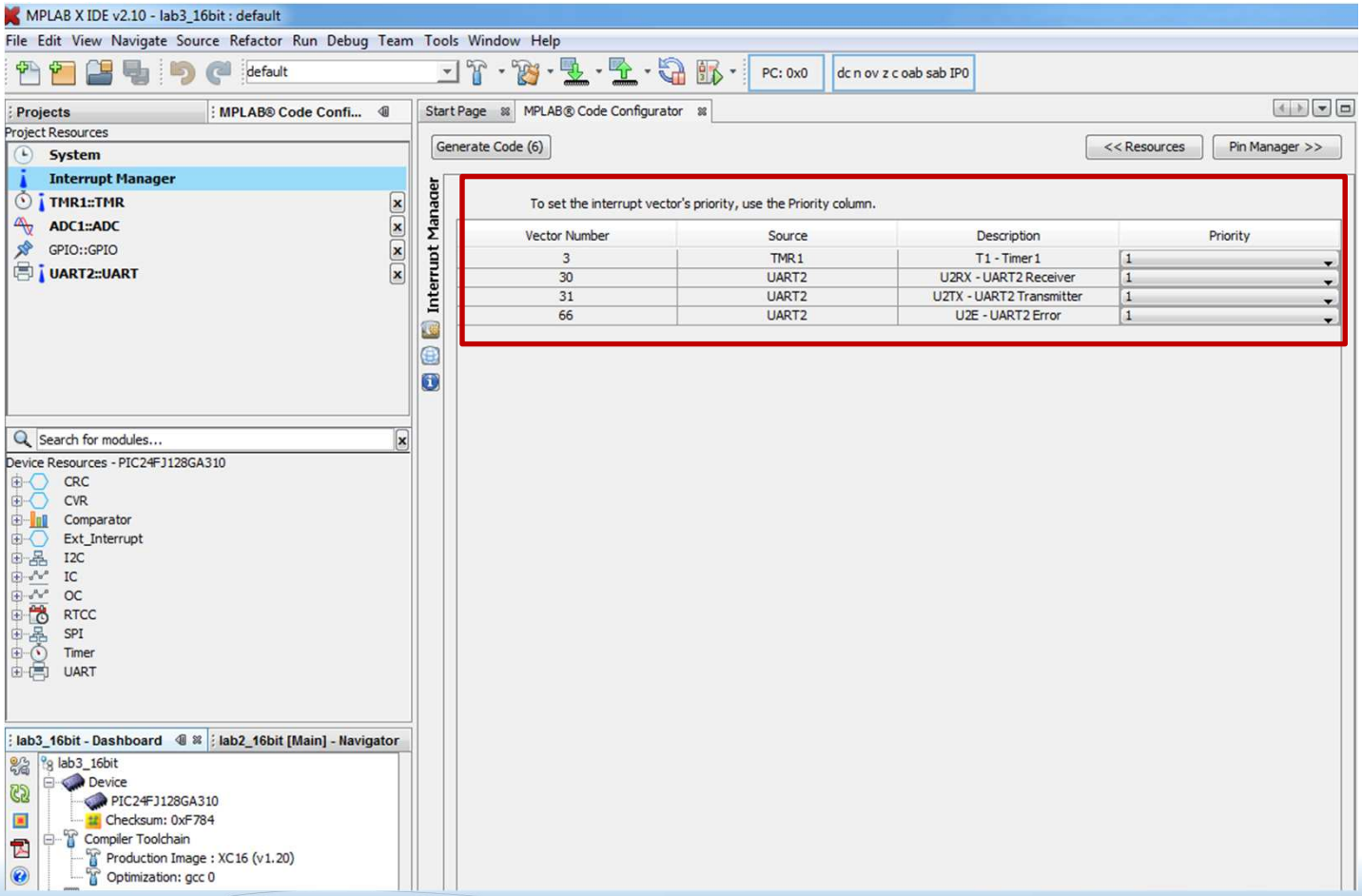
PIC24 Lab 3

- Open Interrupt Manager to see the UART and Timer Interrupts added



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PIC24 Lab 3

- **Did you know …**

- **that between the Project Resources and Composer windows, the MCC icons provide helpful links?**

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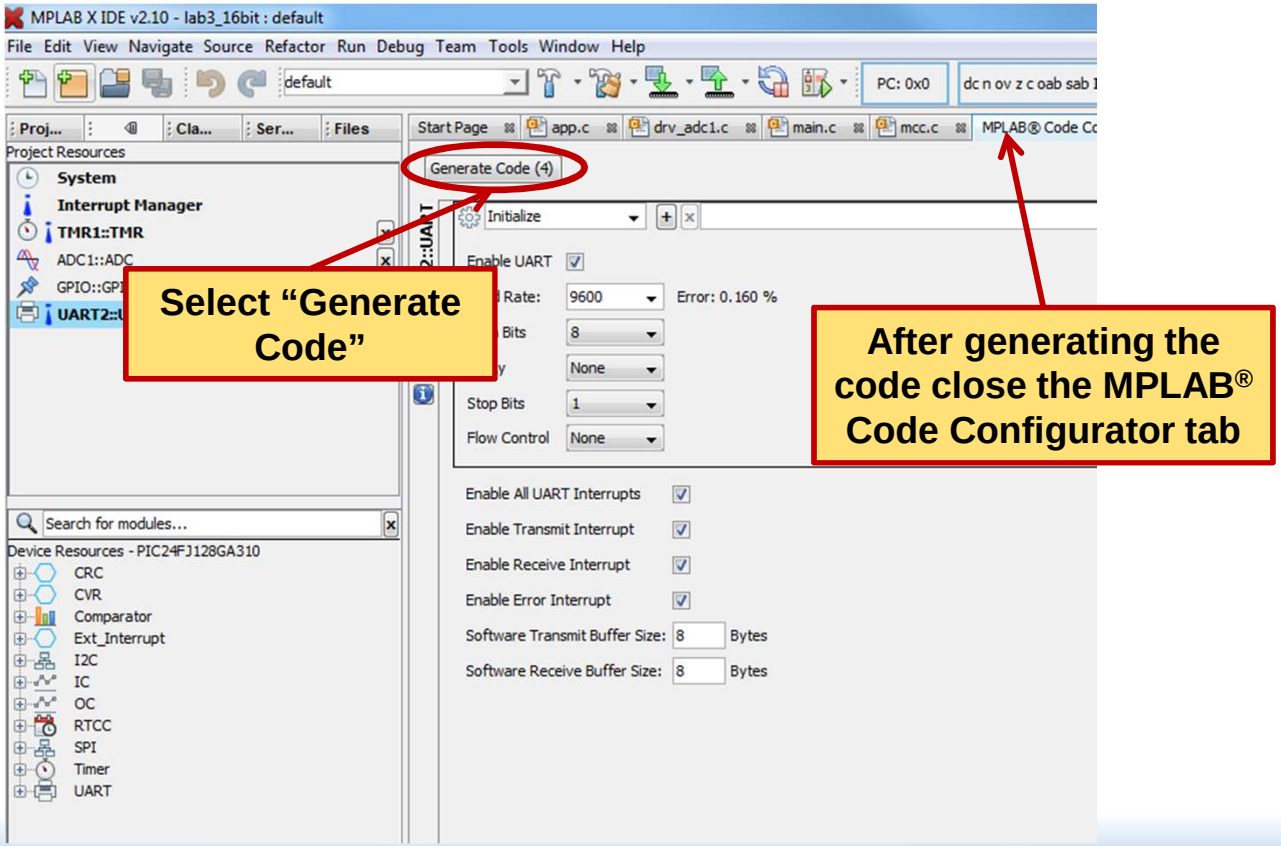
PIC24 Lab 3

- **Generate the code and close MPLAB® Code Configurator**



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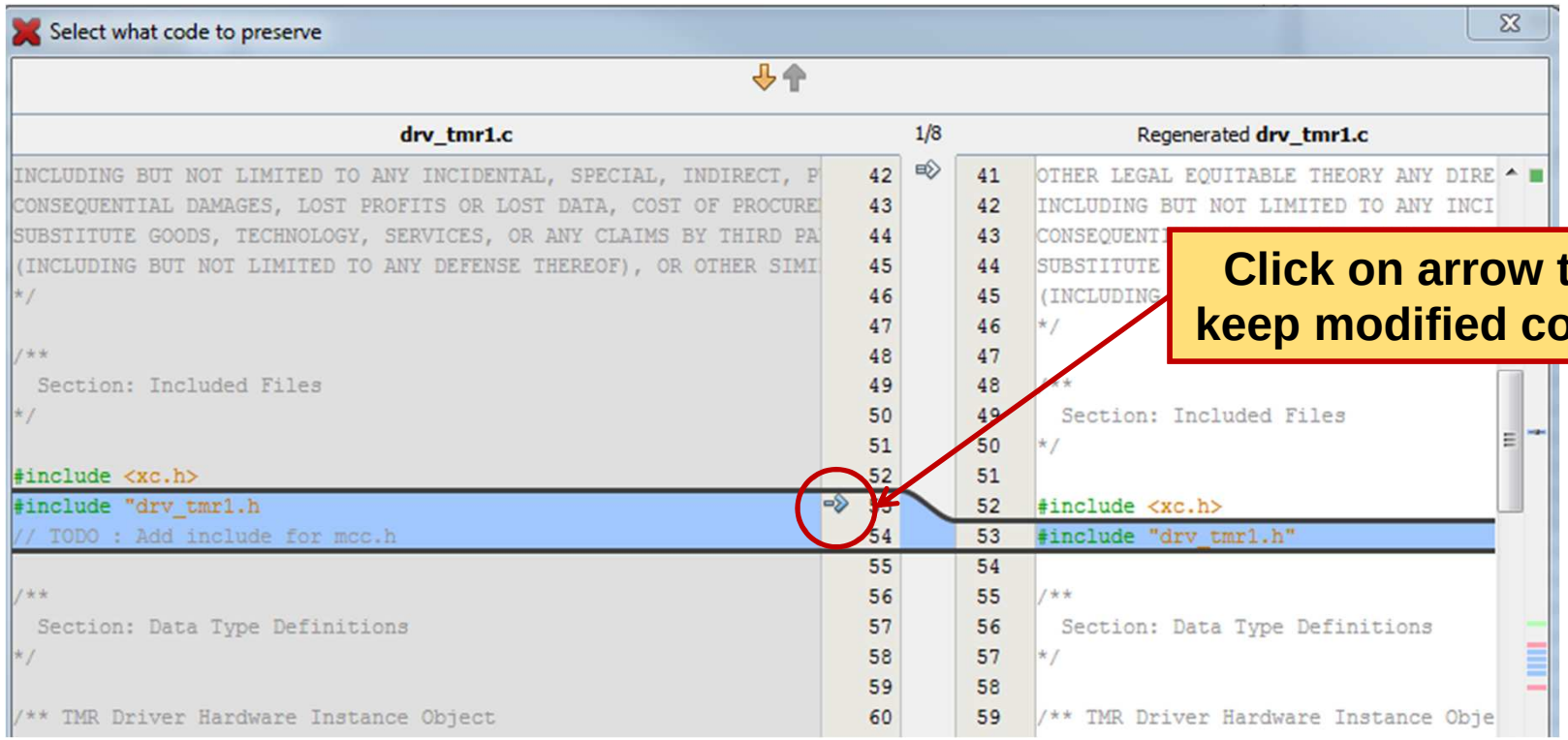
PIC24 Lab 3

- **Use the difference window to keep the line of modified code**



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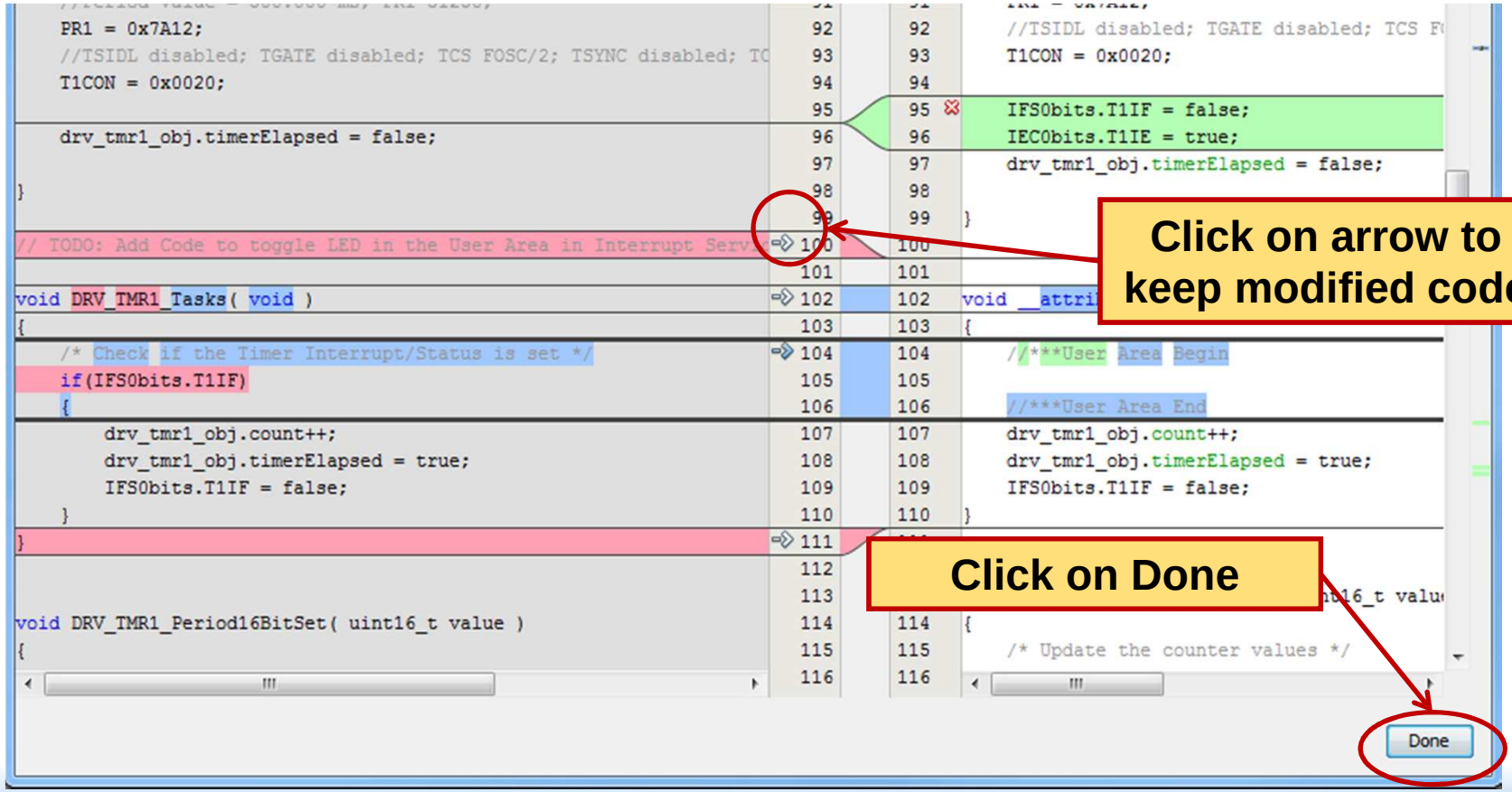
PIC24 Lab 3

- Use the difference window to keep the line of modified code highlighted.



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PIC24 Lab 3

- Did you know …

- that you can resize the package view in the Pin Manager by pressing <CTRL> and using the scroll wheel on the mouse

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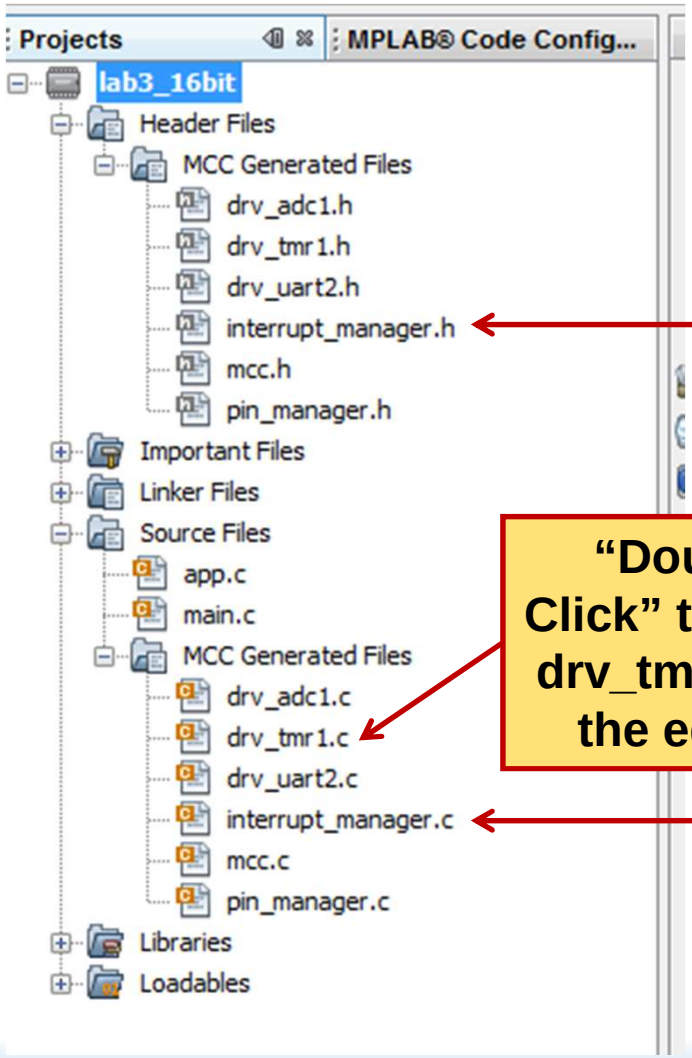
PIC24 Lab 3

- Did you know …

- that you can bring up the Project and Device resource windows by pressing the ‘Resources” button in the Composer window

PIC24 Lab 3

Open drv_tmr1.c

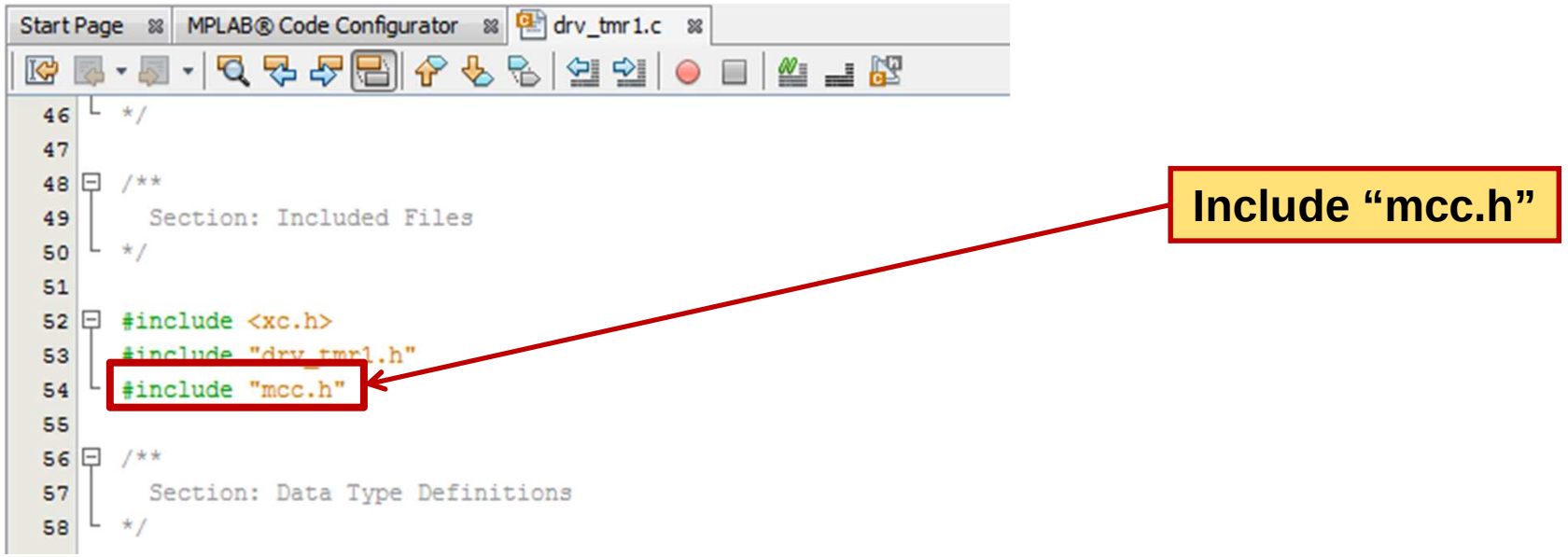


Note: interrupt_manager.c and interrupt_manager.h files are added to the project.

"Double Click" to open drv_tmr1.c in the editor

PIC24 Lab 3

- **Open drv_tmr1.c and Include “mcc.h”**



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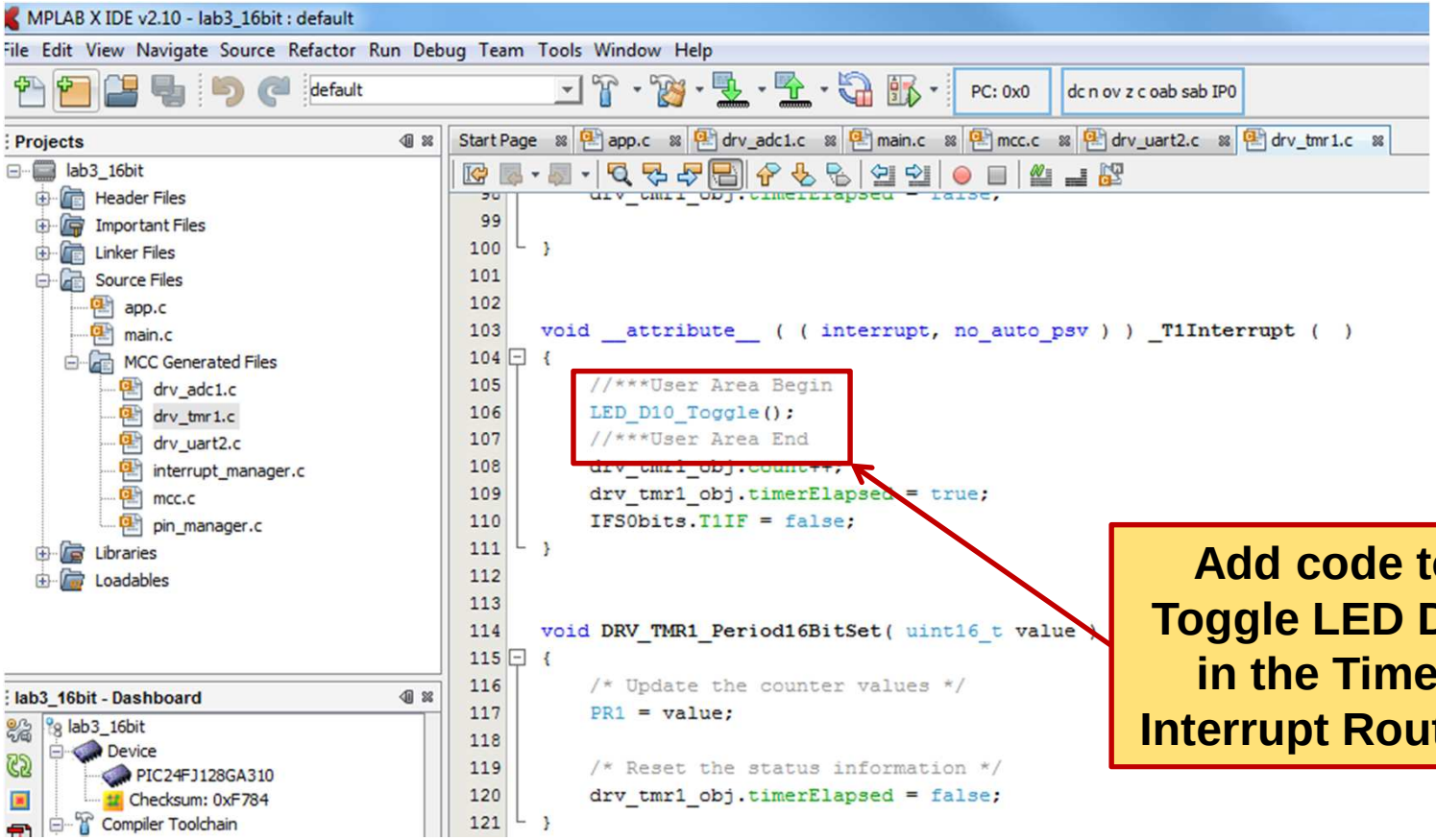
PIC24 Lab 3

- **Add code to toggle LED D10**



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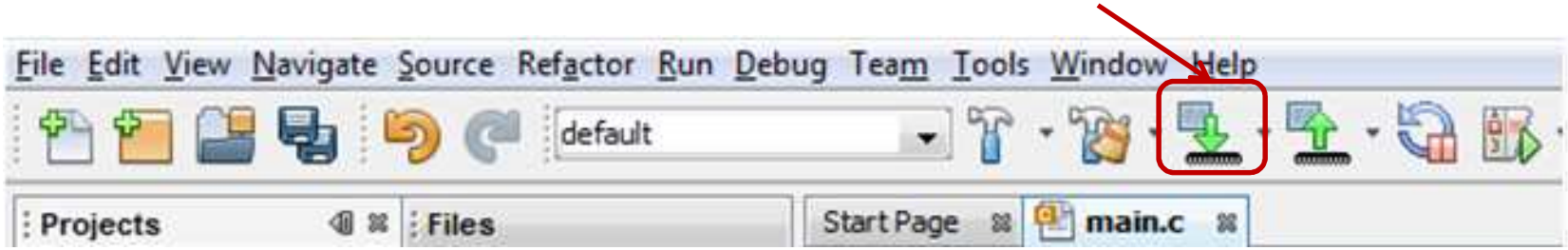
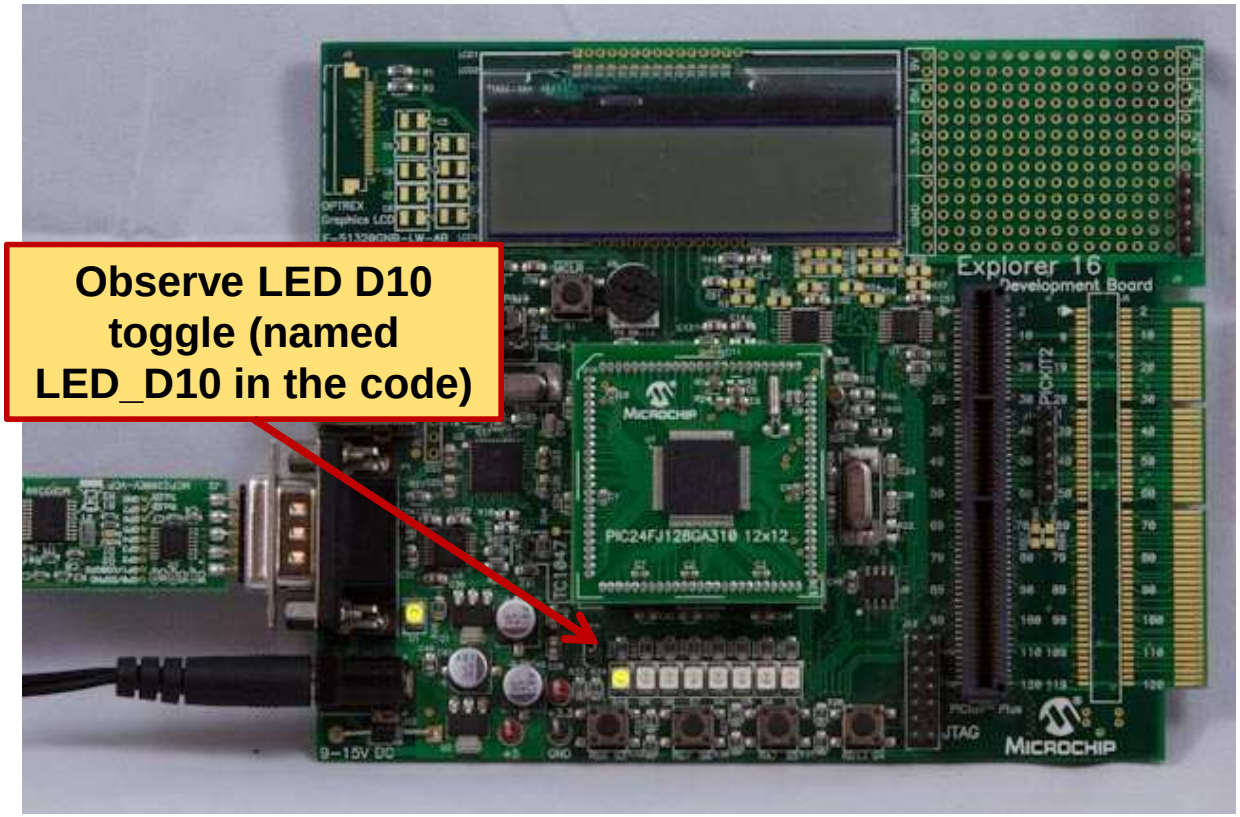
PIC24 Lab 3

- **“Make and Program” the project**



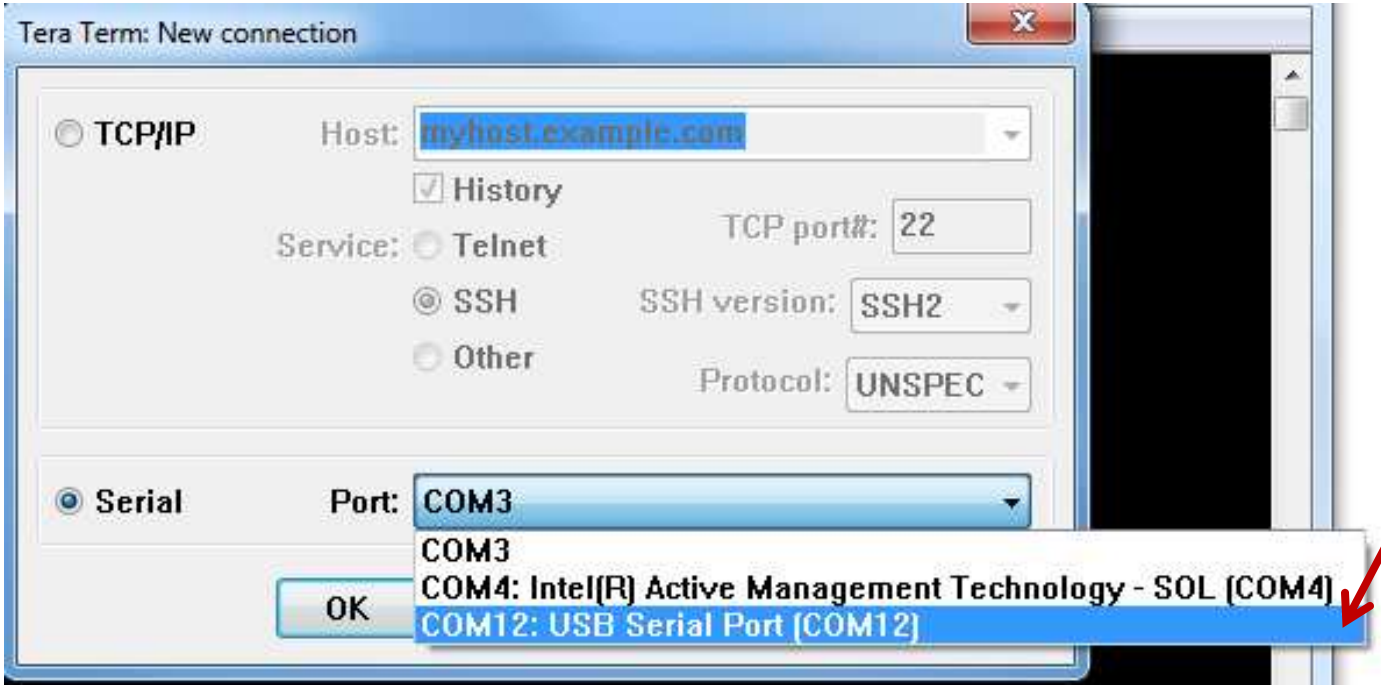
PIC24 Lab 3

- **LED_D10 toggles every second**



PIC24 Lab 3

- **Start Tera Term**
- **Select the USB Serial Port**



Open "Tera Term" from your desktop and set up a new connection. Choose the COMx: USB Serial Port

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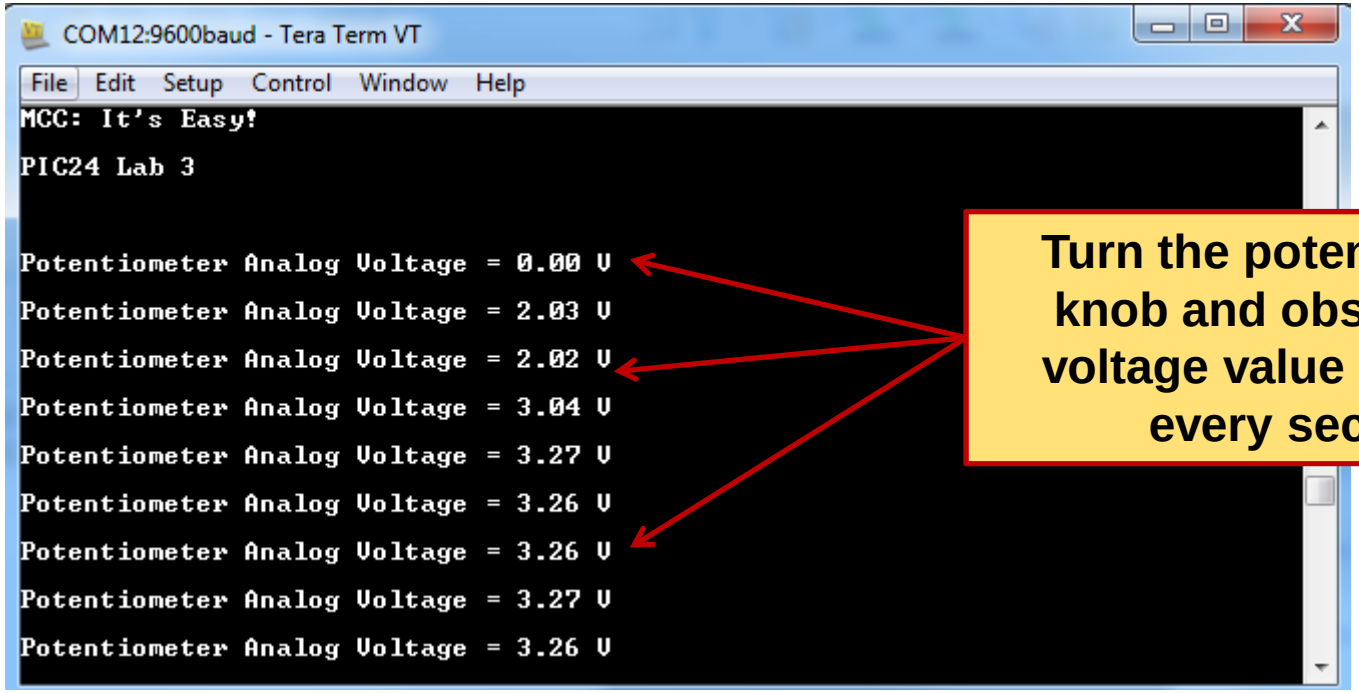
PIC24 Lab 3

- Tera Term shows the potentiometer voltage updating every second



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PIC24 Lab 3 Summary

- We configured TMR1 to use interrupts
- We configured UART2 to use interrupts
- We wrote code to be executed every time the TMR1 interrupt is triggered

PIC24 Lab 4:
Building a Small Application

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PIC24 Lab 4 Objectives

- **Create a menu of commands**
- **Select functions from the menu using push-buttons**
- **From the menu choose between the following operations:**
  - Read Potentiometer using ADC
  - Read Temperature sensor using ADC
  - Toggle a LED once per second

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PIC24 Lab 4 Overview

- Close any files open in the editor, and close all MPLAB® X IDE Projects

- Open lab4_16bit.X

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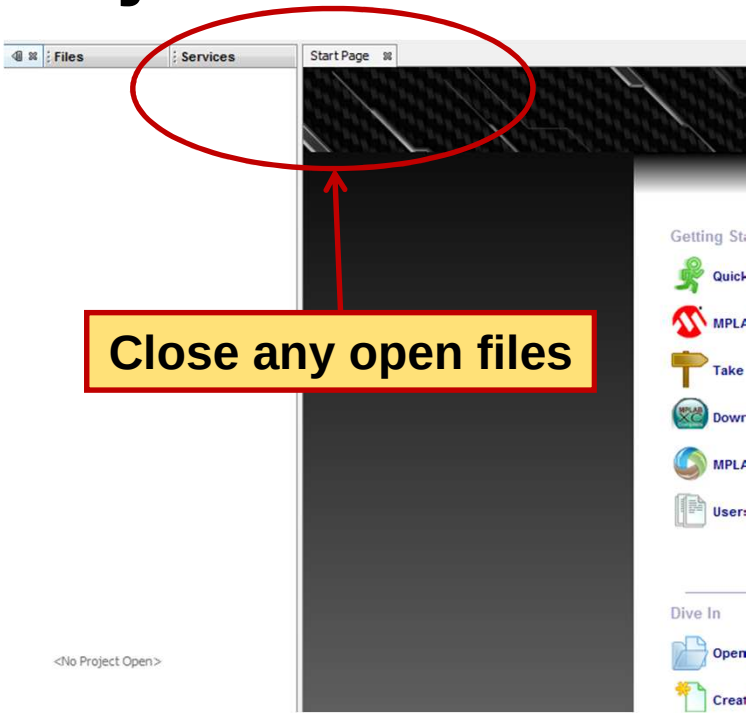
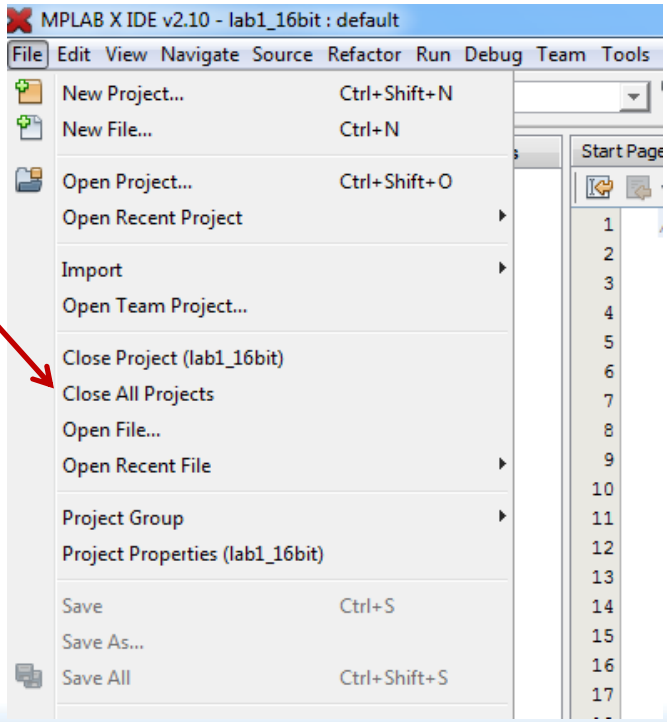
PIC24 Lab 4 Overview

- **Setup TMR1 for multiple initializers**
  - DebounceDelay - 0.03 s
  - DisplayPotDelay - 0.3 s
  - DisplayTempDelay - 0.6 s
  - ToggleDelay - 1 s
- **Setup ADC1**
  - Add AN4, name: TEMP_CHANNEL
- **Setup GPIO**
  - Setup Switch S3 and Switch S6

PIC24 Lab 4

- **Close any open files in the editor window, and all open MPLAB® X IDE projects**





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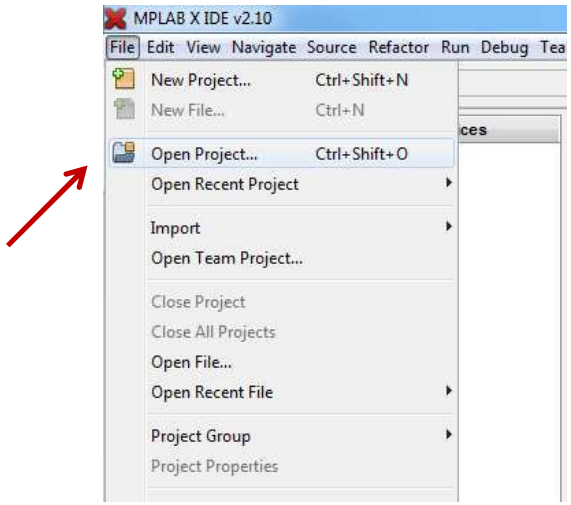
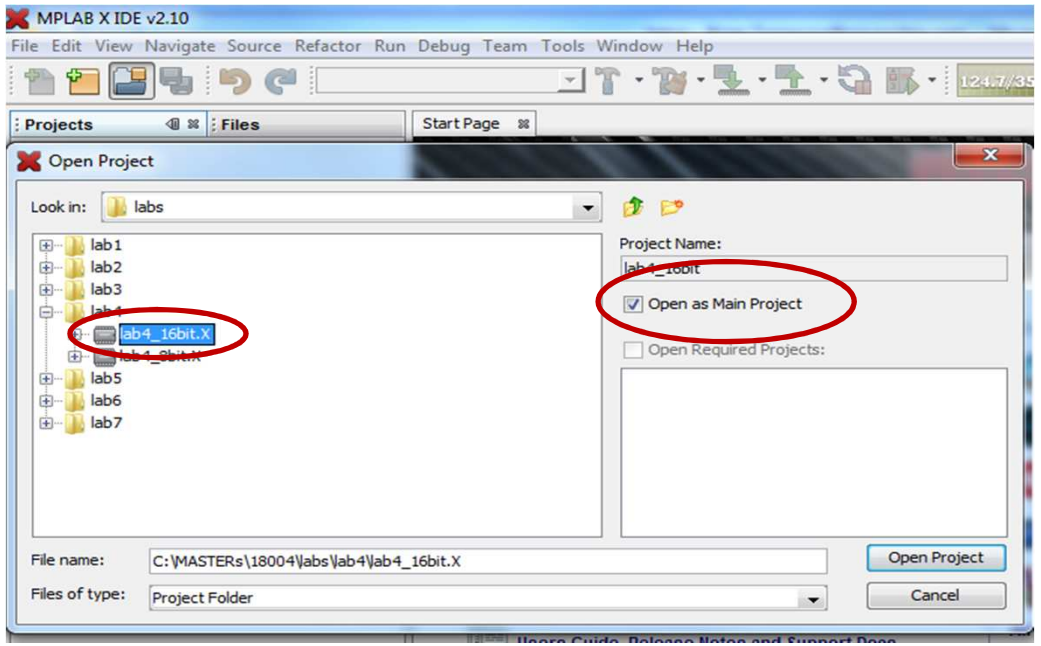
PIC24 Lab 4

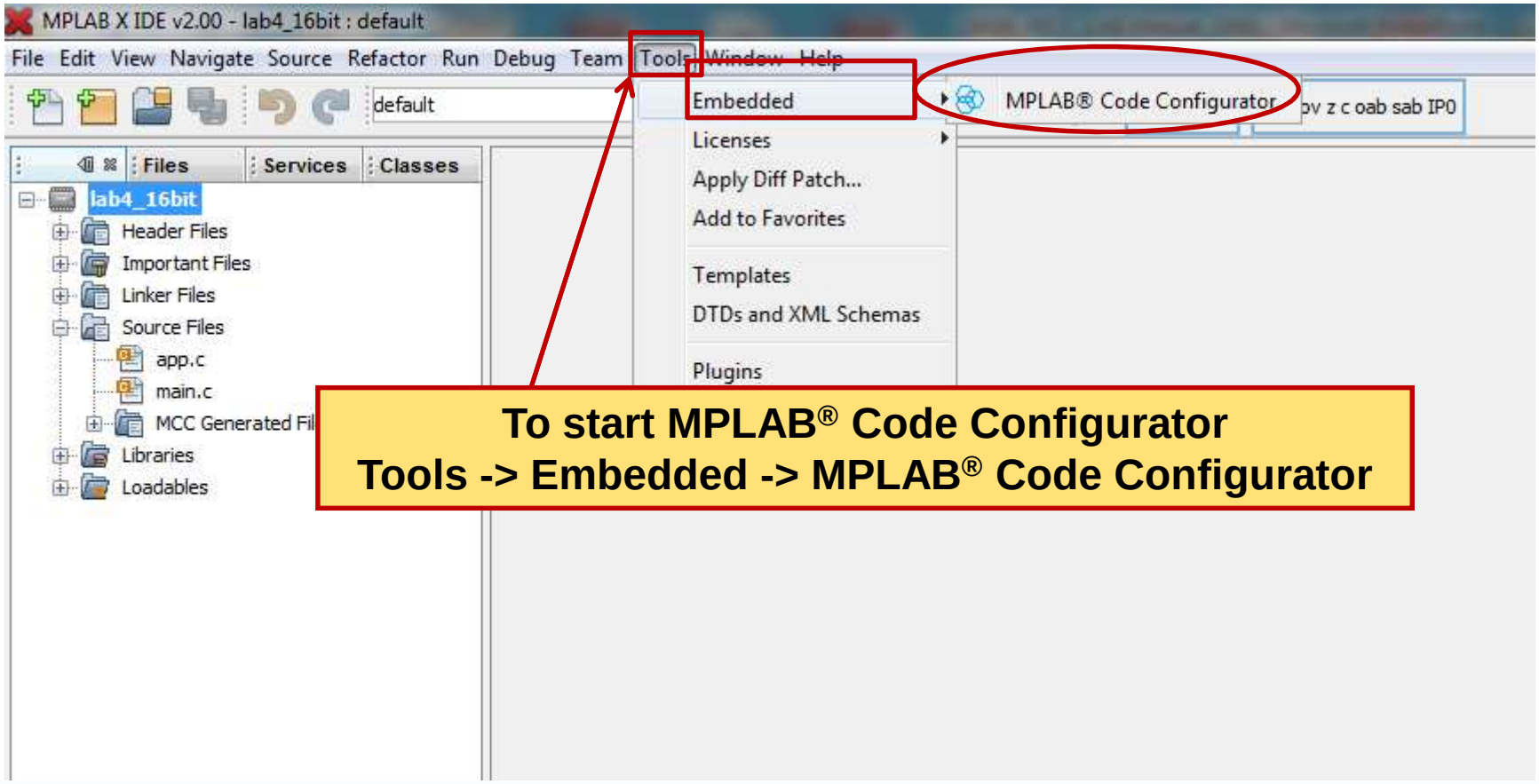
- **Open lab4_16bit.X**





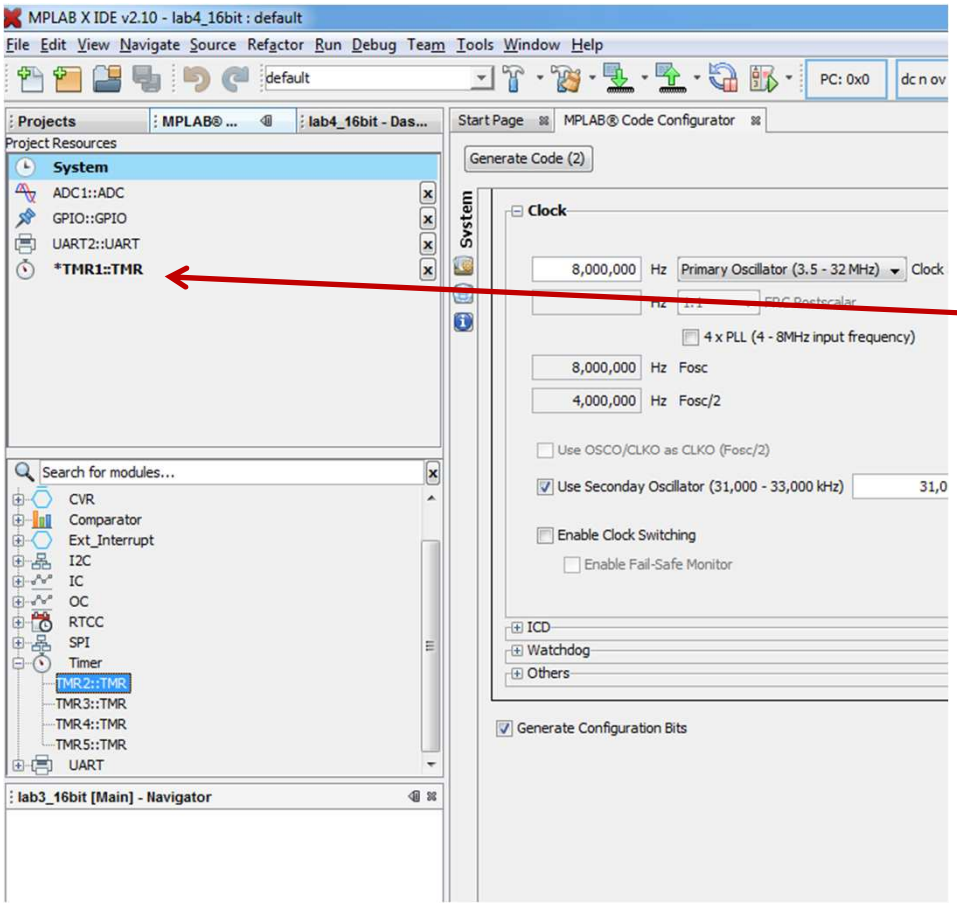
PIC24 Lab 4

- **Start MPLAB® Code Configurator**



PIC24 Lab 4

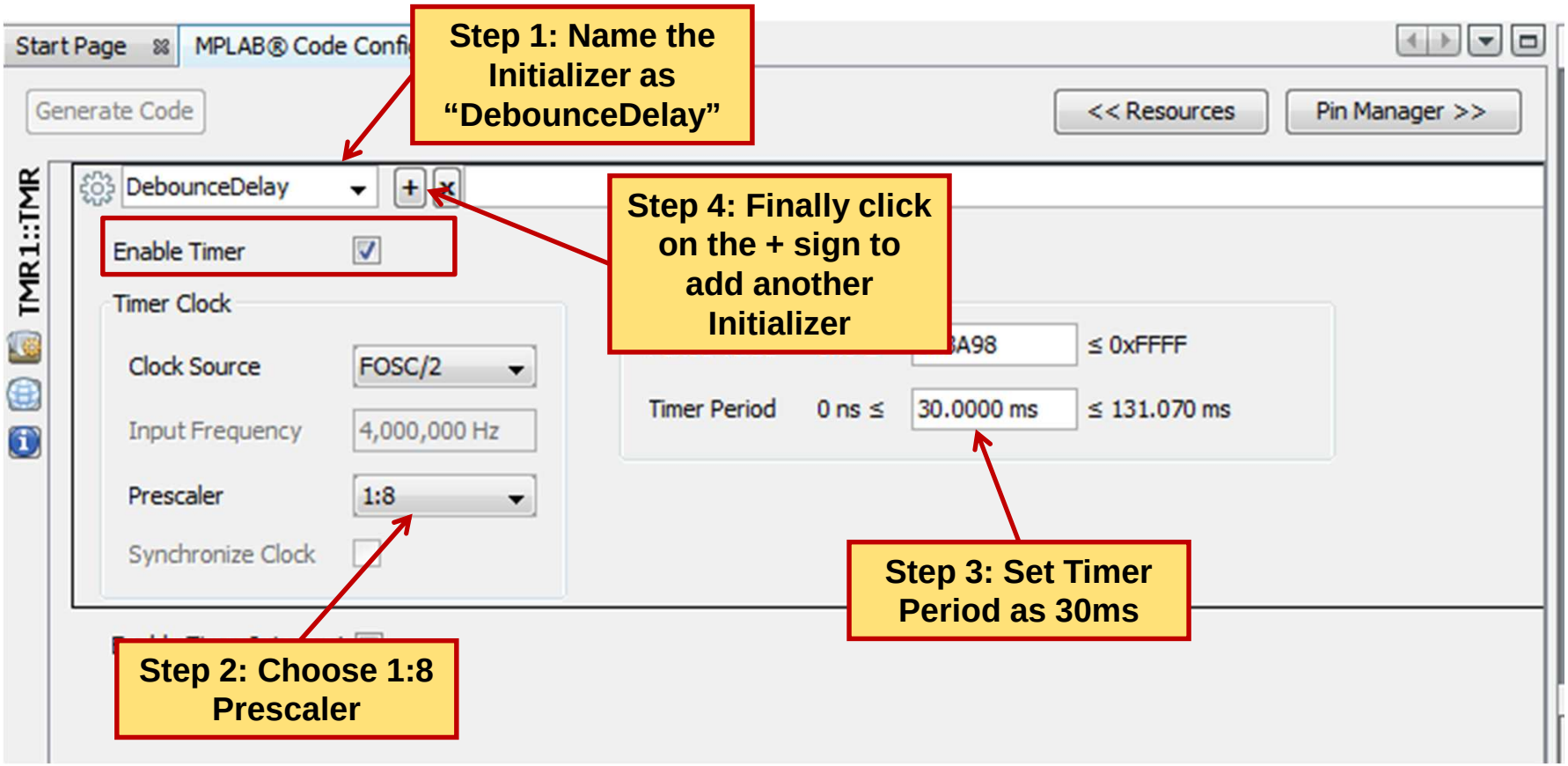
- **Select TMR1**



Select TMR1::TMR from Device Resources and move it to Project Resources.

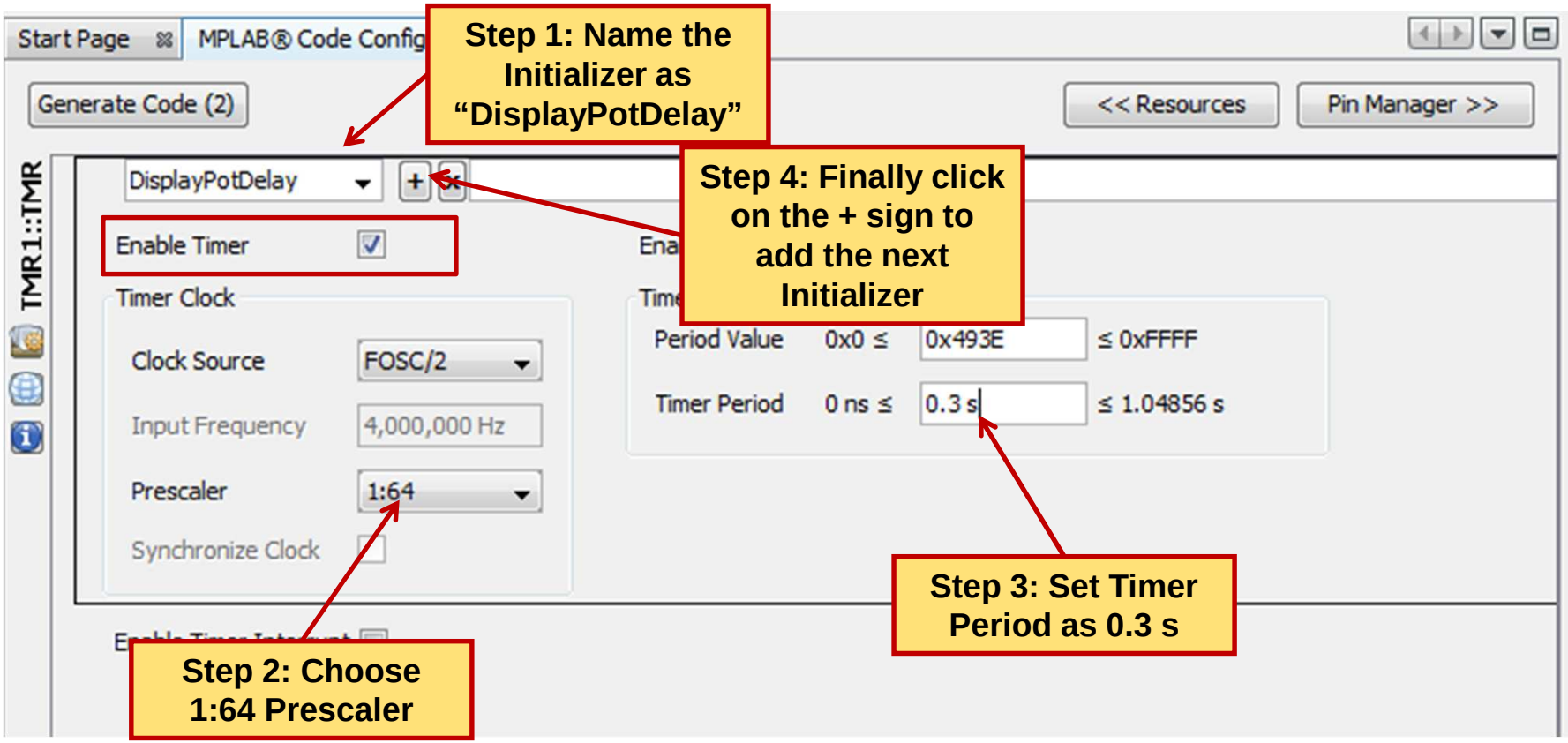
PIC24 Lab 4

- **Add DebounceDelay Initializer**



PIC24 Lab 4

- **Add DisplayPotDelay Initializer**



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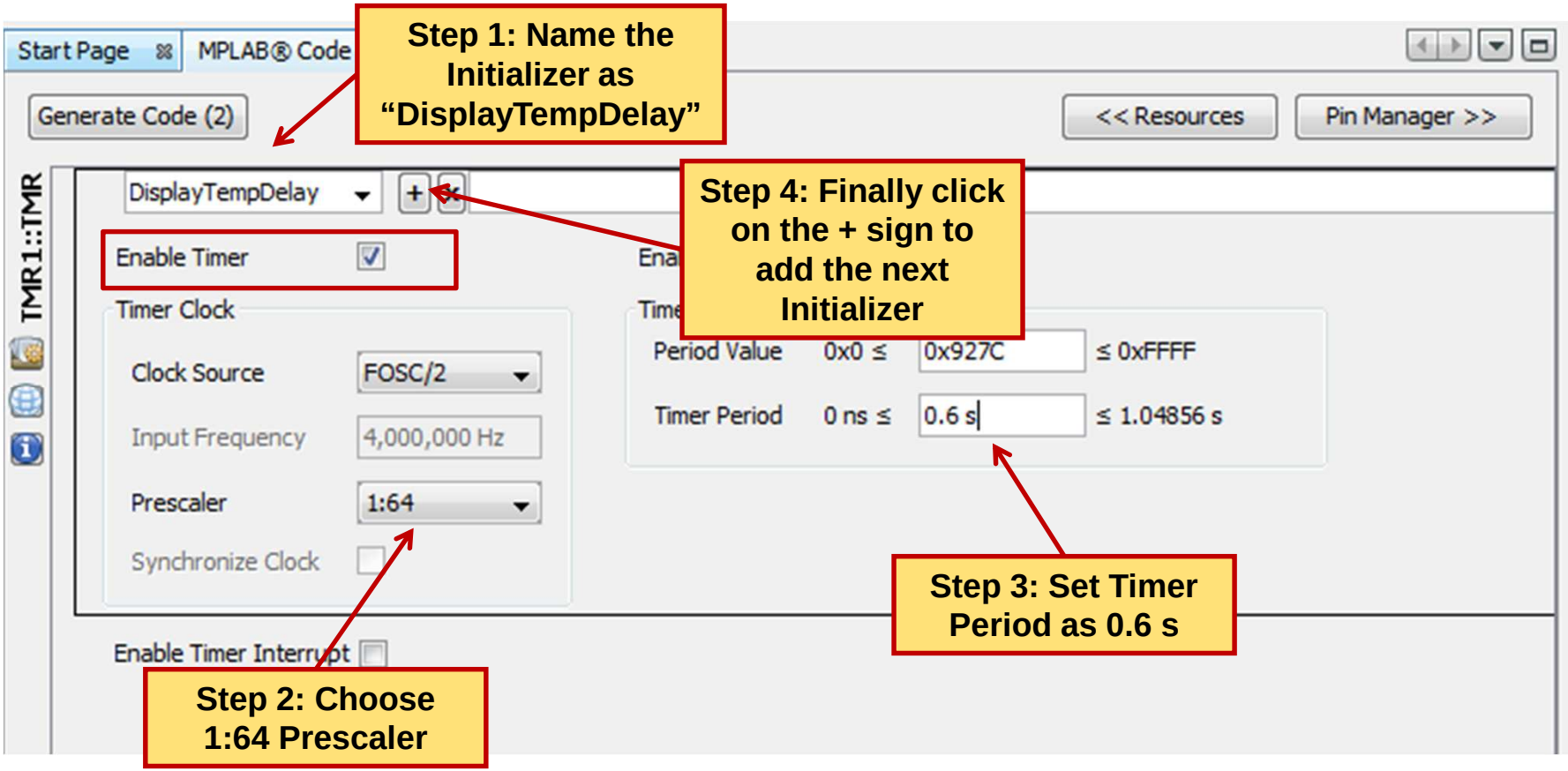
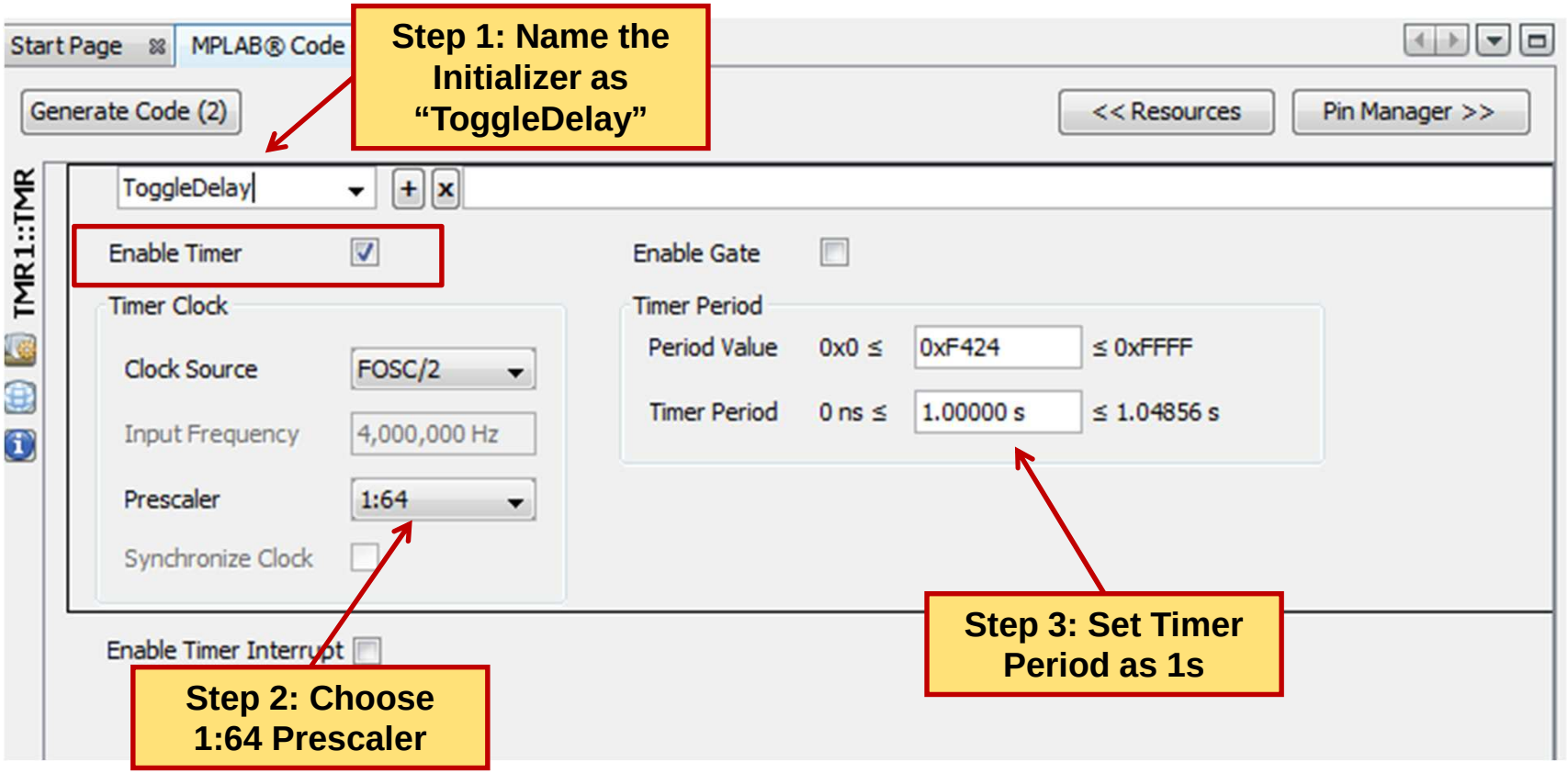
PIC24 Lab 4

- **Add DisplayTempDelay Initializer**



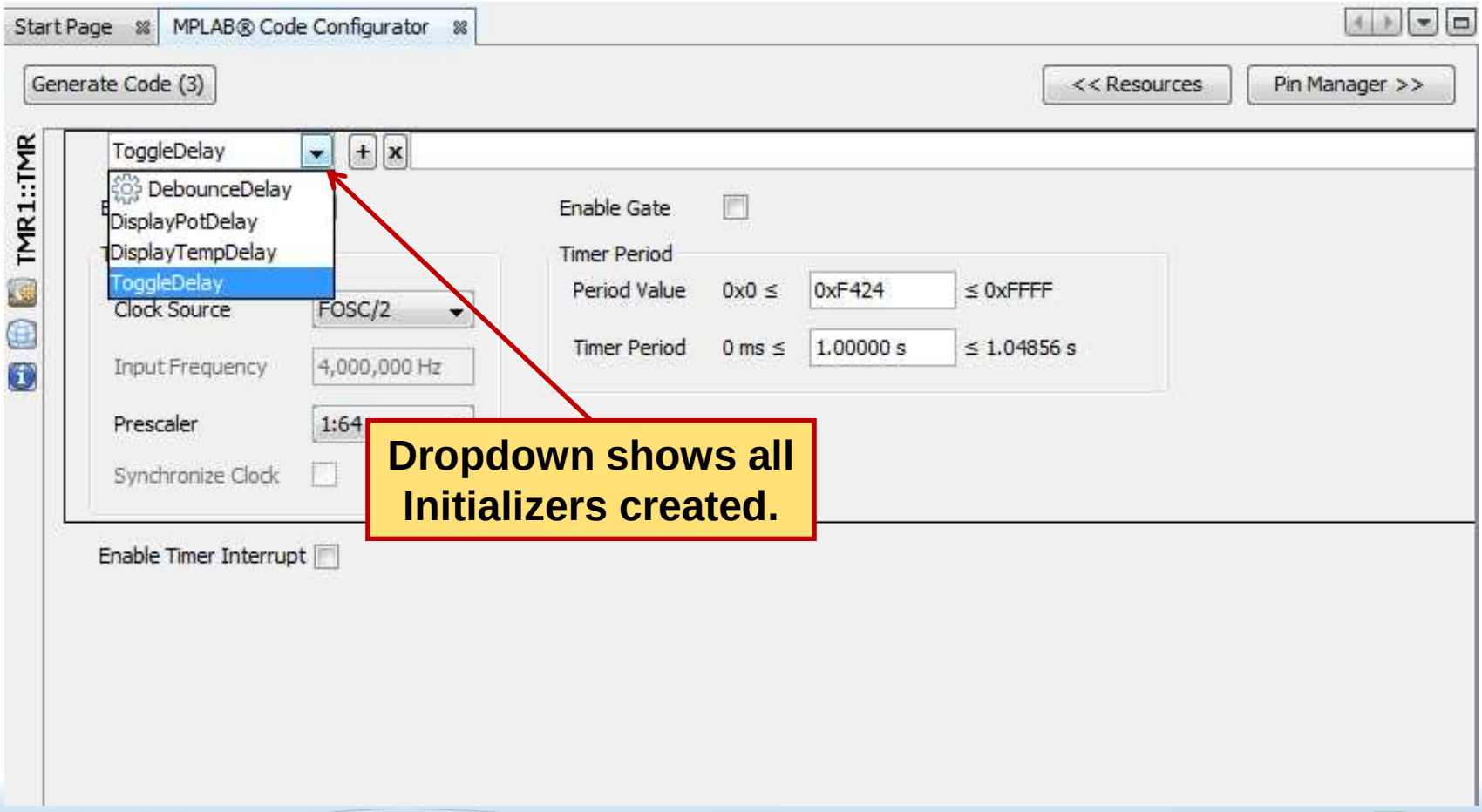
PIC24 Lab 4

- **Add ToggleDelay Initializer**



PIC24 Lab 4

- **Use dropdown to see all initializers added**



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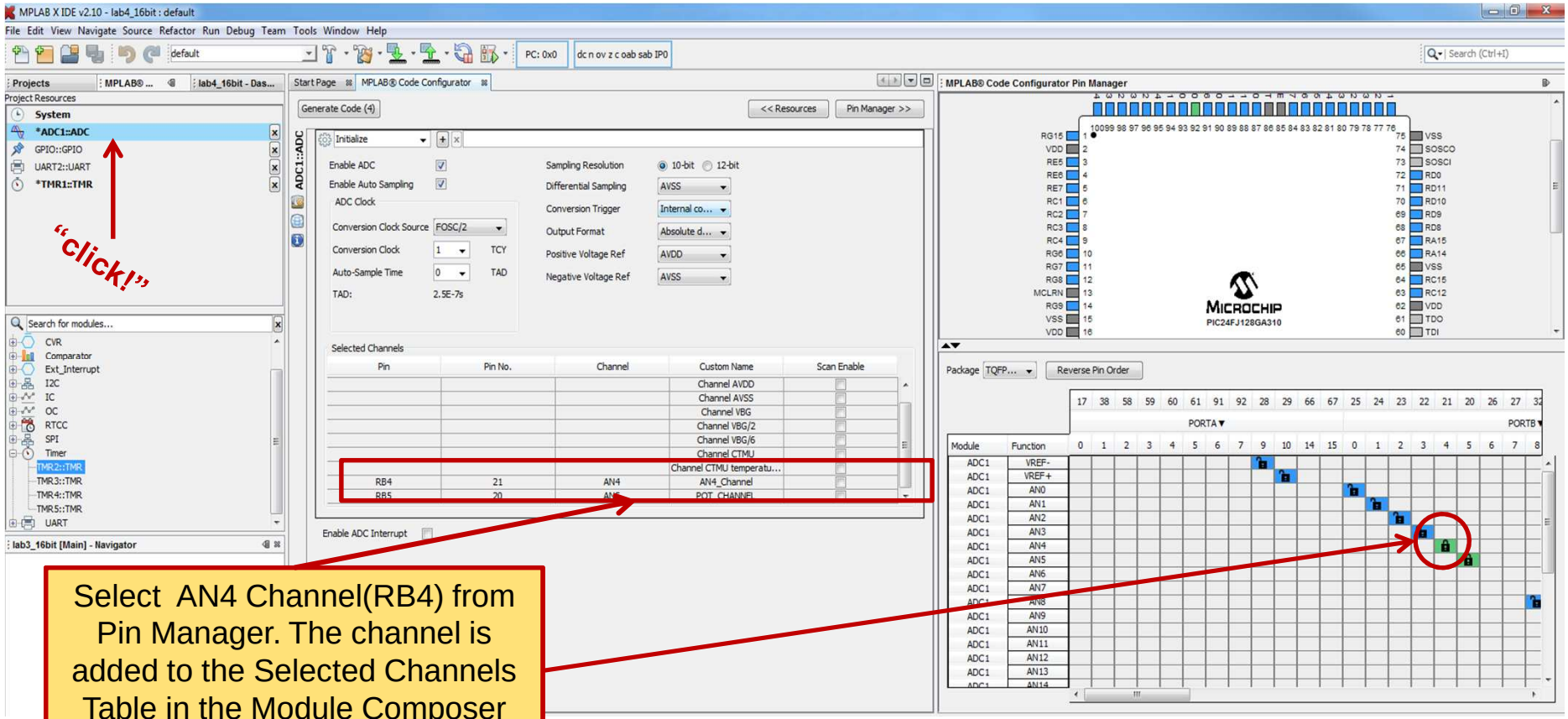
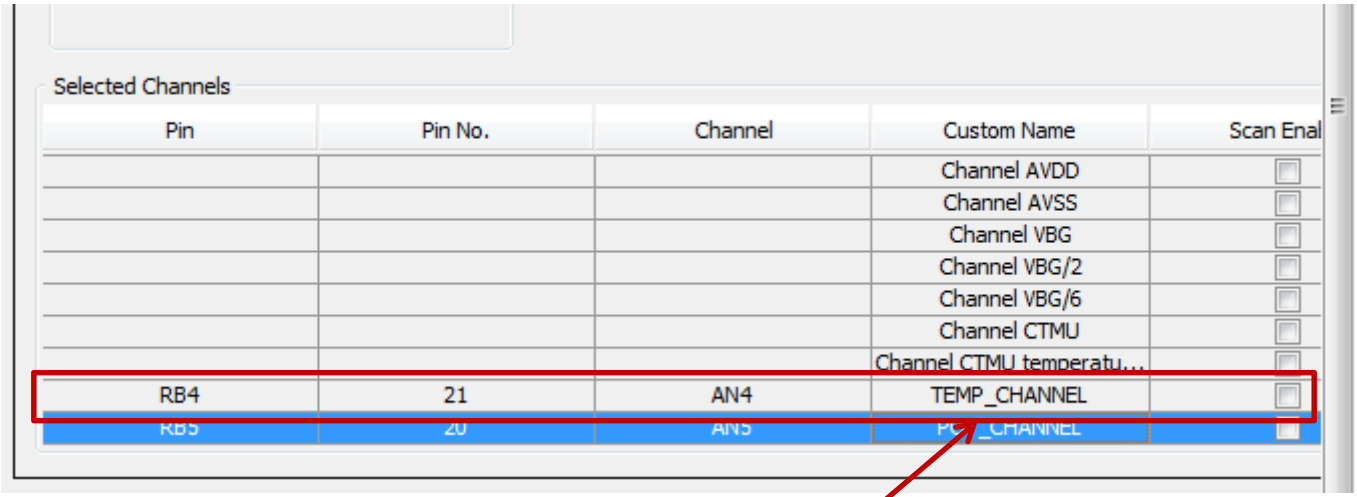
PIC24 Lab 4

- **Add AN4 Channel to ADC Configuration**



PIC24 Lab 4

- **Rename AN4_Channel as TEMP_CHANNEL**



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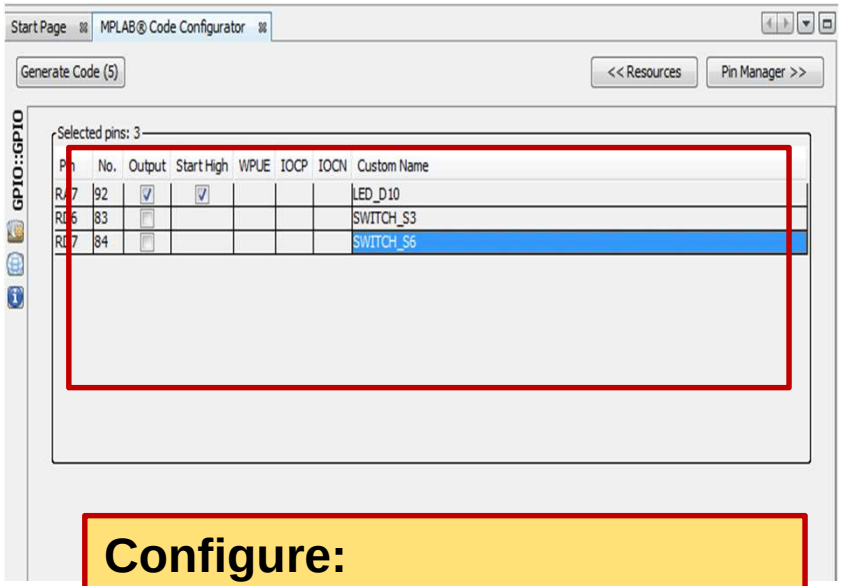
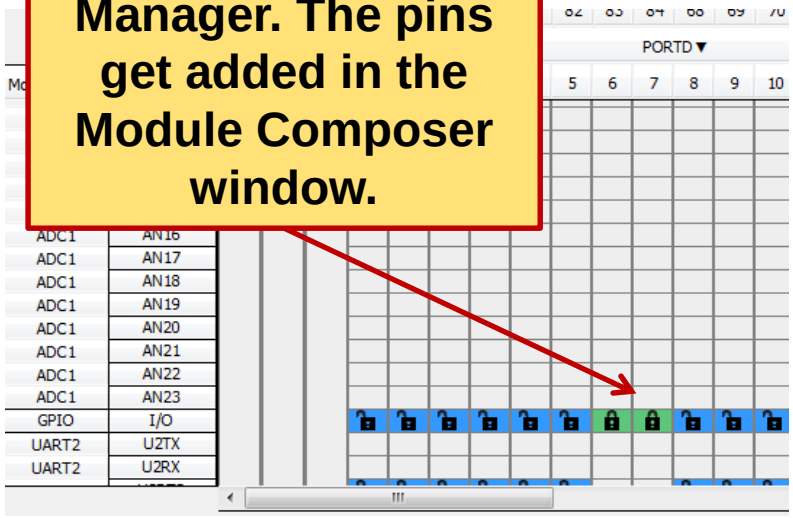
PIC24 Lab 4

- **Configure the added GPIO Pins**



Configure:
→RD6 as input. Rename it as SWITCH_S3
→RD7 as input. Rename it as SWITCH_S6

Add RD6 and RD7 pins from the GPIO row in the Pin Manager. The pins get added in the Module Composer window.



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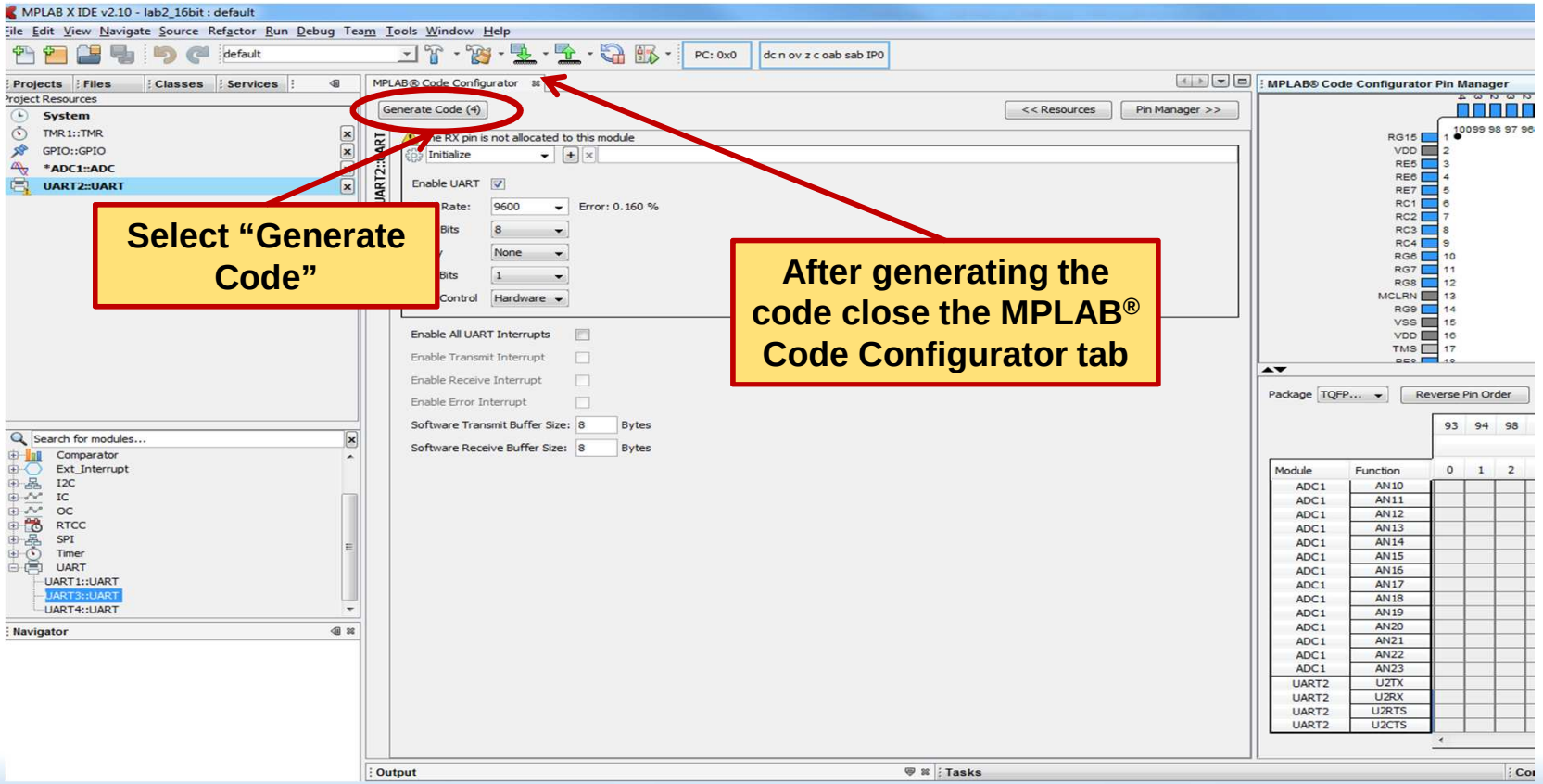
PIC24 Lab 4

- **Generate the code and close MPLAB® Code Configurator**



PIC24 Lab 4

- Open main.c and add the following code

Start Page | MPLAB® Code Configurator | main.c

```
68
69          if(currentOption == 0)
70          {
71              while(!lastKeyPressed)
72              {
73                  /*Select temperature sensor as ADC input*/
74                  DRV_ADC1_ChannelSelect(DRV_ADC1_TEMP_CHANNEL);
75                  DRV_ADC1_Start();
76
77                  adcResult = DRV_ADC1_ConversionGet();//Digital value is read
78                  double res = GetTempSensorResult(adcResult);
79
80                  /*Delete the current line and set cursor to beginning of the current line*/
81                  sprintf(bufferWrite, "\033[2K\033[8;0H");
82                  Write2UART(bufferWrite, strlen(bufferWrite));
83
84                  /*Temperature value is transmitted over UART*/
85                  sprintf(bufferWrite, "\r\n    Temperature = %f%cC or %f%cF \r\n", res, 248, (doub
86                  Write2UART(bufferWrite, strlen(bufferWrite));
87
88                  DRV_TMR1_DisplayTempDelay();
89                  DRV_TMR1_Start();
90                  while(!DRV_TMR1_GetElapsedThenClear())
91                  {
92                      DRV_TMR1_Tasks();
93                      if(!lastKeyPressed)
94                      {
95                          lastKeyPressed = GetKeyPressed();
96                      }
97                  }
98              }
99          }
100         else if(currentOption == 1)
101         {
102             while(!lastKeyPressed)
```

PIC24 Lab 4

- Open main.c and add the following code

Start Page | MPLAB® Code Configurator | main.c

```
99          }
100         else if(currentOption == 1)
101         {
102             while(!lastKeyPressed)
103             {
104                 /*Select potentiometer as ADC input*/
105                 DRV_ADC1_ChannelSelect(DRV_ADC1_POT_CHANNEL);
106                 DRV_ADC1_Start();
107
108                 adcResult = DRV_ADC1_ConversionGet();//Digital value is read
109                 ConvertADCVoltage(adcResult);
110
111                 /*Delete the current line and set cursor to beginning of the current line*/
112                 sprintf(bufferWrite, "\033[2K\033[8;0H");
113                 Write2UART(bufferWrite, strlen(bufferWrite));
114
115                 /*Potentiometer value is transmitted over UART*/
116                 sprintf(bufferWrite, "\r\n    Potentiometer Voltage = %d.%d%d V \r\n",adones, adt
117                 Write2UART(bufferWrite, strlen(bufferWrite));
118
119                 DRV_TMR1_DisplayPotDelay();
120                 DRV_TMR1_Scale();
121                 while(!DRV_TMR1_GetElapsedThenClear())
122                 {
123                     DRV_TMR1_Tasks();
124                     if(!lastKeyPressed)
125                     {
126                         lastKeyPressed = GetKeyPressed();
127                     }
128                 }
129             }
130         }
131         else if(currentOption == 2)
132         {
133             /*Delete the current line and set cursor to beginning of the current line*/
```

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PIC24 Lab 4

- Open main.c and add the following code

Start Page | MPLAB® Code Configurator | main.c

```
120                 DRV_TMR1_Start();
121                 while(!DRV_TMR1_GetElapsedThenClear())
122                 {
123                     DRV_TMR1_Tasks();
124                     if(!lastKeyPressed)
125                     {
126                         lastKeyPressed = GetKeyPressed();
127                     }
128                 }
129             }
130         }
131         else if(currentOption == 2)
132         {
133             /*Delete the current line and set cursor to beginning of the current line*/
134             sprintf(bufferWrite, "\033[2K\033[8;0H");
135             Write2UART(bufferWrite, strlen(bufferWrite));
136
137             /*Potentiometer value is transmitted over UART*/
138             sprintf(bufferWrite, "\r\n    LED D10 toggles at every 1 second \r\n");
139             Write2UART(bufferWrite, strlen(bufferWrite));
140
141             DRV_TMR1_ToggleDelay();
142             DRV_TMR1_Start();
143             while(!lastKeyPressed)
144             {
145                 lastKeyPressed = GetKeyPressed();
146                 DRV_TMR1_Tasks();
147                 if(DRV_TMR1_GetElapsedThenClear())
148                 {
149                     LED_D10_Toggle();// Toggle LED
150                 }
151             }
152         }
153     }
154
```

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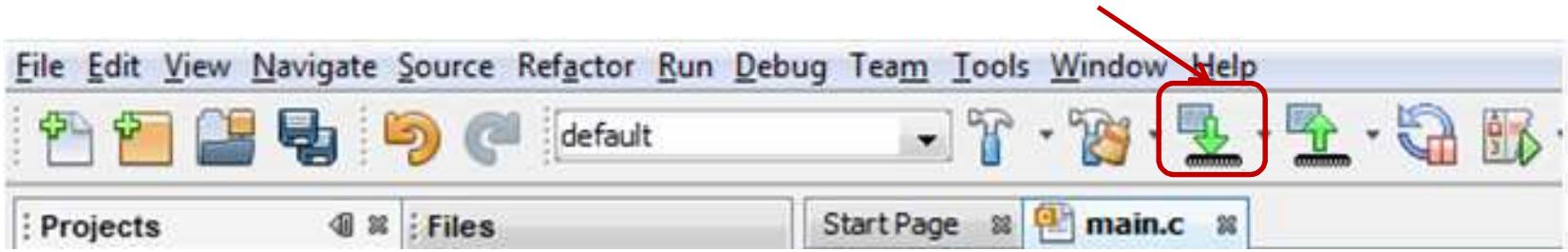
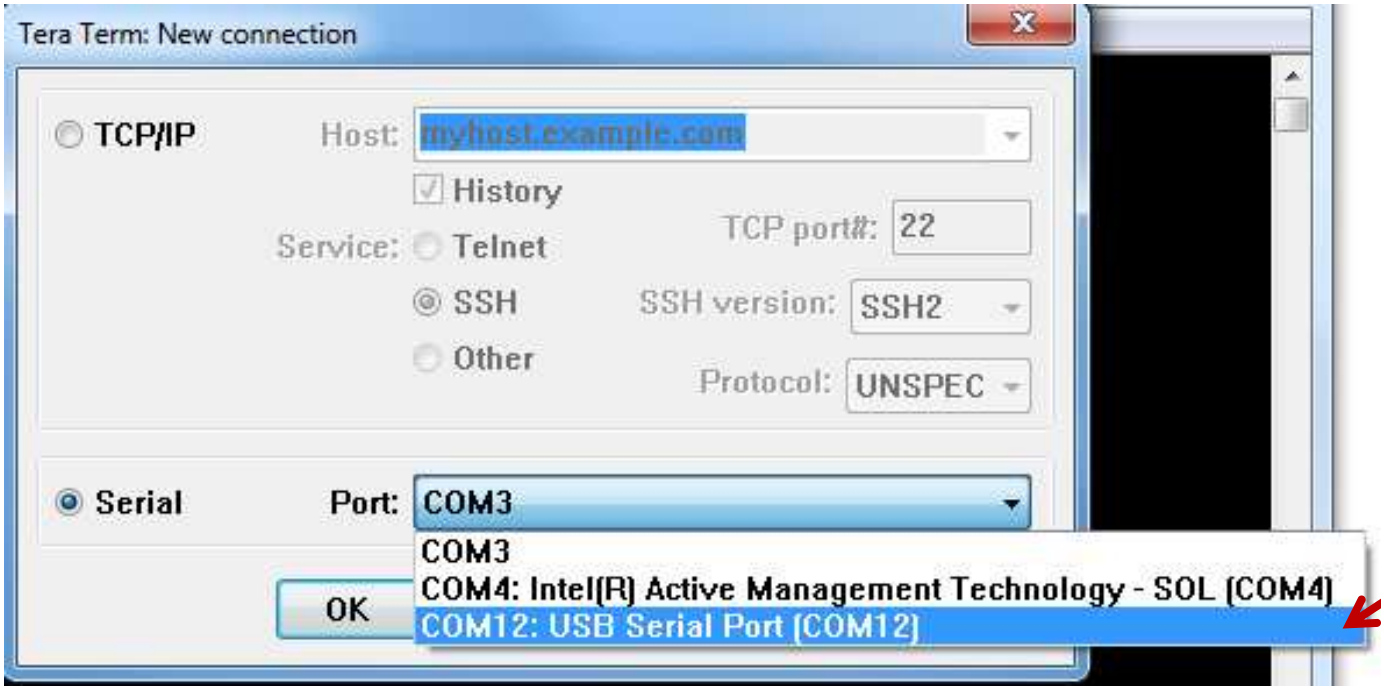
PIC24 Lab 4

- **“Make and Program” the project**



PIC24 Lab 4

- **Start Tera Term**
- **Select the USB Serial Port**



Open "Tera Term" from your desktop and set up a new connection. Choose the COMx: USB Serial Port

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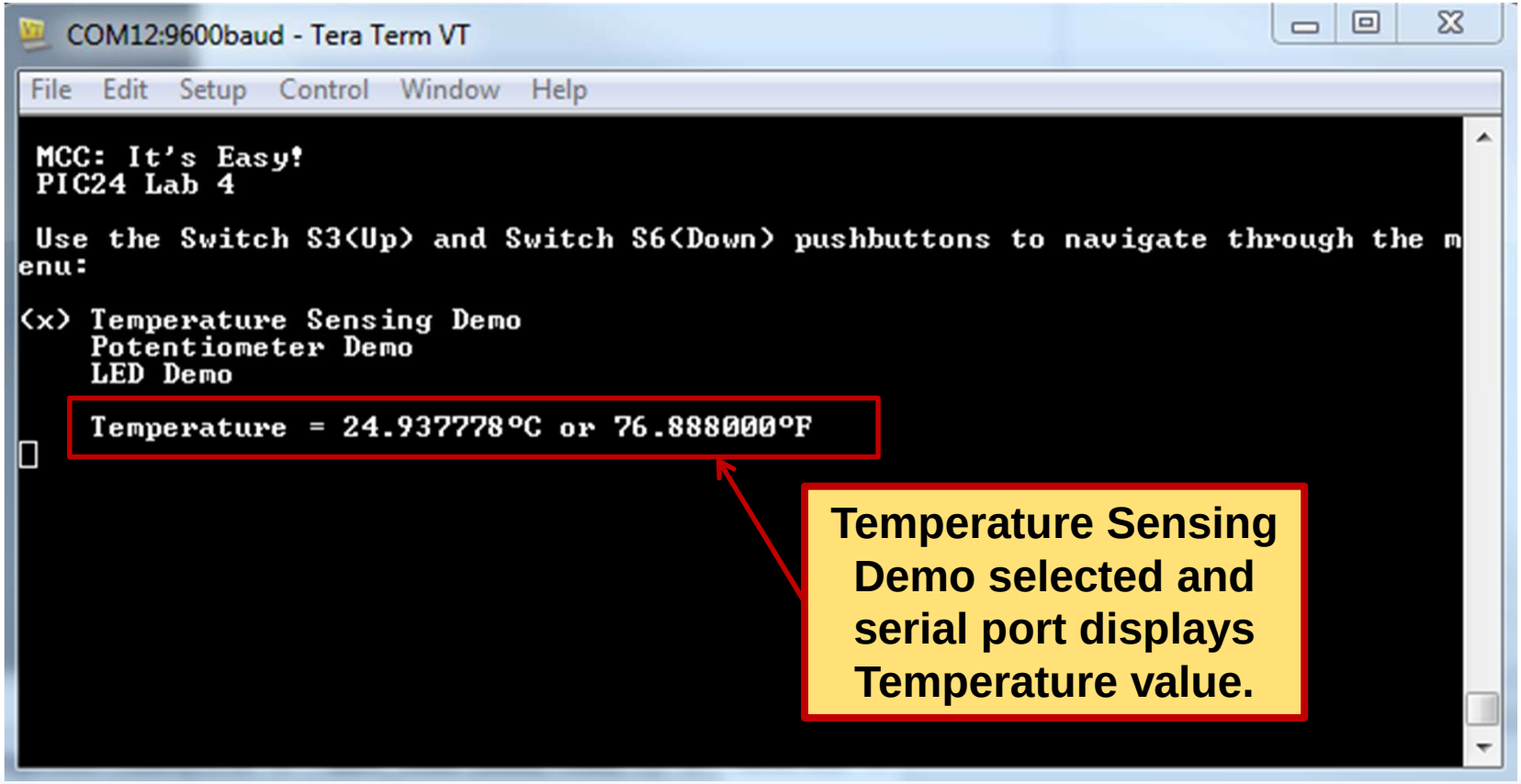
PIC24 Lab4

Scroll through the Menu using Switch S3 and Switch S6



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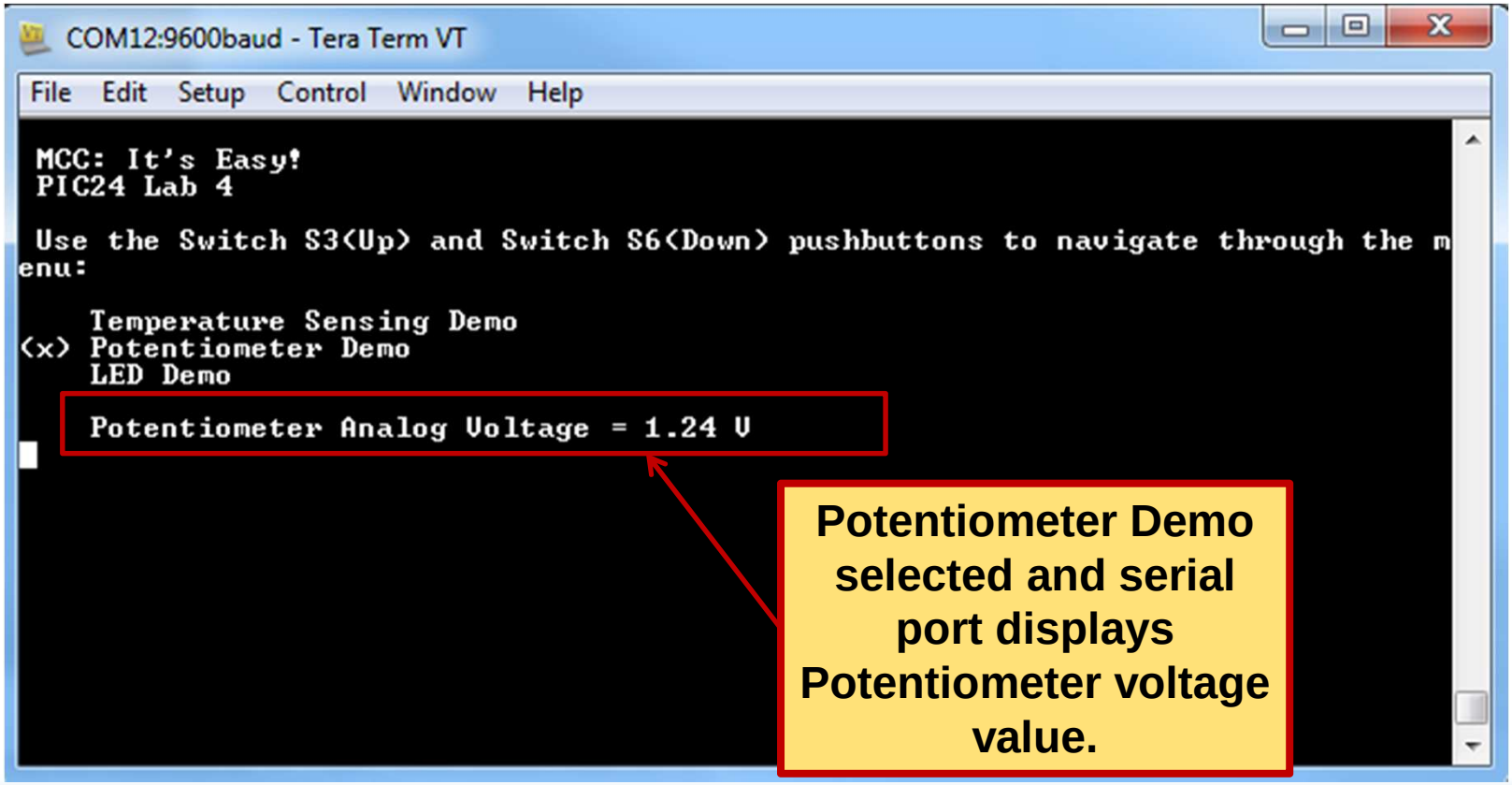
PIC24 Lab 4

Use Switch S6 to choose Potentiometer Demo



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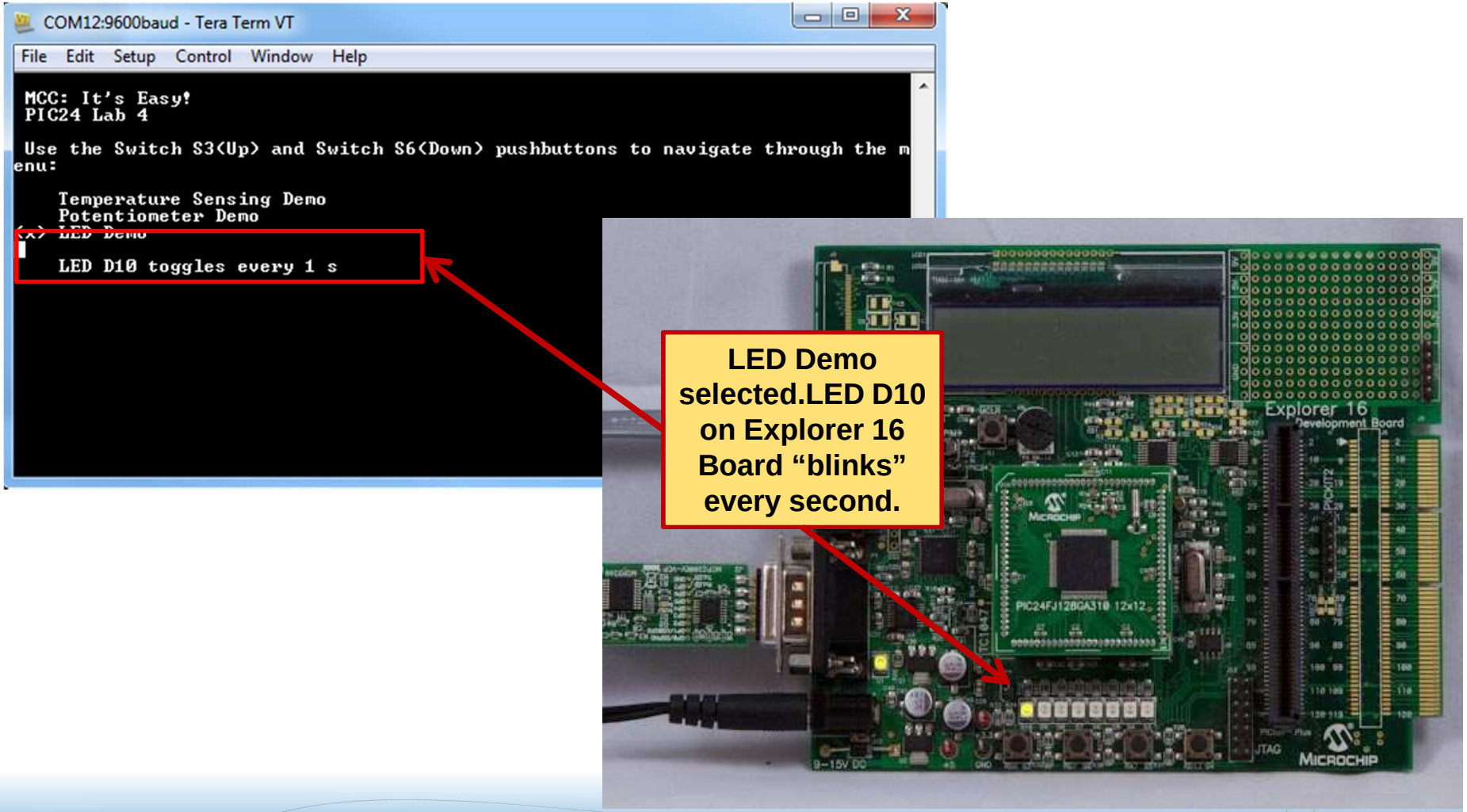
PIC24 Lab 4

Use Switch S6 to choose LED Demo



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PIC24 Lab 4 Summary

- We configured multiple initializers in the Timer module

- We configured pushbuttons to navigate through a menu of commands and perform different tasks

PIC24 Lab 5:
I²C Communication

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PIC24 Lab 5 Objectives

- Communication using I^2C
- Configure and use I^2C to read and write data into I^2C EEPROM Slave
- Configure UART to receive feedback messages

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PIC24 Lab 5 Overview

- Close any files open in the editor, and close all MPLAB® X IDE Projects
- Open lab5_16bit.X
- Install the I²C EEPROM PIM
- Setup I²C1 Master
  - Setup Baud Rate Generator Value as 5

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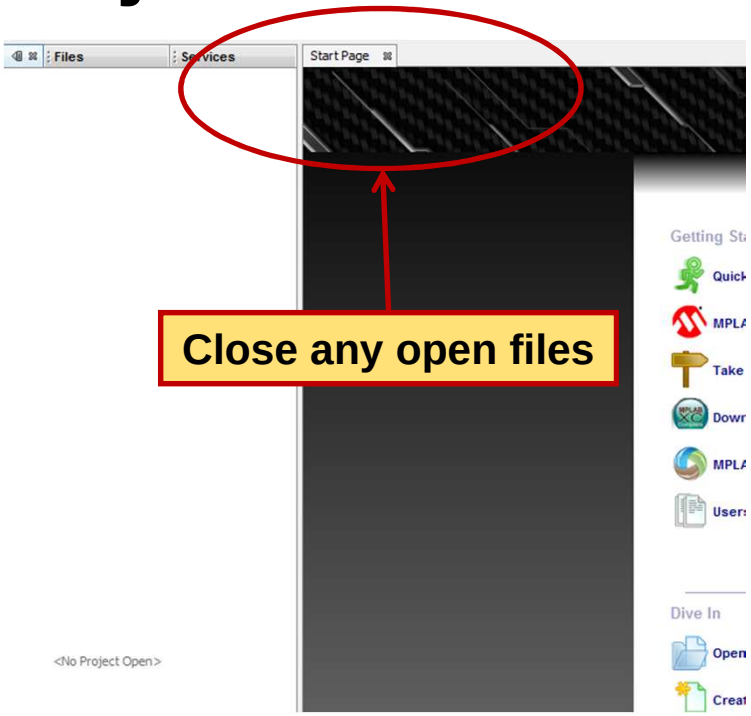
PIC24 Lab 5

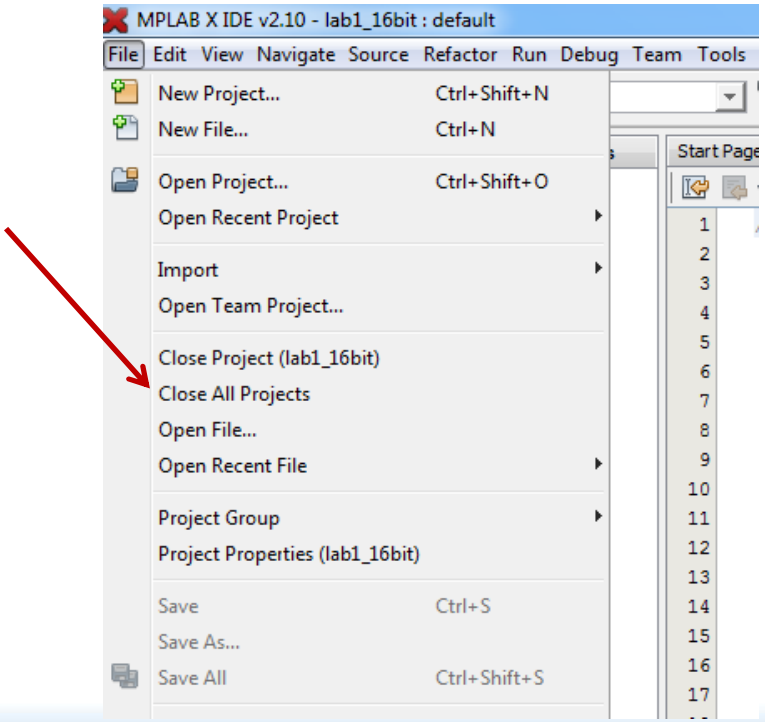
- Remove power from the Explorer 16 Board

- Install the I²C EEPROM
- Reconnect the Power to the board

PIC24 Lab 5

- Close any open files in the editor window, and all open MPLAB® X IDE projects





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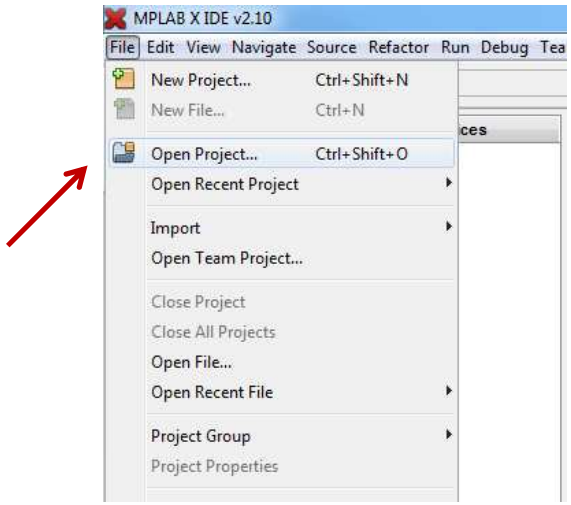
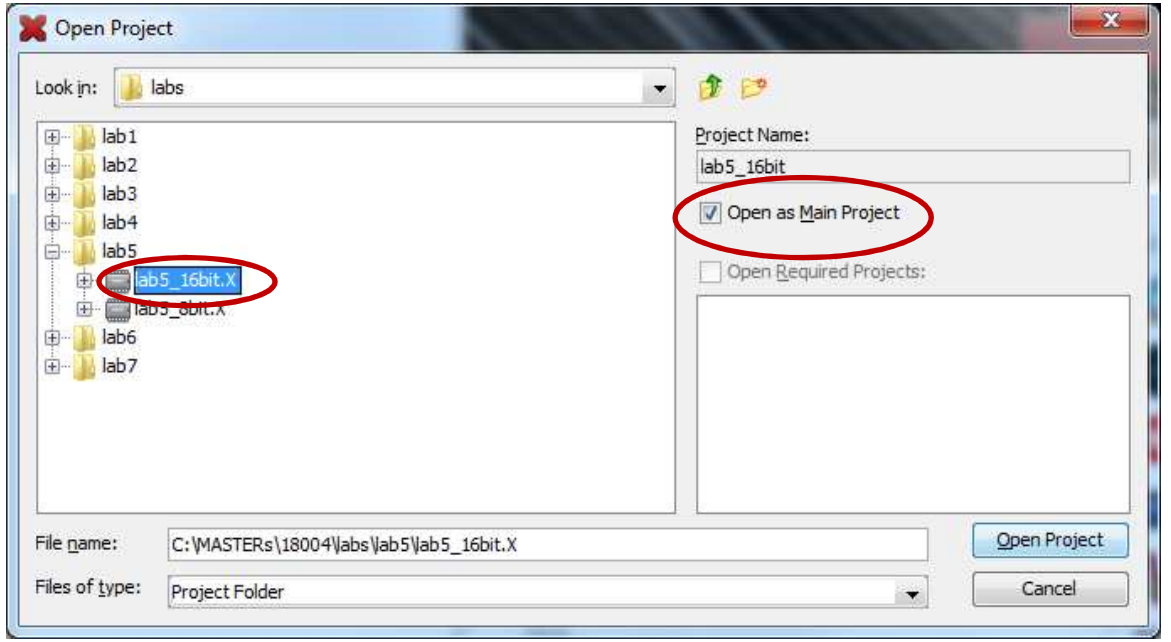
PIC24 Lab 5

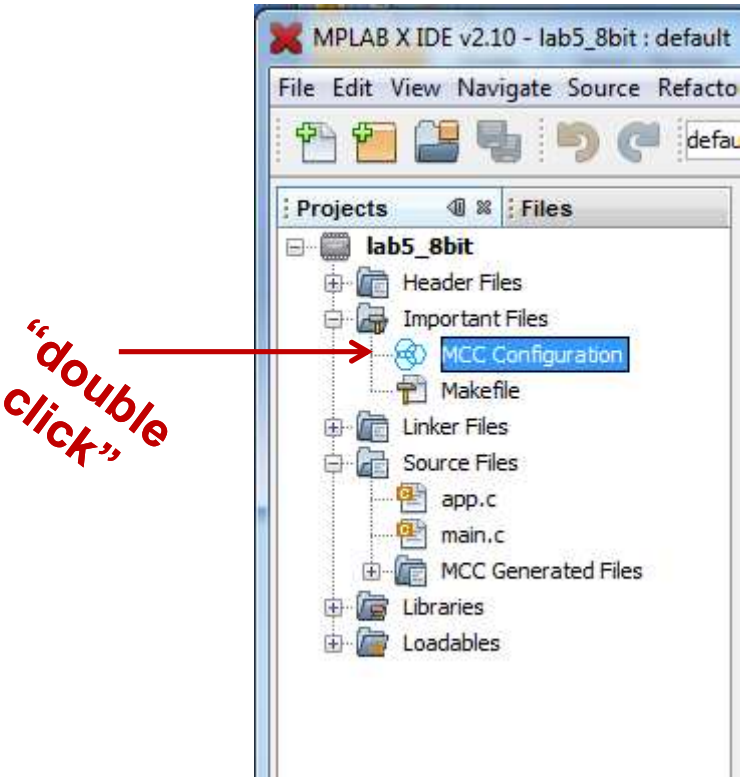
- **Open lab5_16bit.X**





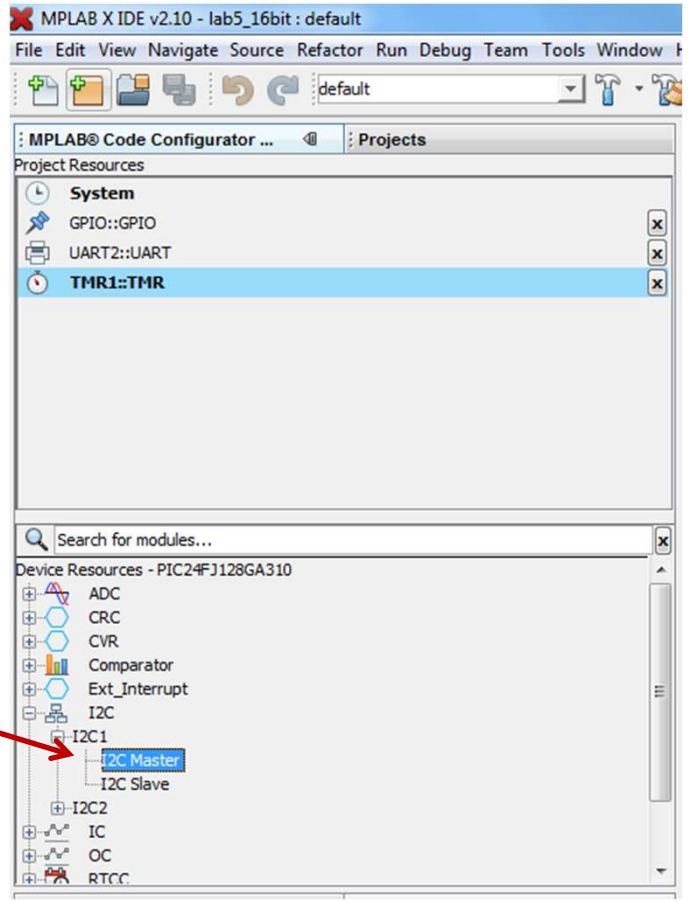
PIC24 Lab 5

- **Start MPLAB® Code Configurator**



PIC24 Lab 5

- Select I²C1 Master from Device Resources



Double Click on I²C1 and Double click on I²C Master

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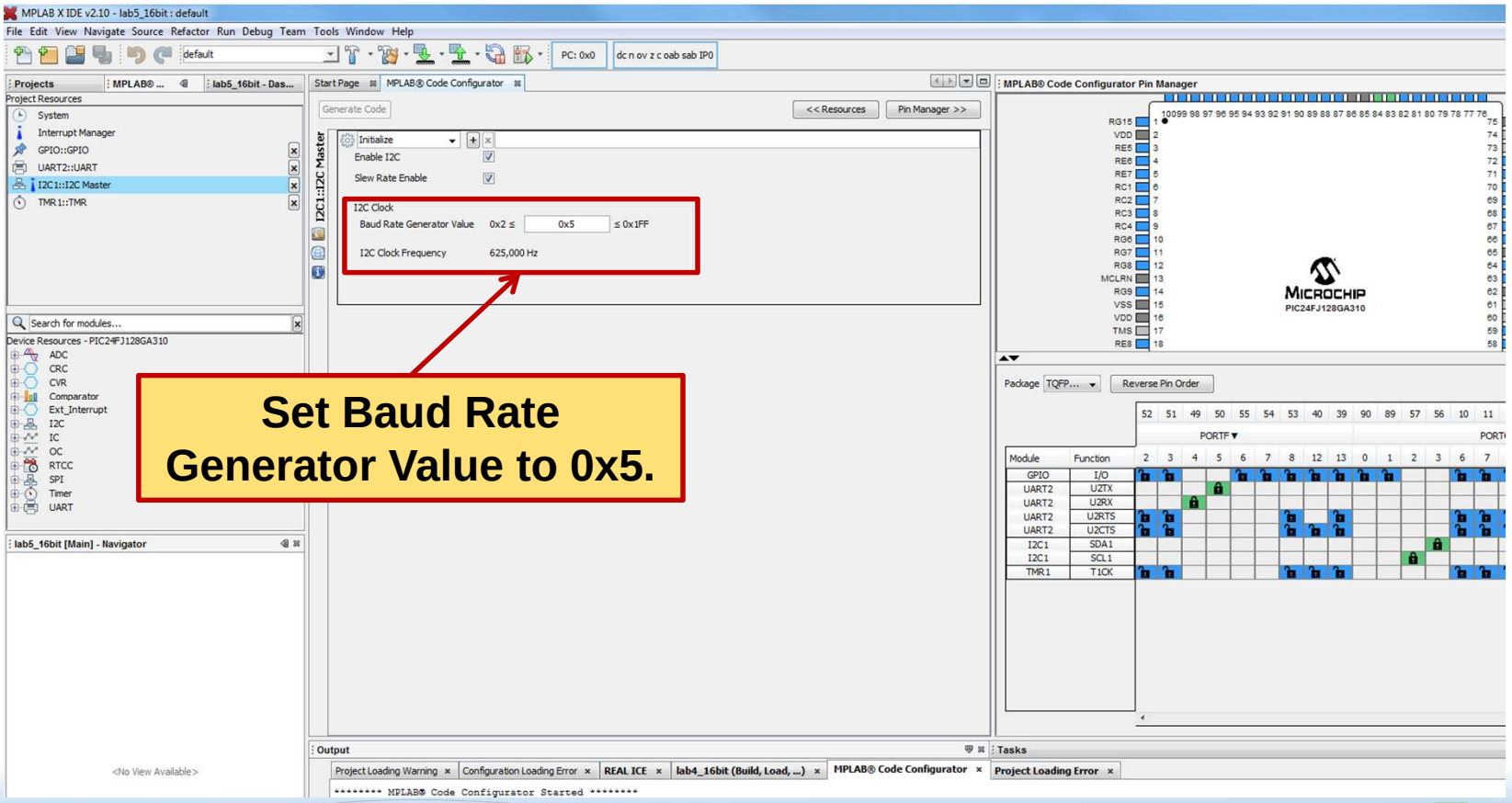
PIC24 Lab 5

- **Configure the I²C module**



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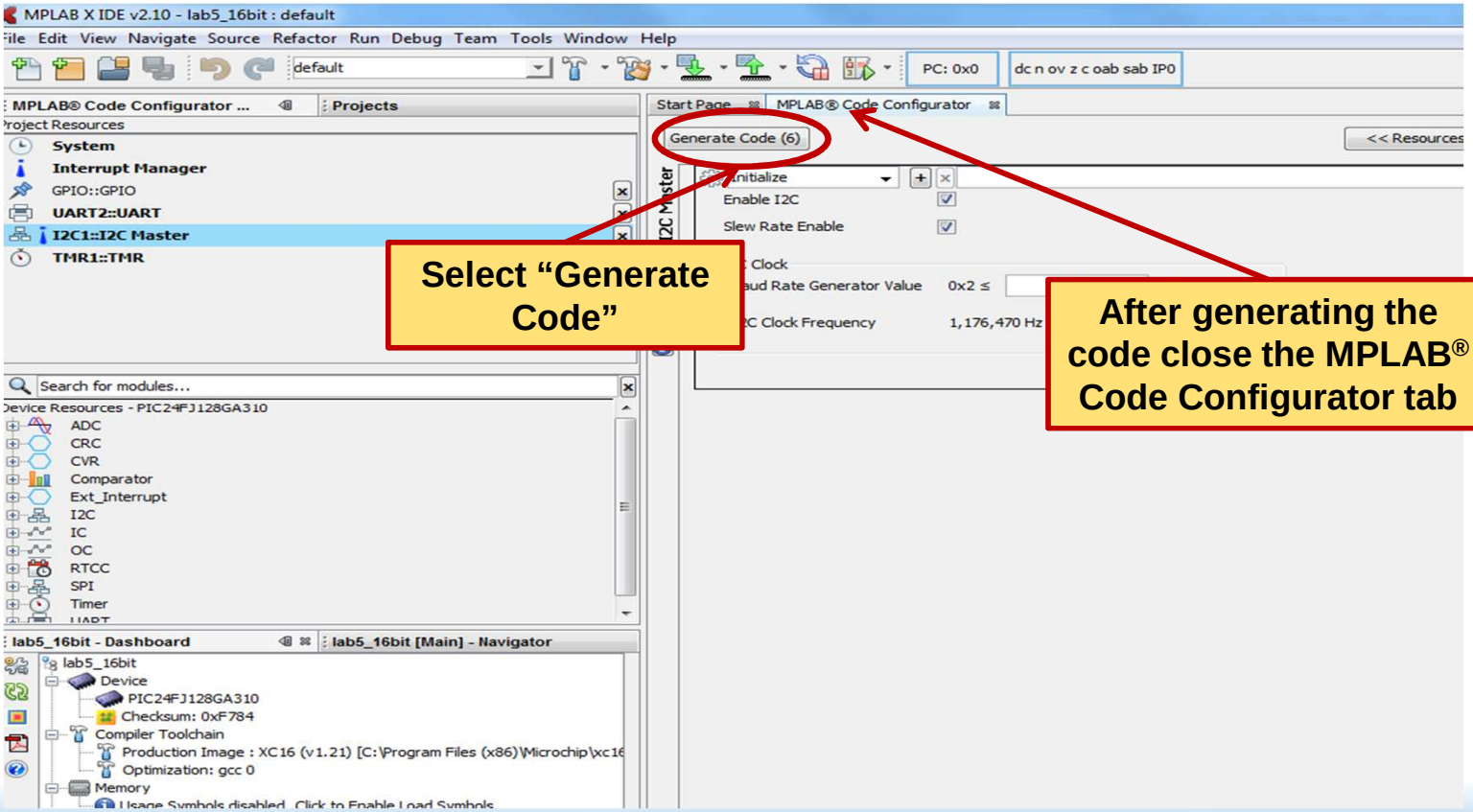
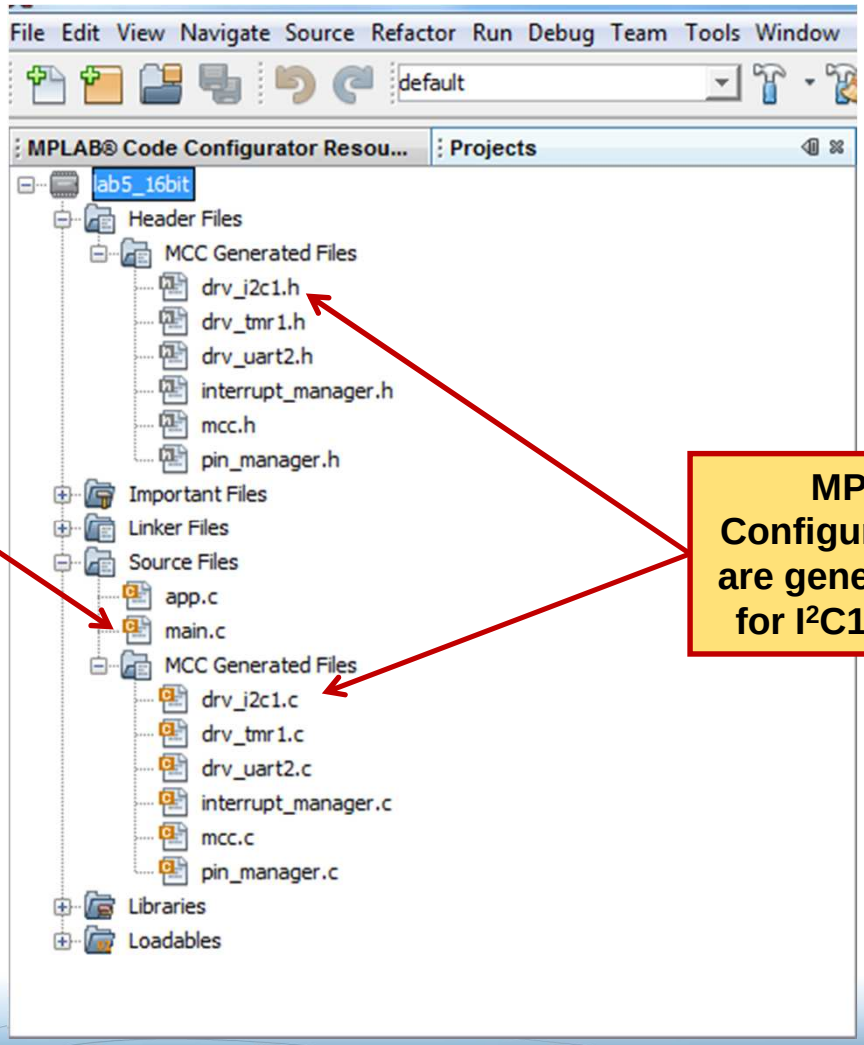
PIC24 Lab 5

- **Generate the code and close MPLAB® Code Configurator**



PIC24 Lab 5

- Generated files added to the project



Open main.c

MPLAB® Code Configurator driver files are generated and added for I²C1 Master module

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PIC24 Lab 5

- **Open main.c and fill in code**

```
while (1)
{
    // Add your application code

    if(1 == GetKeyPressed())
    {
        pressedKey = 0;
        //Write Data to EEPROM
        DRV_I2C1_MasterWrite(eepromWriteBuffer,sizeof(eepromWriteBuffer),I2C_SLAVE_ADDRESS,&i2cStatus);
        //delay to complete I2C Write
        DRV_TMR1_EepromDelay();
        while(!DRV_TMR1_GetElapsedThenClear())
        {
            DRV_TMR1_Tasks();
        }
        DRV_TMR1_Stop();

        sprintf(bufferWrite, "\r\nEEPROM Write was executed\r\n");
        Write2UART(bufferWrite, strlen(bufferWrite));
    }
    else if(2 == GetKeyPressed())
```

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PIC24 Lab 5

- **Open main.c and fill in code**

```
    Write2UART(bufferWrite, strlen(bufferWrite));
}
else if(2 == GetKeyPressed())
{
    pressedKey = 0;
    //Put PC back to EEPROM Start Address Location
    DRV_I2C1_MasterWrite(eepromWriteBuffer,NUM_ADDRESS_BYTES,I2C_SLAVE_ADDRESS,&i2cStatus);
    //I2C communication delay
    DRV_TMR1_EepromDelay();
    while(!DRV_TMR1_GetElapsedThenClear())
    {
        DRV_TMR1_Tasks();
    }
    DRV_TMR1_Stop();

    //Read data from EEPROM
    DRV_I2C1_MasterRead(eepromReadBuffer,sizeof(eepromReadBuffer),I2C_SLAVE_ADDRESS, &i2cStatus);
    sprintf(bufferWrite, "\r\nEEPROM Read was executed\r\n");
    Write2UART(bufferWrite, strlen(bufferWrite));

    match = true;
    for(i = 0; i < (sizeof(eepromReadBuffer)); i++)
    {
```

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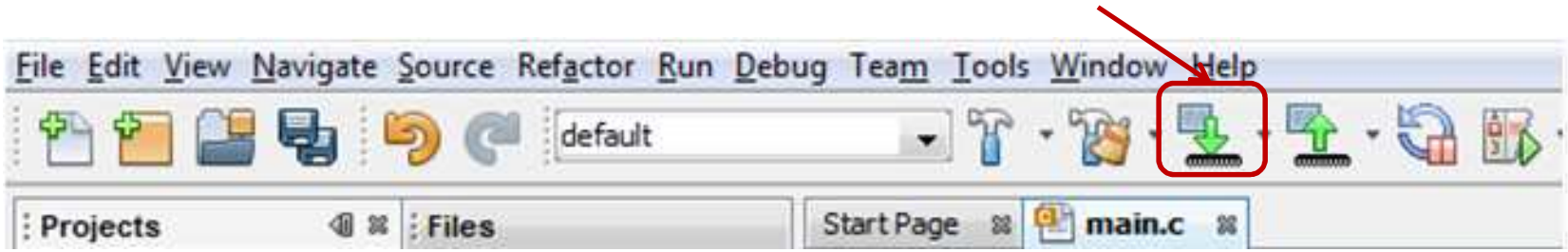
PIC24 Lab 5

- **“Make and Program” the project**



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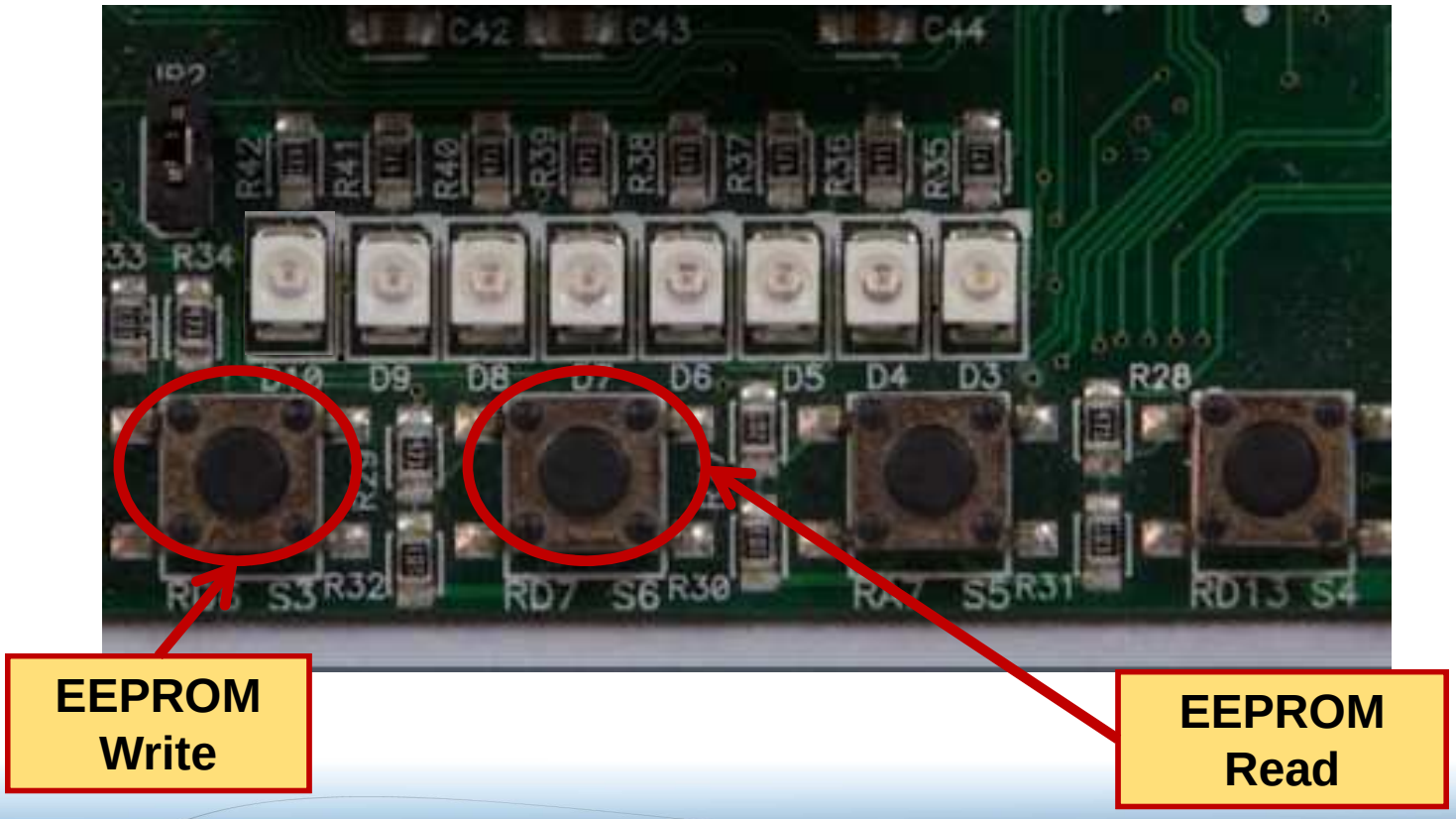
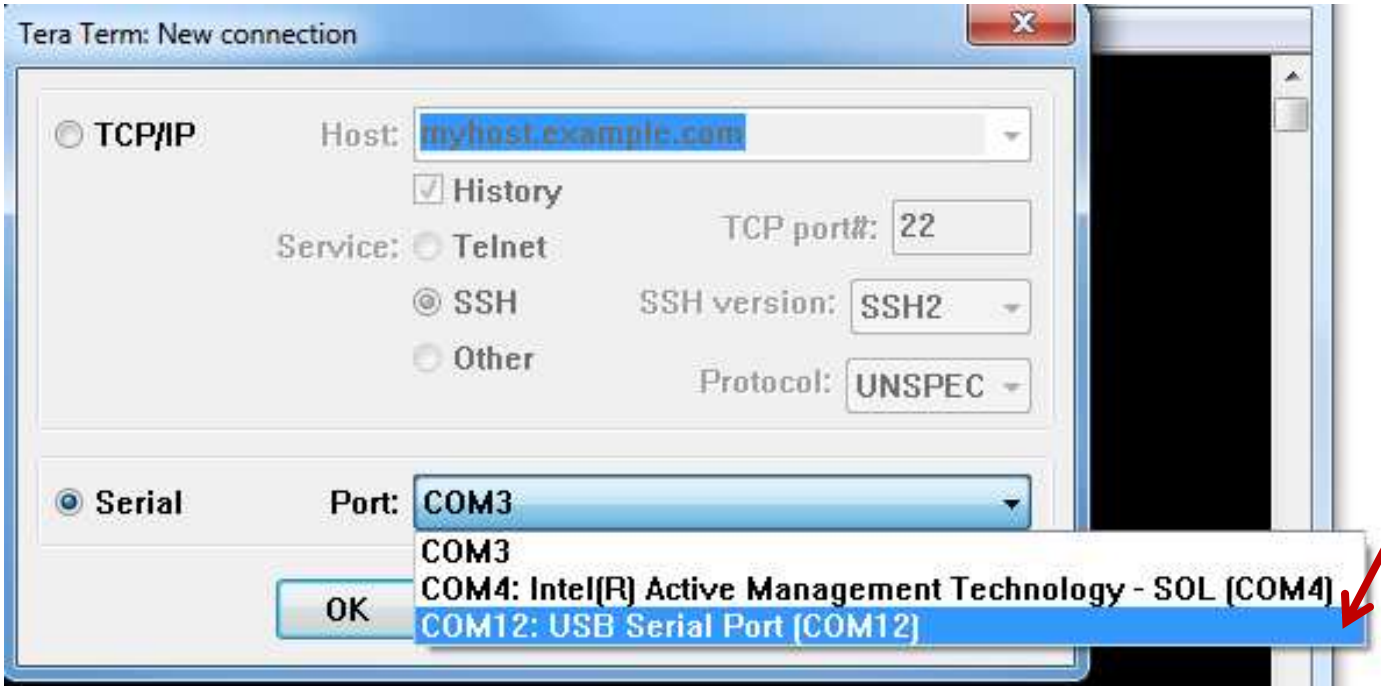
PIC24 Lab 5

- Press S3 to execute EEPROM Write
- Press S6 to execute EEPROM Read



PIC24 Lab 5

- **Start Tera Term**
- **Select the USB Serial Port**



Open "Tera Term" from your desktop and set up a new connection. Choose the COMx: USB Serial Port

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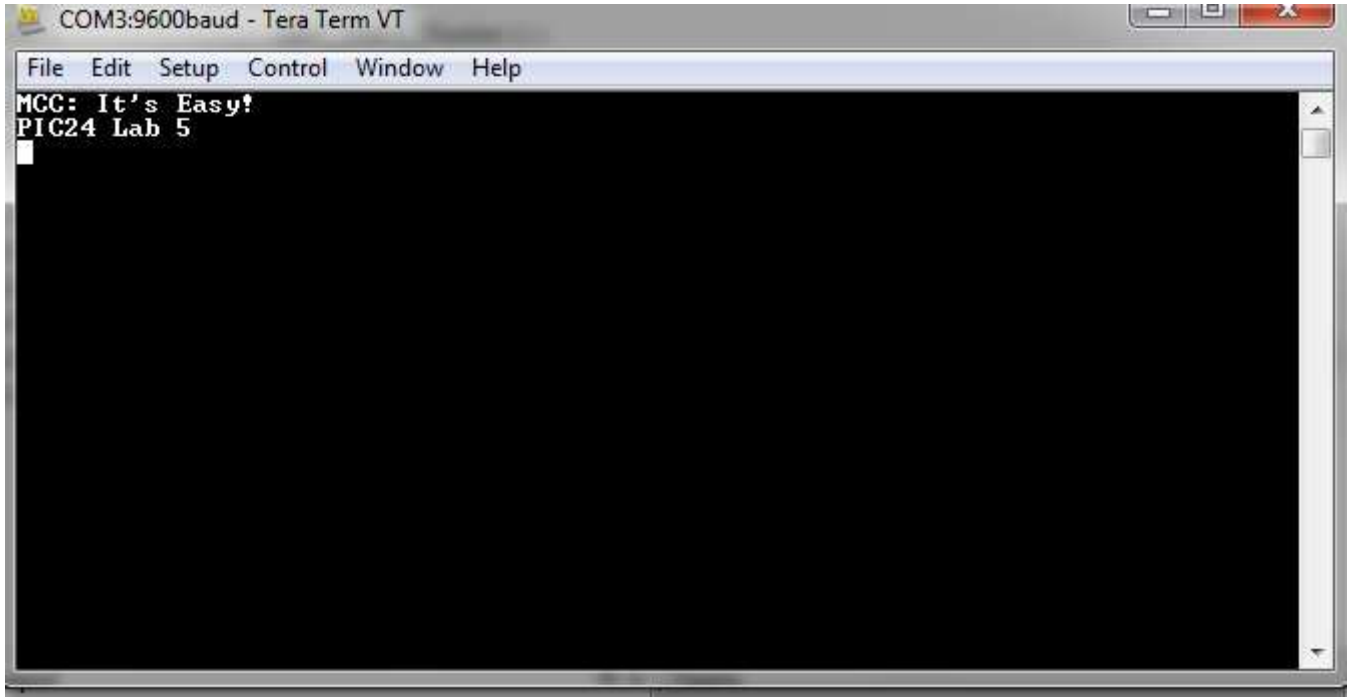
PIC24 Lab 5

Tera Term should display Lab 5 welcome message as shown



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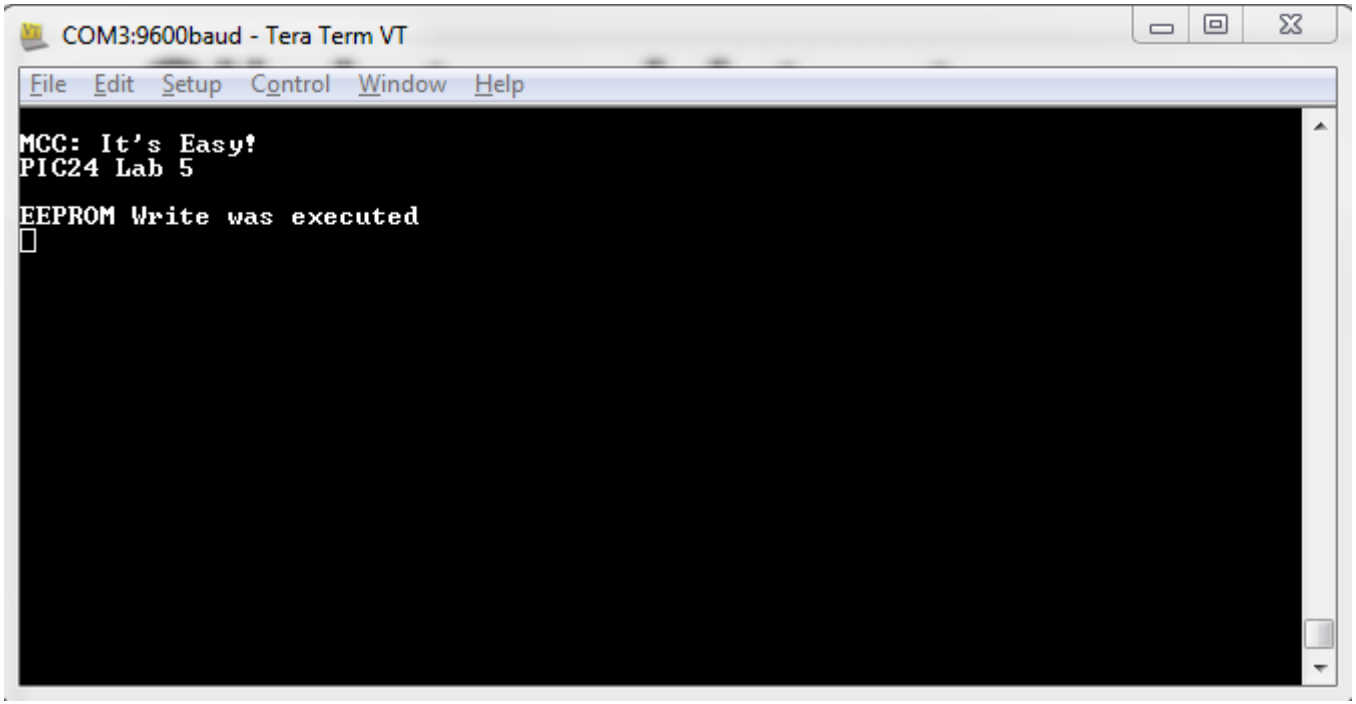
PIC24 Lab 5

Press Switch S3 to execute EEPROM Write
Tera Term should display execution message



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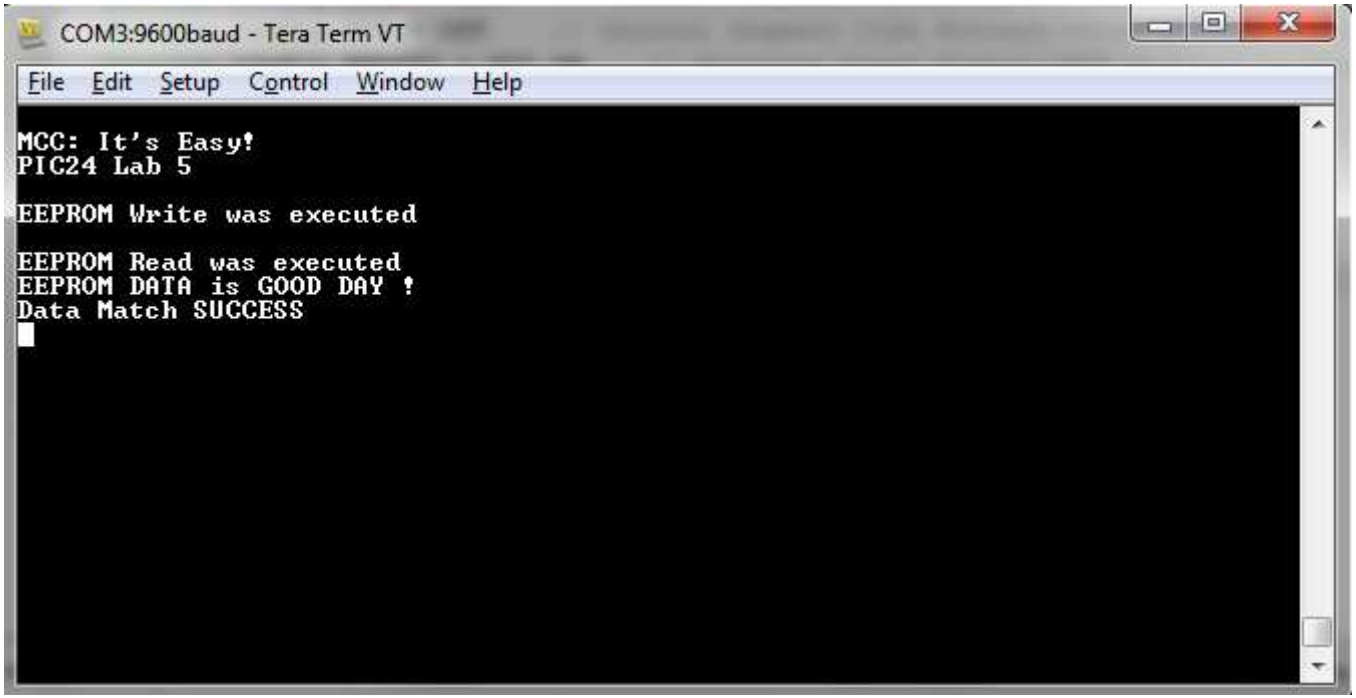
PIC24 Lab 5

Press Switch S6 to execute EEPROM Read
Tera Term should display execution and data match success messages



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PIC24 Lab 5 Summary

- We learned how to write and read data from the I2C EEPROM board with the Explorer 16 Board

- We displayed the message read back from the EEPROM on Tera Term and verified if it was a success or a failure

PIC24 Lab 6:
Let's Play some music using SPI + PWM (Bonus Lab)

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PIC24 Lab 6 Objectives

- Set up SPI to read music stored on EEPROM
- Utilize PWM to play music on the Speech Playback PICtail Plus board
- Enable the ADC to read the potentiometer connected to input RA5 to alter the speed the music is played
- Integrate MCC generated drivers with existing application

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PIC24 Lab 6 Overview

- Close any files open in the editor, and close all MPLAB® X IDE Projects
- Open lab6_16bit.X
- Install the Speech Playback PICTail Board
- Set up SPI to communicate with EEPROM on the Explorer 16 Board
- Setup OC1 to play music

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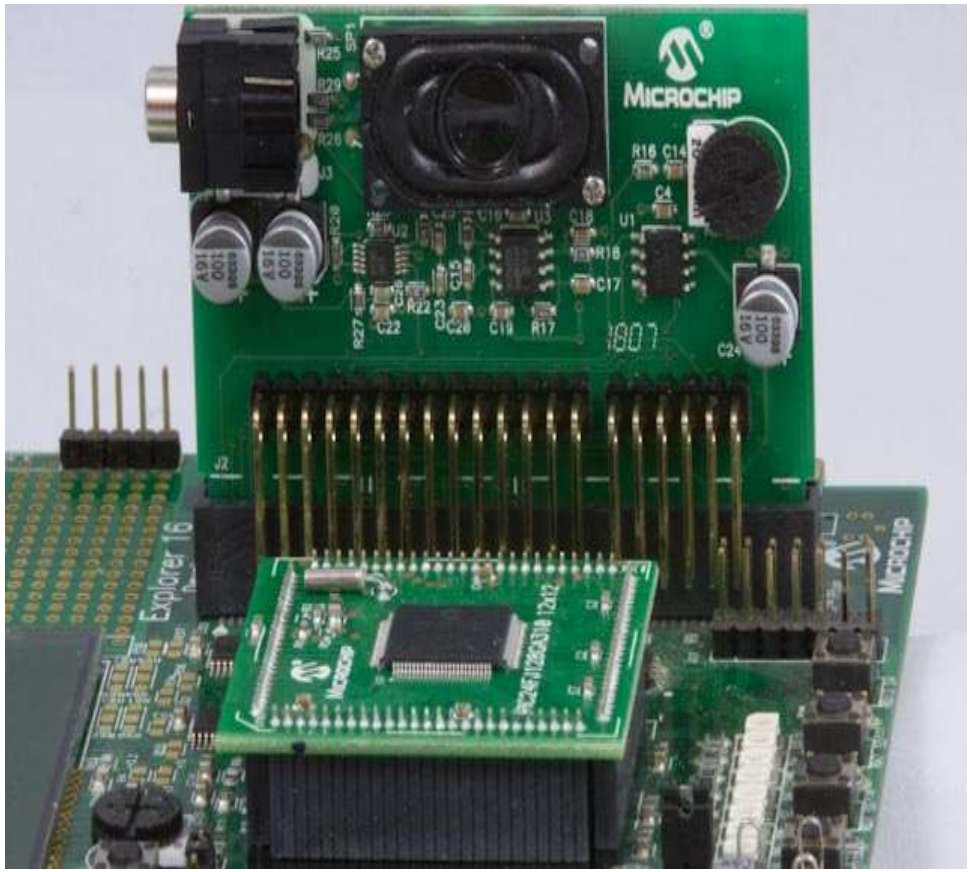
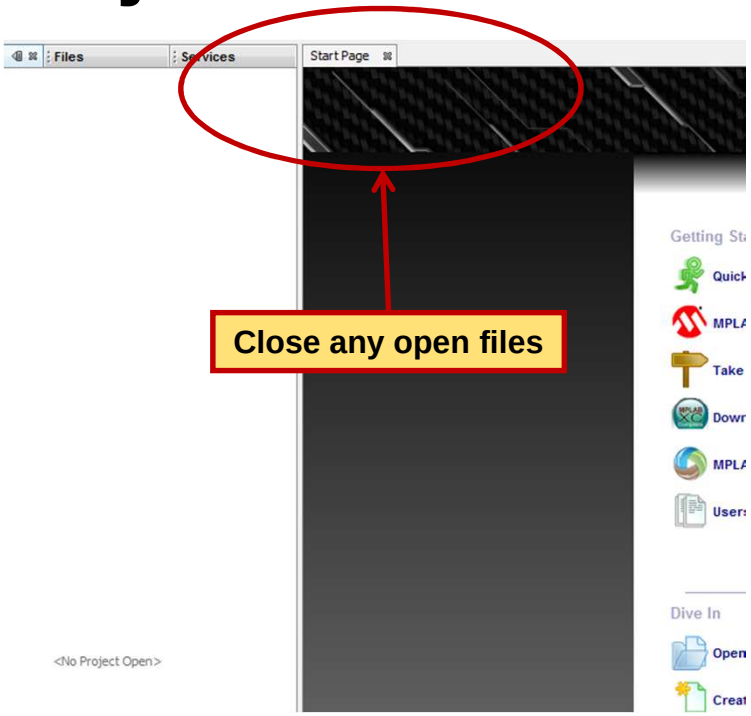
PIC24 Lab 6

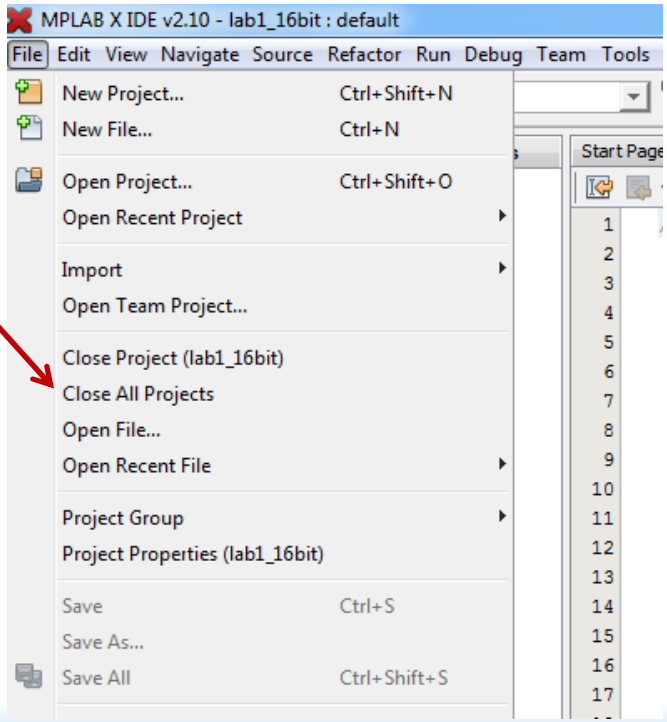
- Remove power from the Explorer 16 Board
- Install the Speech Playback PICtail board
- Reconnect the Power to the board



PIC24 Lab 6

- **Close any open files in the editor window, and all open MPLAB® X IDE projects**





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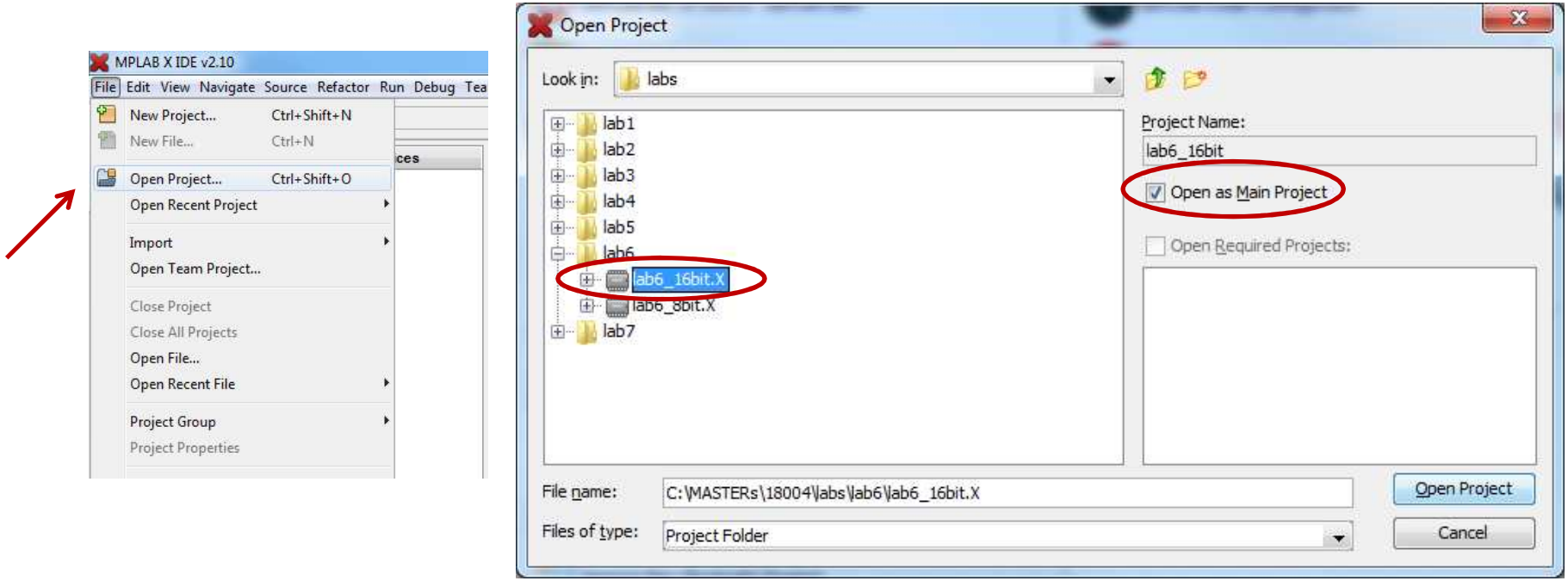
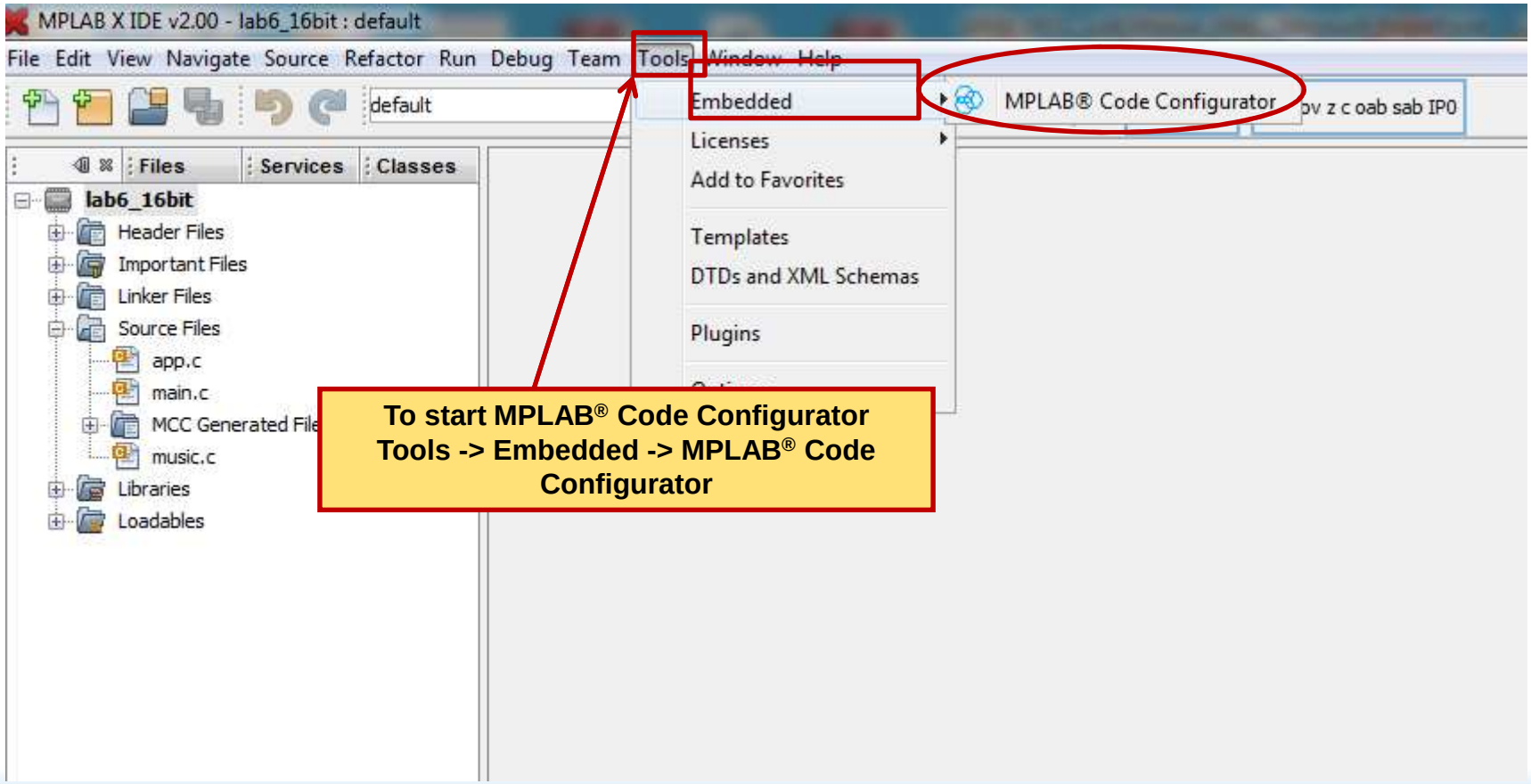
Lab 6

- **Open lab6_16bit.X**



PIC24 Lab 6

- **Start MPLAB® Code Configurator**



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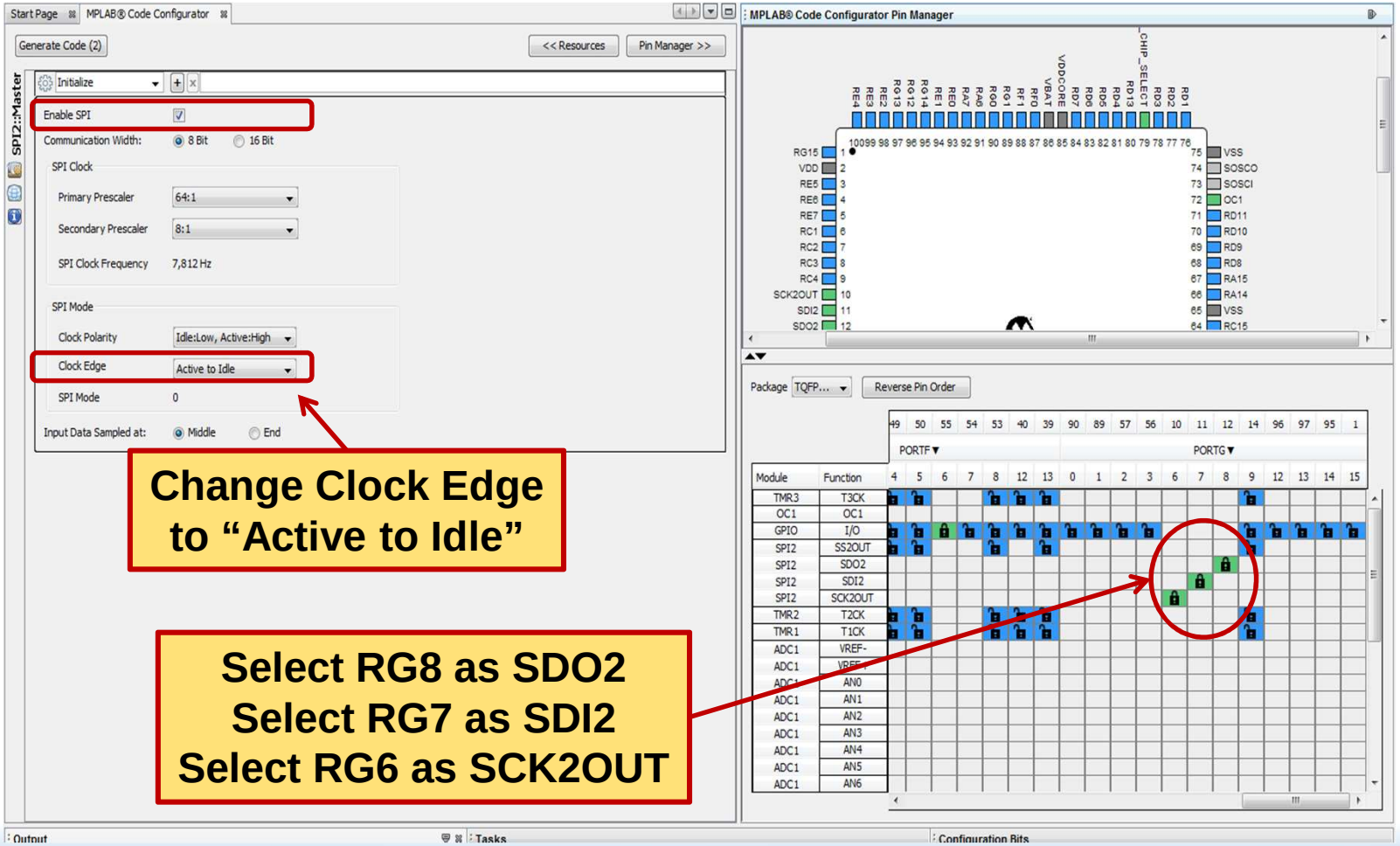
PIC24 Lab 6

- **Configure the SPI2 as SPI Master**



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PIC24 Lab 6

- **Did you know …**
- **that the MPLAB X Output window displays information from MCC**

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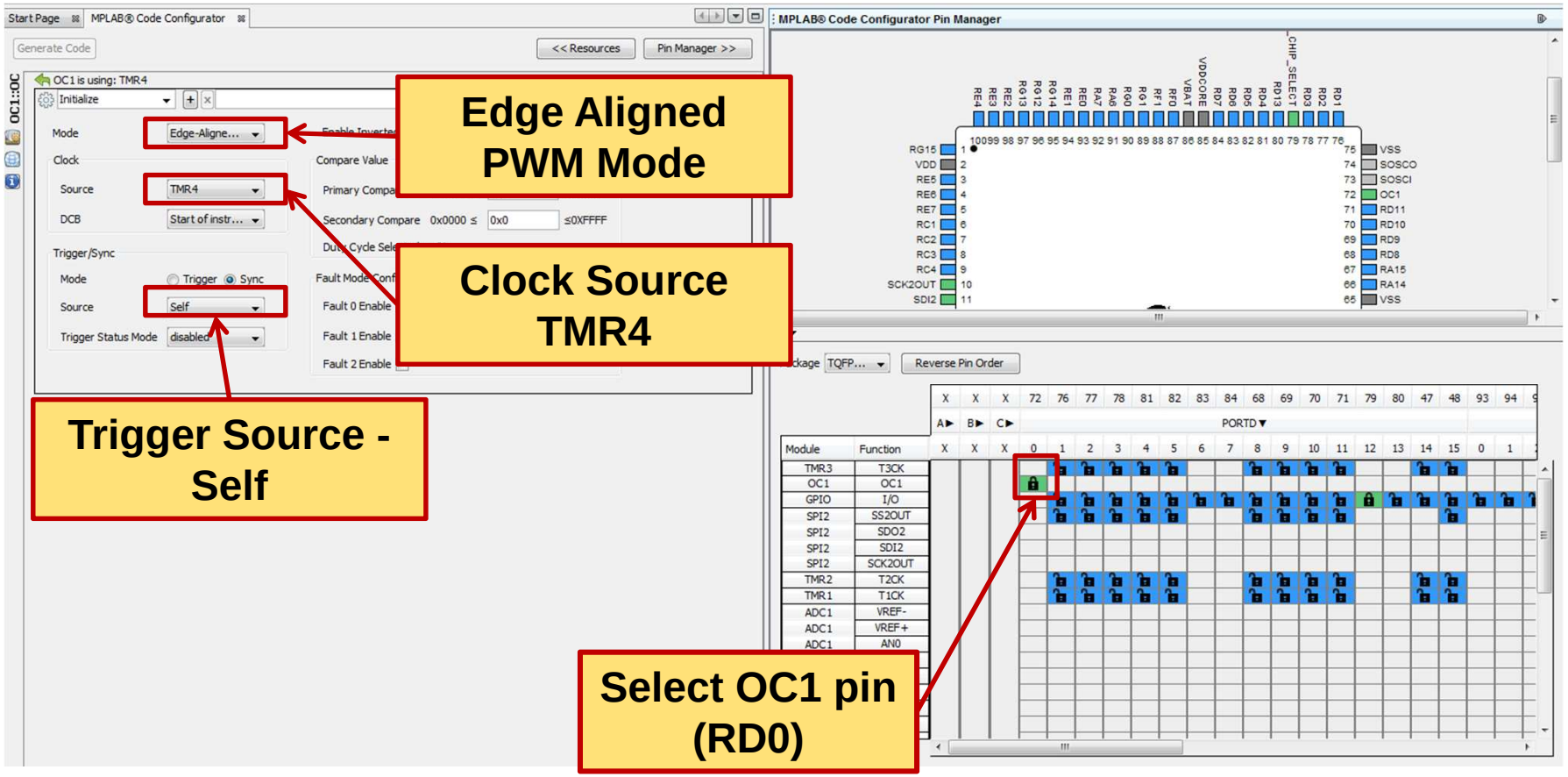
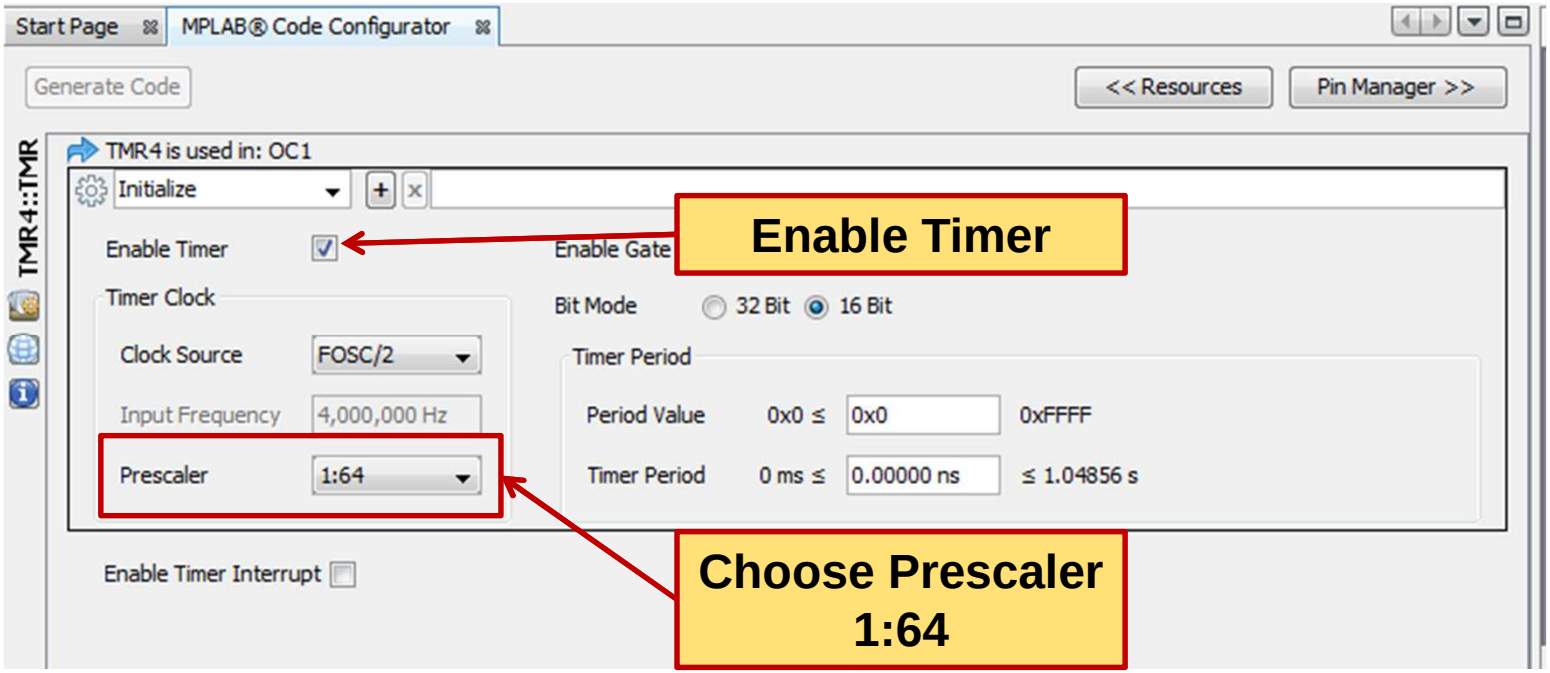
PIC24 Lab 6

- **Set up OC1 in Edge Aligned PWM Mode**



PIC24 Lab 6

- Enable TMR4 to use as Clock Source for OC1



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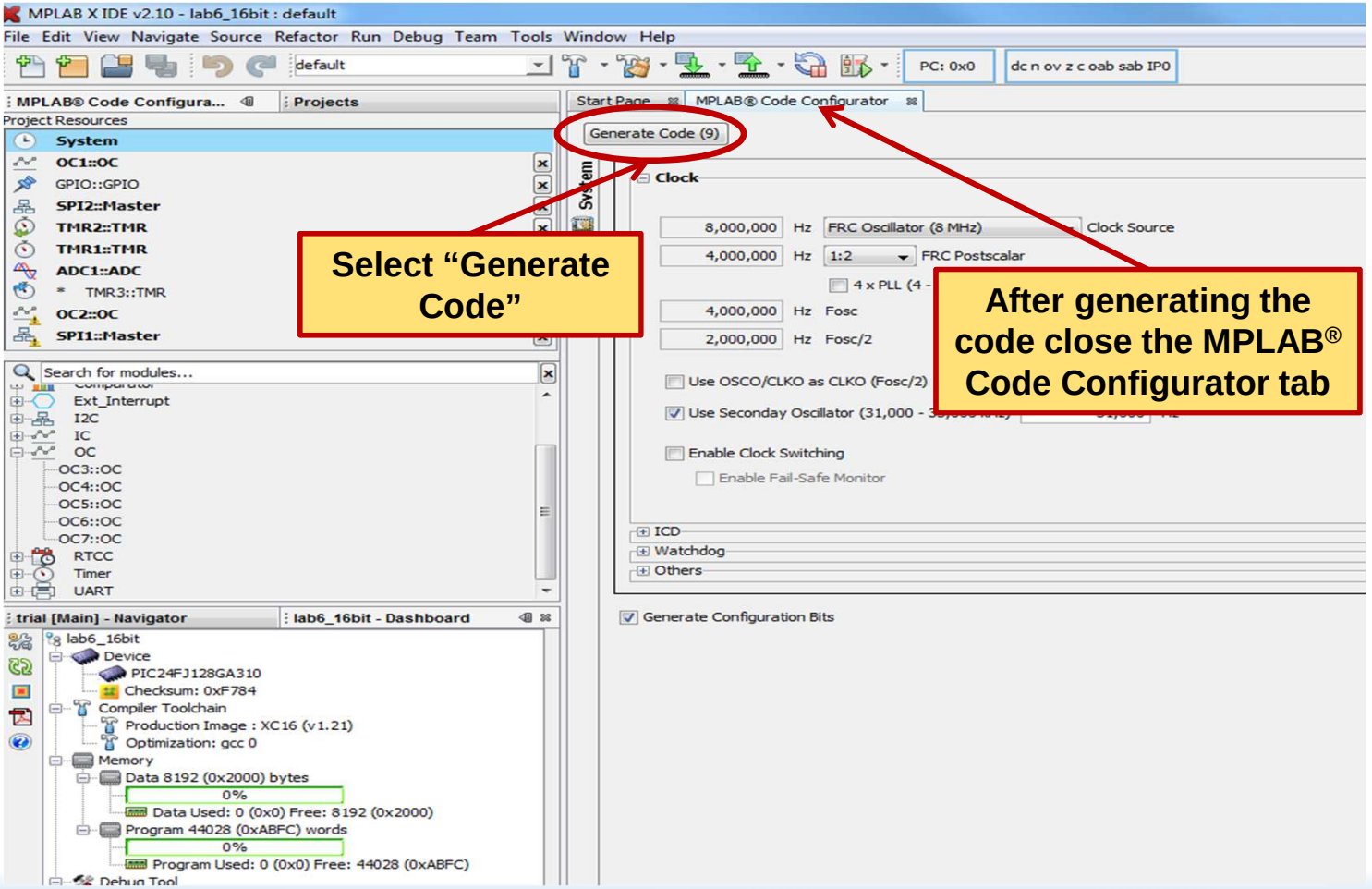
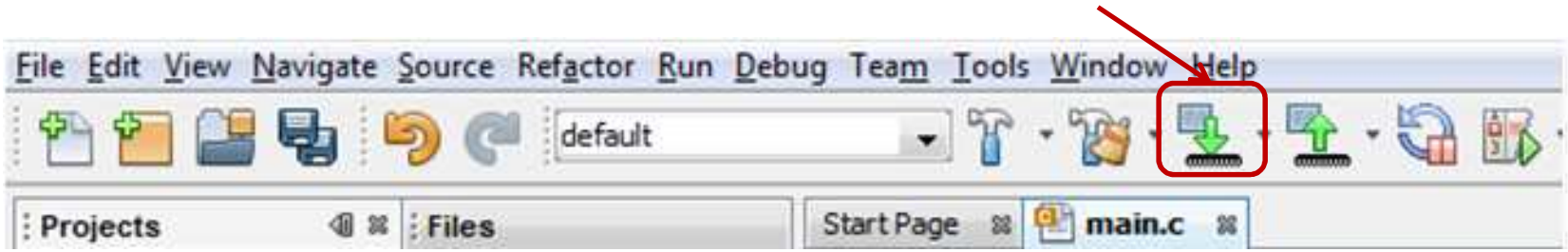
PIC24 Lab 6

- **Generate Code**



PIC24 Lab 6

- **“Make and Program” the project**



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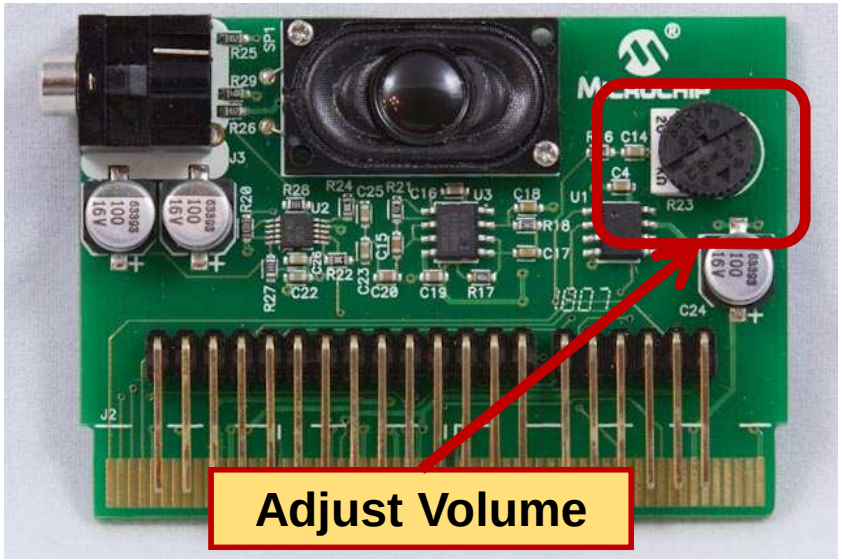
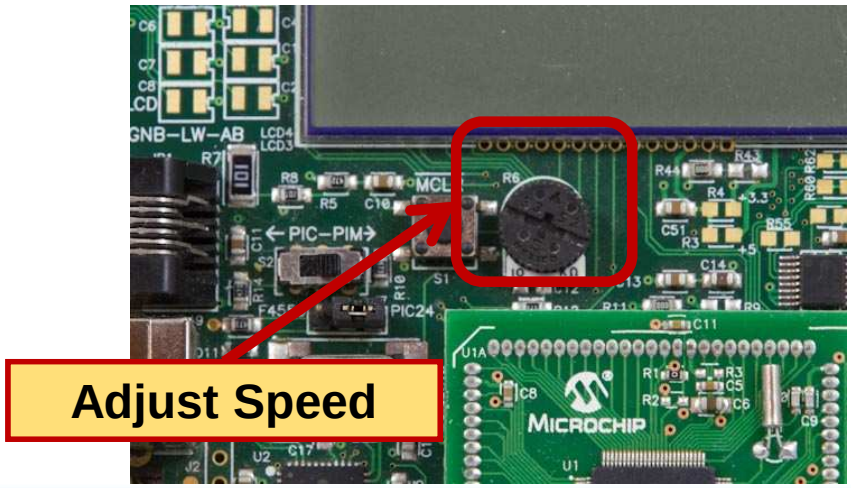
PIC24 Lab 6

- **Music playing**
- **Adjust Volume On Speech Playback board**
- **Adjust Speed on Explorer 16 Board**





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PIC24 Lab 6 Summary

- We used SPI to read music data from an EEPROM
- We use the OC module to play music with the Speech Playback PICtail board
- We used an ADC input to control the speed the song was played

PIC24 Lab 7:
Use all the features of the Explorer 16 board
(Bonus Lab)

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PIC24 Lab 7 Objectives

- To learn to use all features of Explorer 16 board and build an application
- To use the on-board LCD display.
- To use switches to select from a menu of commands to

  - display potentiometer voltage
  - display temperature
  - display date and time
  - toggle LED

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PIC24 Lab 7 Overview

- Close any files open in the editor, and close all MPLAB® X IDE Projects

- Open lab7_16bit.X

- Setup RTCC
  - Enable RTCC
  - Enable RTCC Output
  - Set RTCC Output to RTCC Clock

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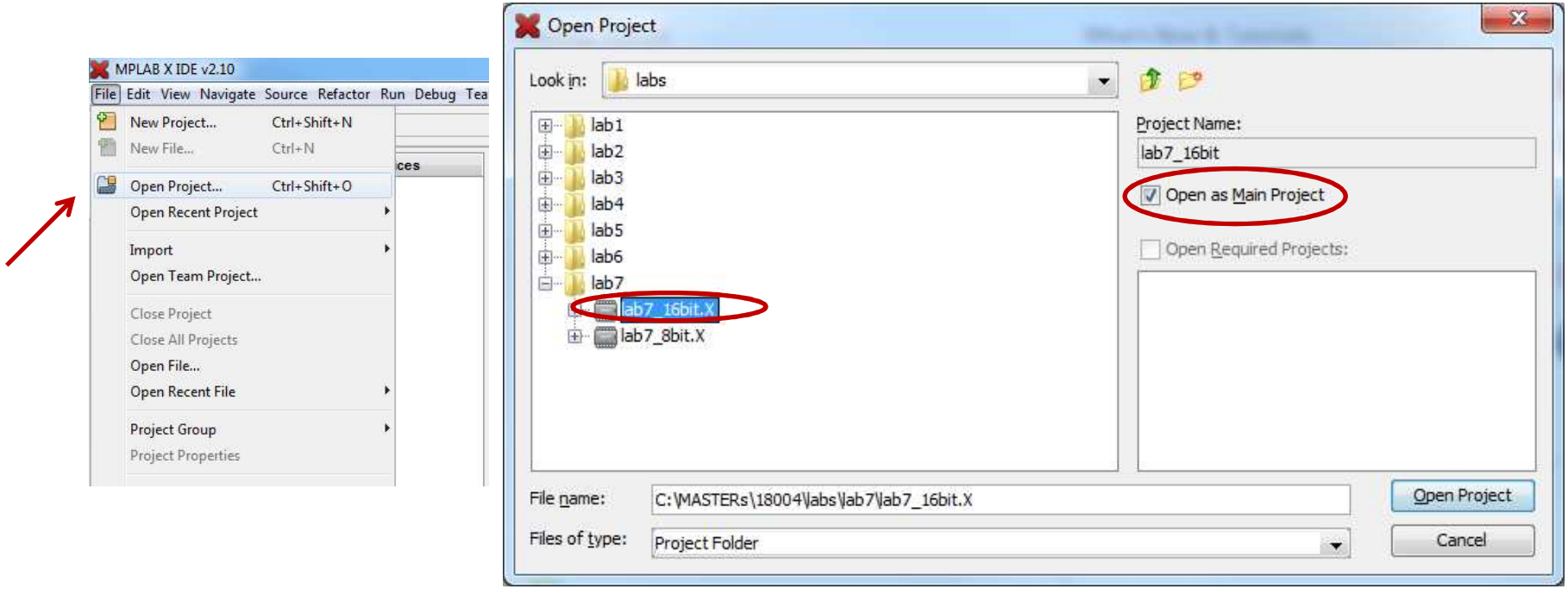
PIC24 Lab 7

- **Open lab7_16bit.X**



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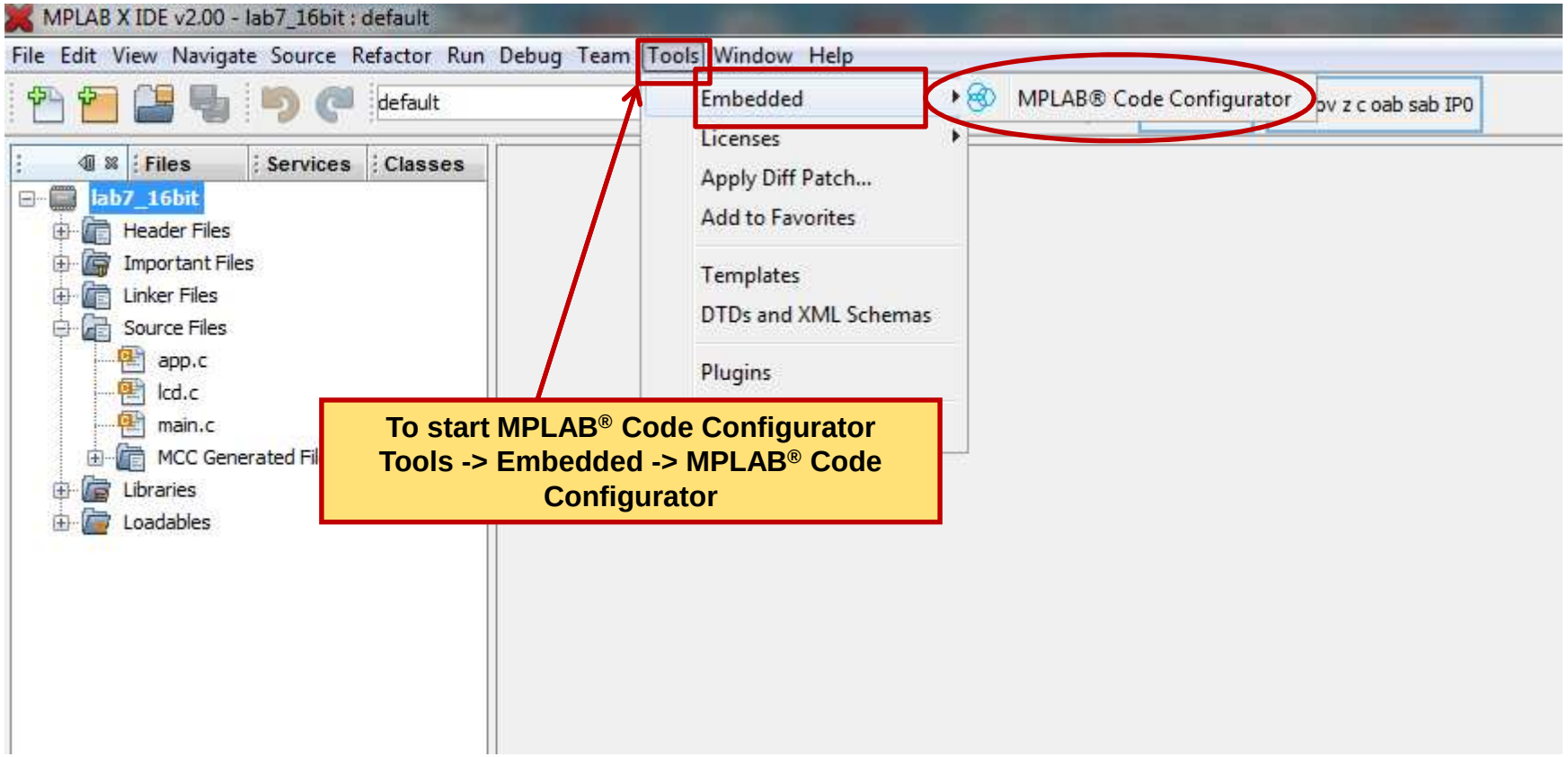
PIC24 Lab 7

- **Start MPLAB® Code Configurator**



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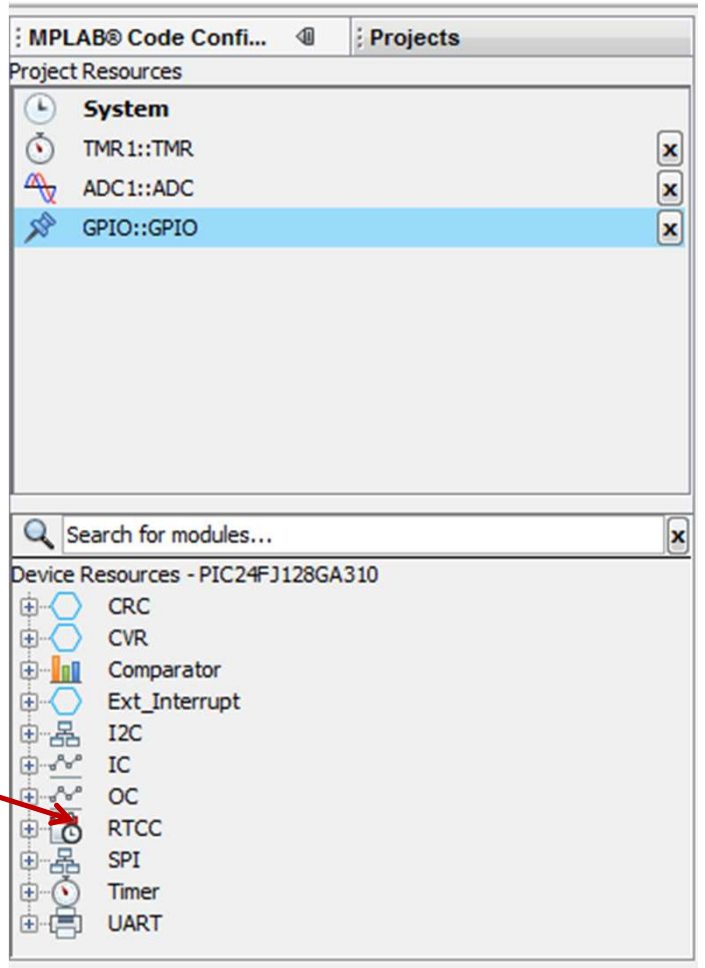
PIC24 Lab 7

- **Select RTCC::RTCC from Device Resources**



Double Click on RTCC and Double click on RTCC::RTCC to configure input-output pins

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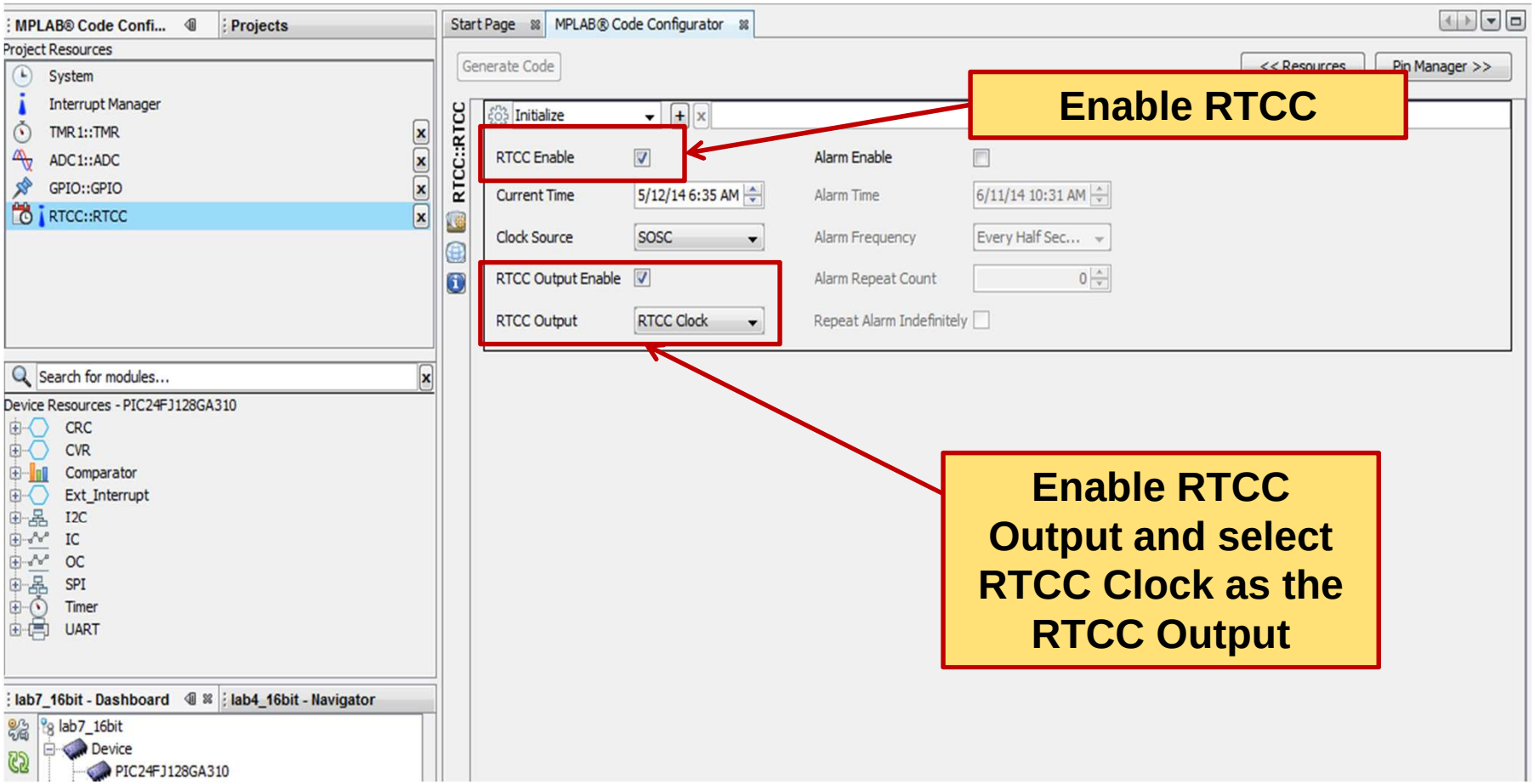
PIC24 Lab 7

- **Configure RTCC module**



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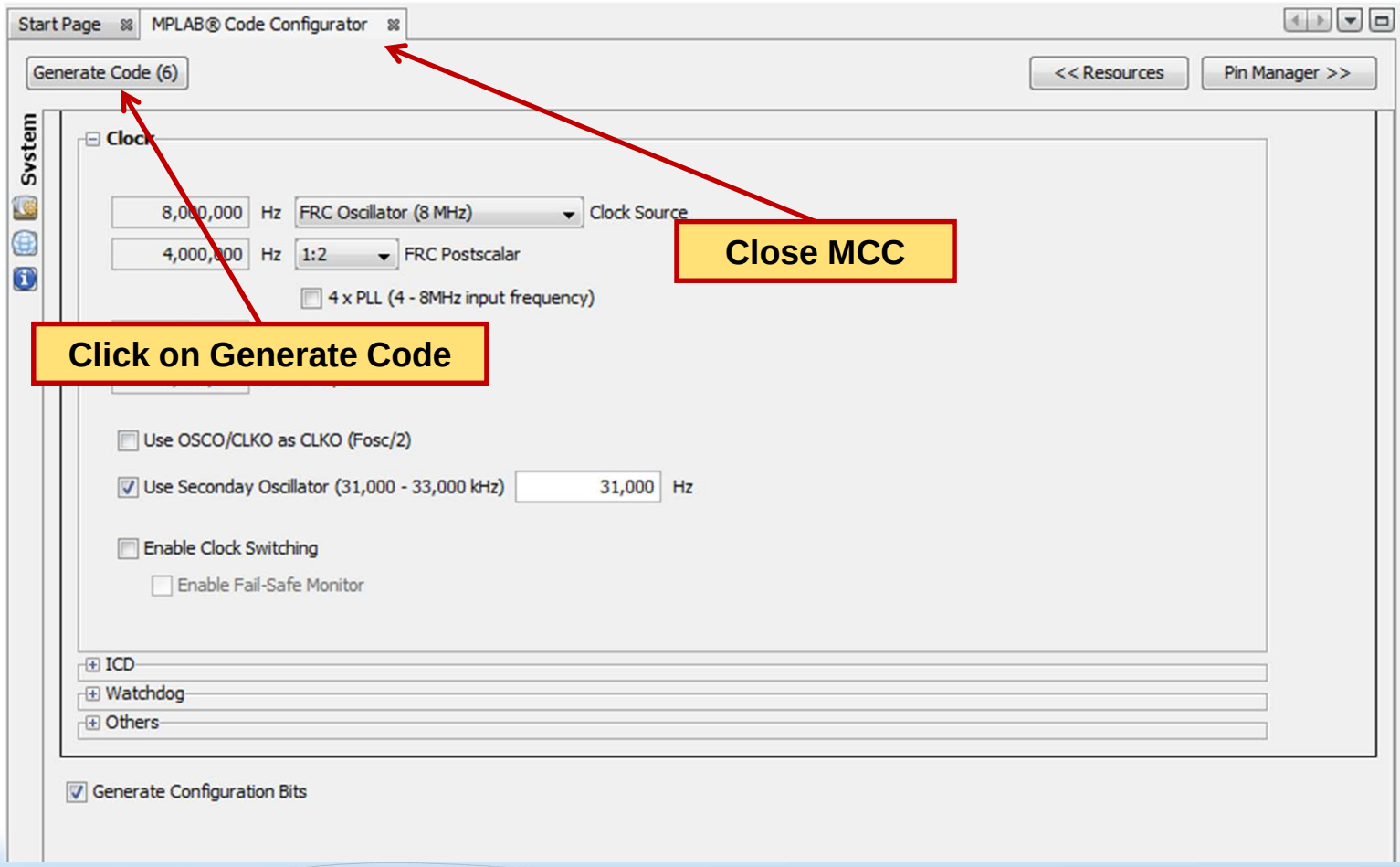
PIC24 Lab 7

- **Generate Code**



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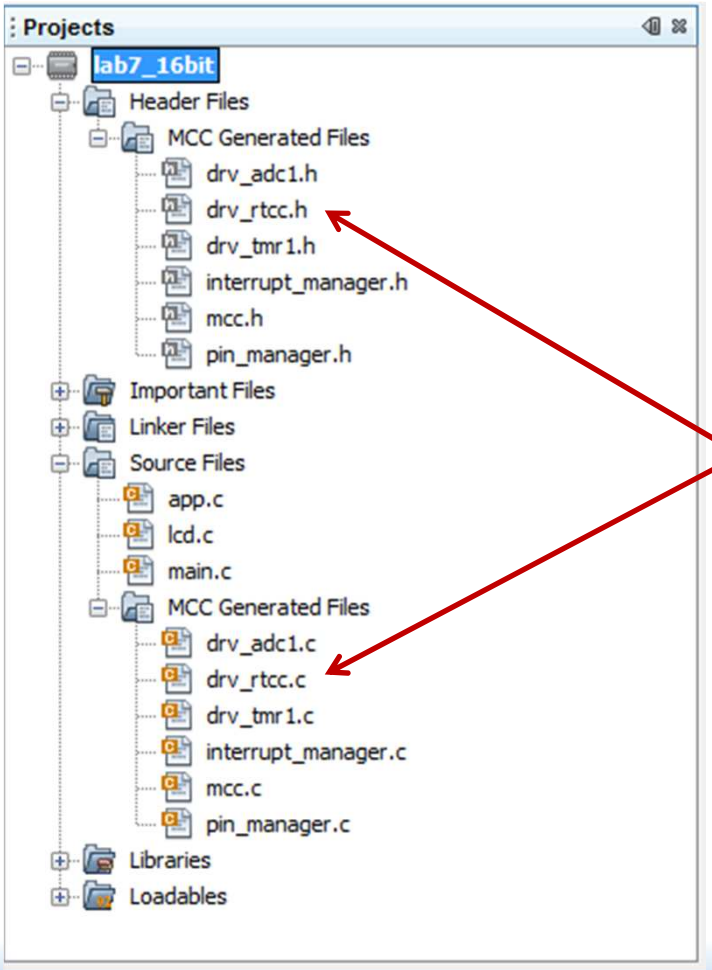
PIC24 Lab 7

- RTCC driver files added to the project
-



MPLAB® Code Configurator driver files for RTCC module are added into the project

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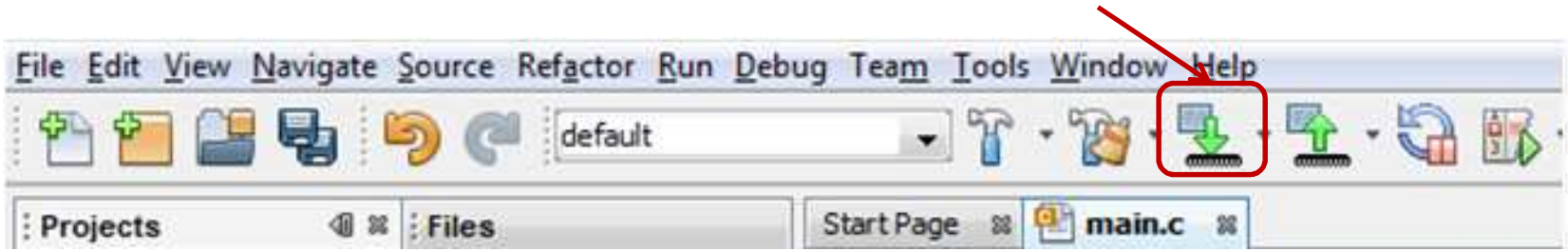
PIC24 Lab 7

- **“Make and Program” the project**



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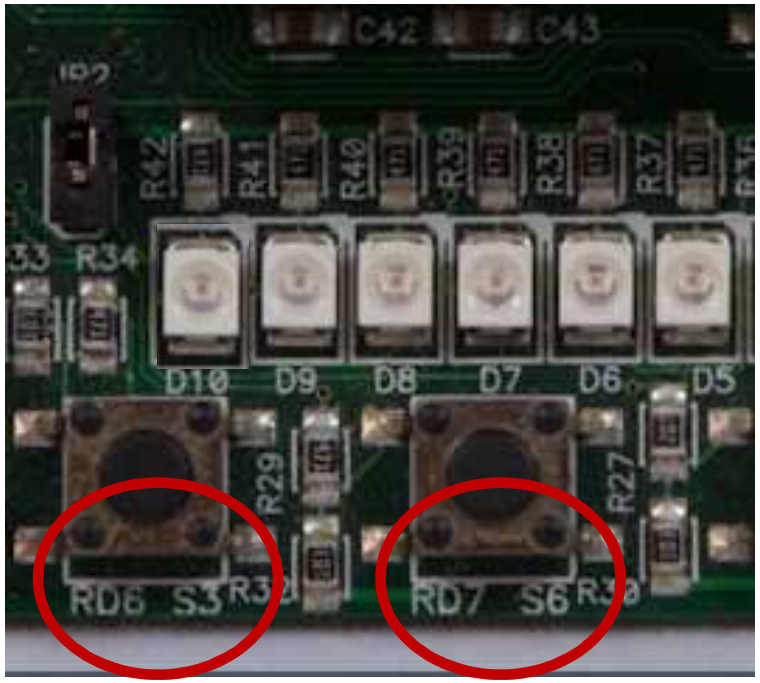
PIC24 Lab 5

- **Use the buttons S3 and S6 to navigate through the menu to display:**
  - **Temperature**
  - **Potentiometer voltage**
  - **Date and Time**
  - **LED blinking**



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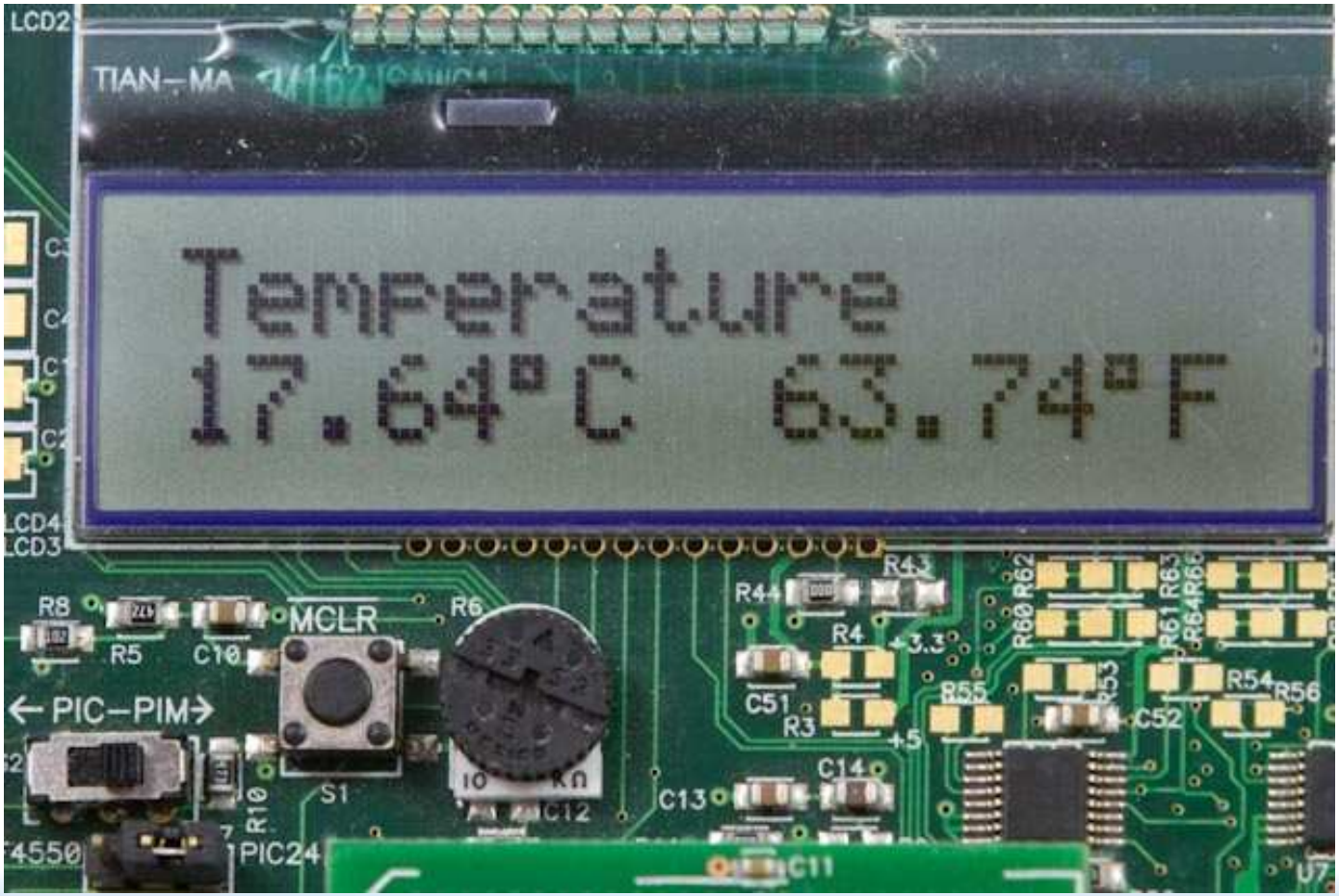
PIC24 Lab 7

Temperature Sensor Demo



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PIC24 Lab 7

Potentiometer Demo

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LED Demo

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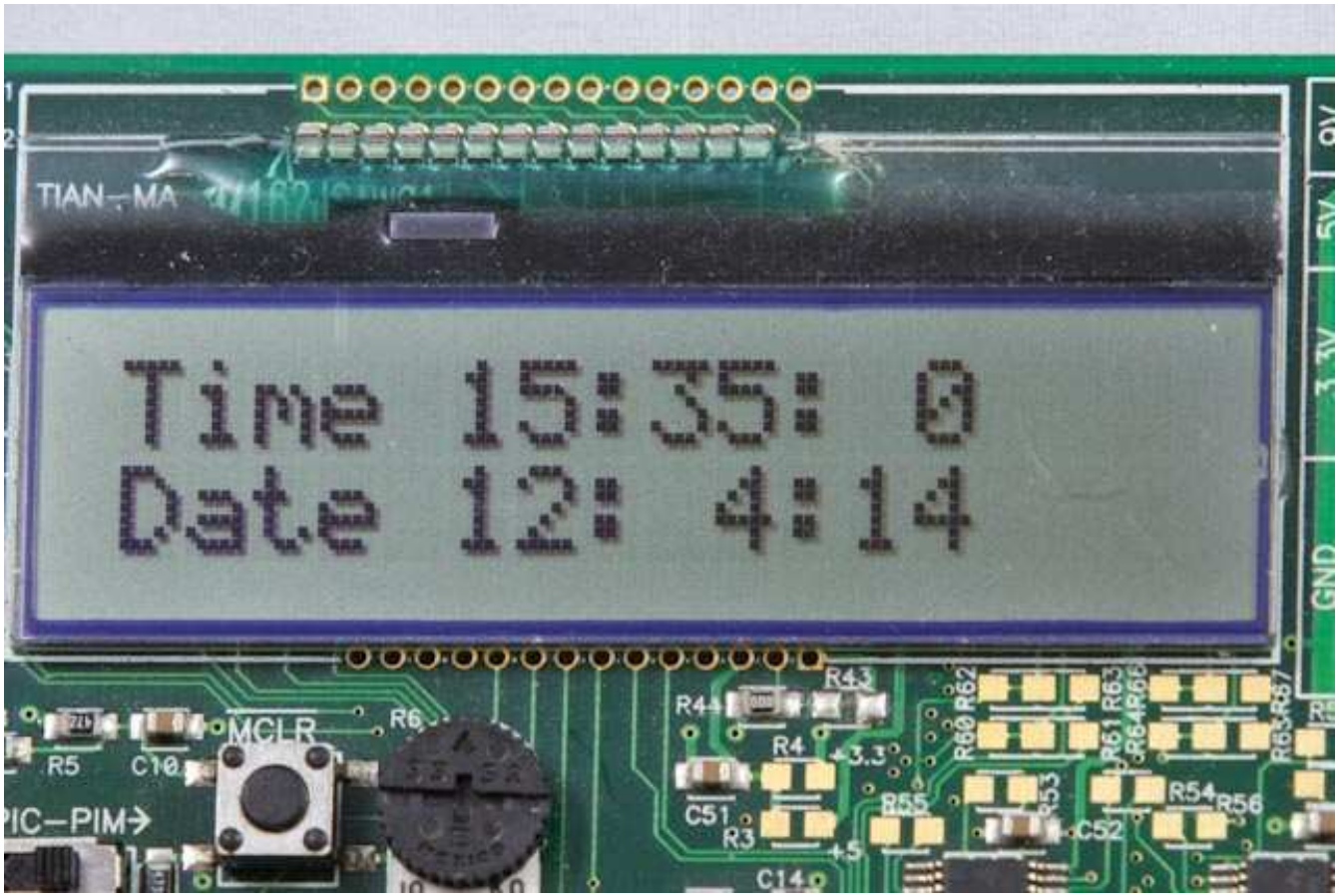
PIC24 Lab 7

RTCC Demo



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PIC24 Lab 7 Summary

- We built an application that uses all features on the Explorer 16 Board.

- We learned to display data on the LCD of the Explorer 16 Board

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Summary

- **Today we covered:**
  - Installing and using MCC for generating code in you projects
  - Demonstrated how easily peripherals can be setup using MCC
  - Had fun using a very cool and very usable GUI

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Summary

MCC v2.0 supports the following:

- **PIC12:**
  - (L)F1501
  - (L)F1822
  - (L)F1840
- **PIC16:**
  - (L)F15xx
  - (L)F17xx
  - (L)F18xx
  - (L)F19xx
- **PIC18:**
  - (L)F2xK20
  - (L)F4xK20
  - (L)F2xK22
  - (L)F4xK22
- **PIC24:**
  - FJxxGA310
  - F(V)16KMxx

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Summary

- **Future support**
  - Peripheral Support
  - Device Support
  - Enhancements

Questions?

Thank you!

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Dev Tools For This Class

- (AC002014) 9V 1.3A Universal Wall Mount Power Supply
- (DM240001) PICDEM PIC24/dsPIC33 Explorer 16 Kit
- (DM183032) PICDEM PIC18 Explorer Board
- (MCP2200EV-VCP) MCP2200 USB to RS232 Demo Board
- (MA180026) PIC18F45K22 44-PIN TQFP TO 84-PIN PIM
- (MA240029) PIC24FJ128GA310 General Purpose PIM

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Dev Tools For This Class

- (AC164125) Speech Playback Speech Playback PICtail™ Plus board Plus Daughter Board
- MPLAB® REAL ICE™ In-circuit emulator
- (AC243003) I^2C EEPROM

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Appendix

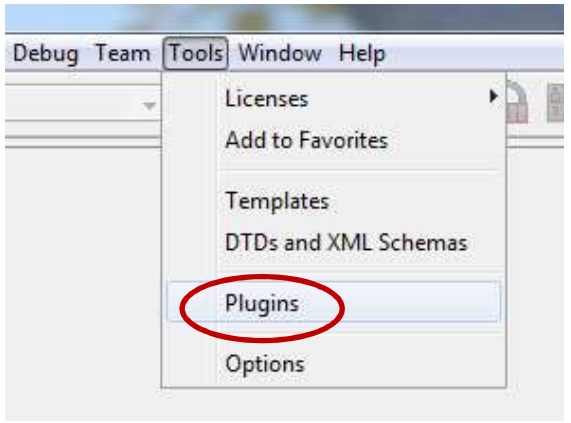
- The MPLAB Code Configurator Plugin should already be installed for this MASTERs class
- The installation instructions are required only if the MCC Plugin needs to be installed
- Proceed with the Labs if the MCC Plugin is already installed

Installing the MCC Plugin

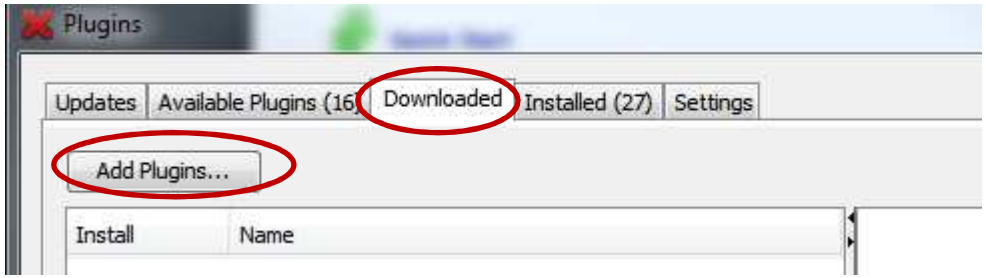
- **There are 2 methods to install MPLAB X Plugins**
  - Off-line
  - Normal Plugin installation (use this during MASTERs)
- **Use only one of these methods**

Off-line Plugin installation

- **Access Tools – Plugins**

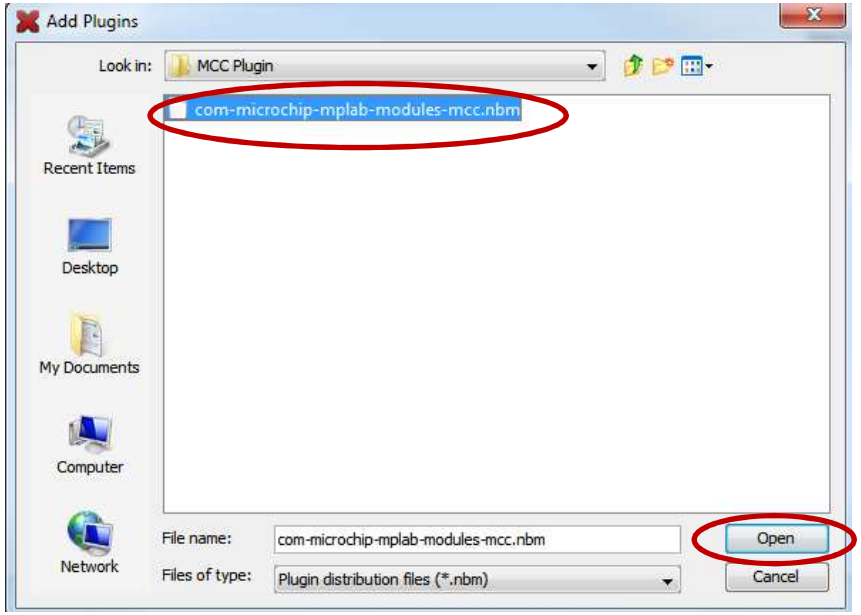


- **Select the Downloaded tab and Click on Add Plugins**



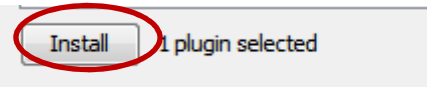
Off-line Plugin installation
Continued

- Navigate to the folder and select the .nbm file and click on open

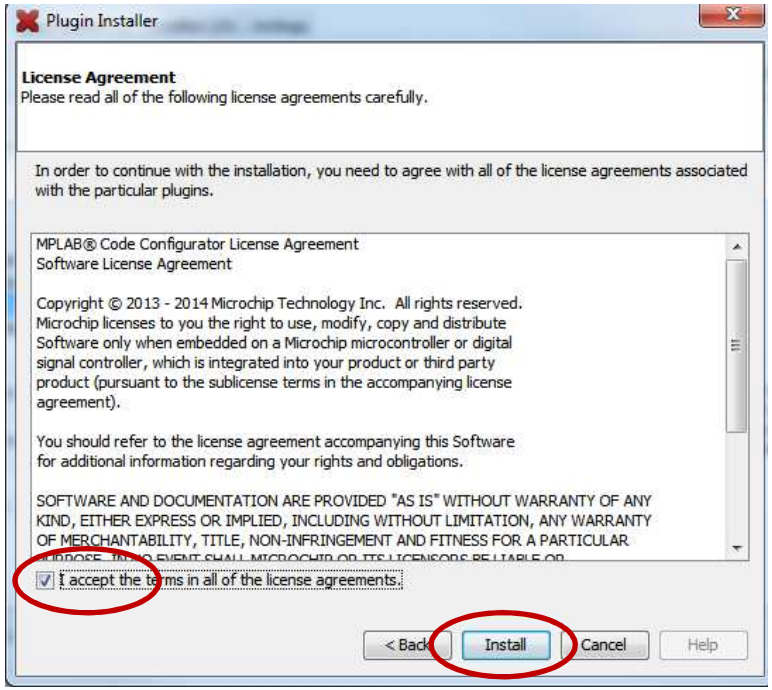


Off-line Plugin installation
Continued

- **Click Install**

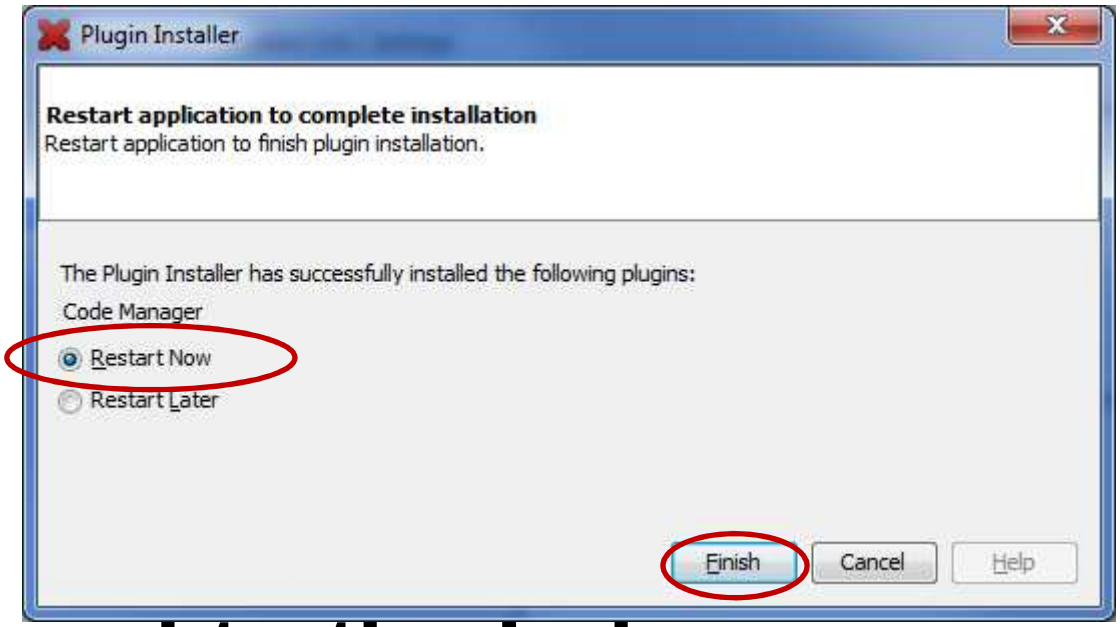


- **Accept and Install License Agreement**



Off-line Plugin installation
Continued

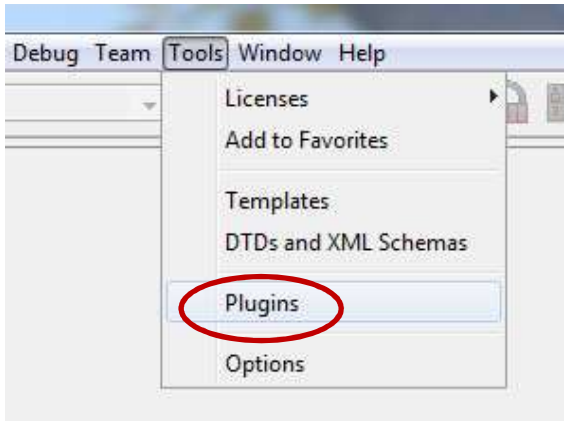
- **Select “Restart Now”**
- **Click Finish**



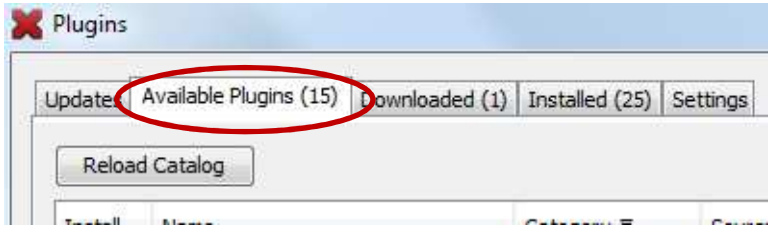
- **Proceed to the Labs**

Normal Plugin Installation

- **Access Tools – Plugins**

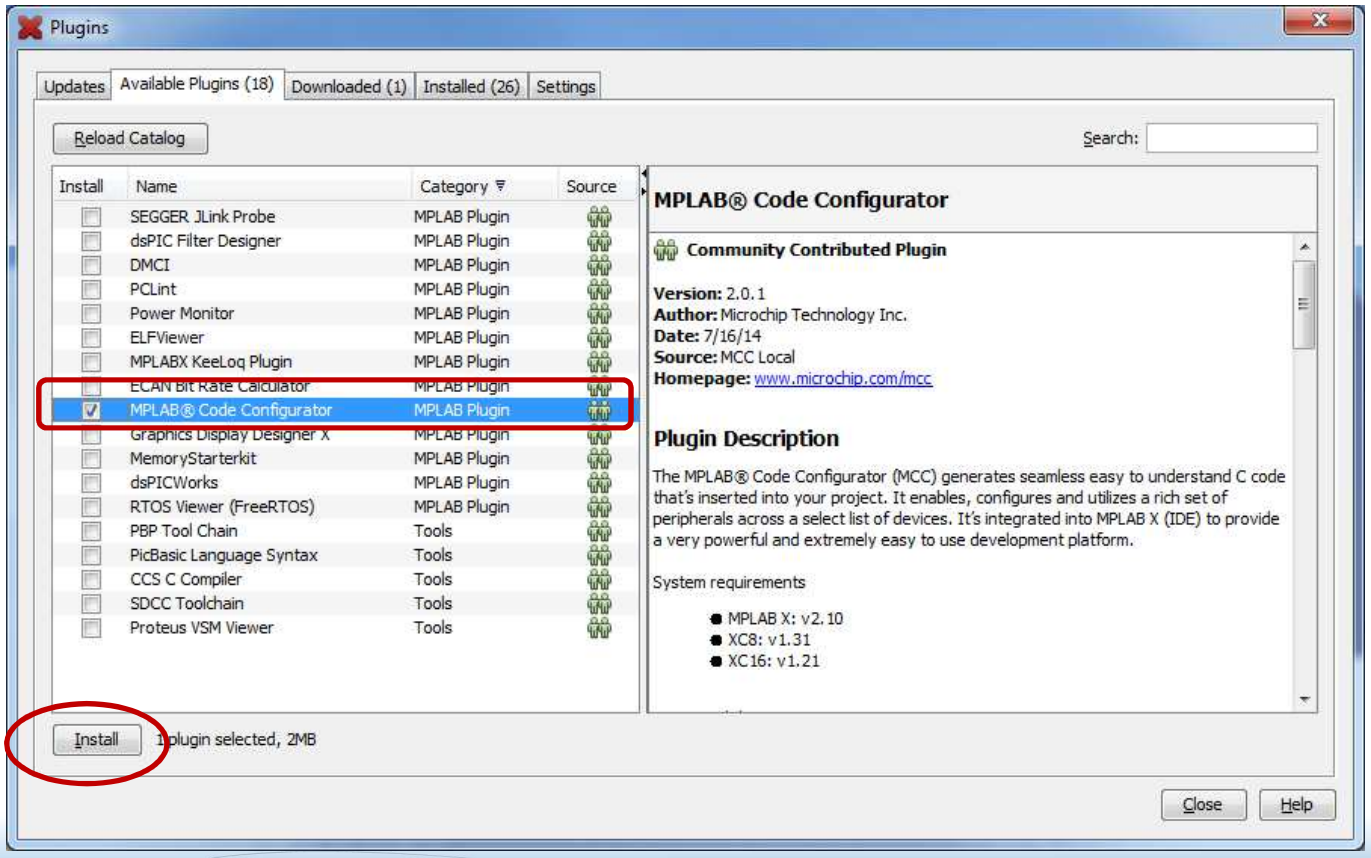


- **Select the Available Plugins Tab**



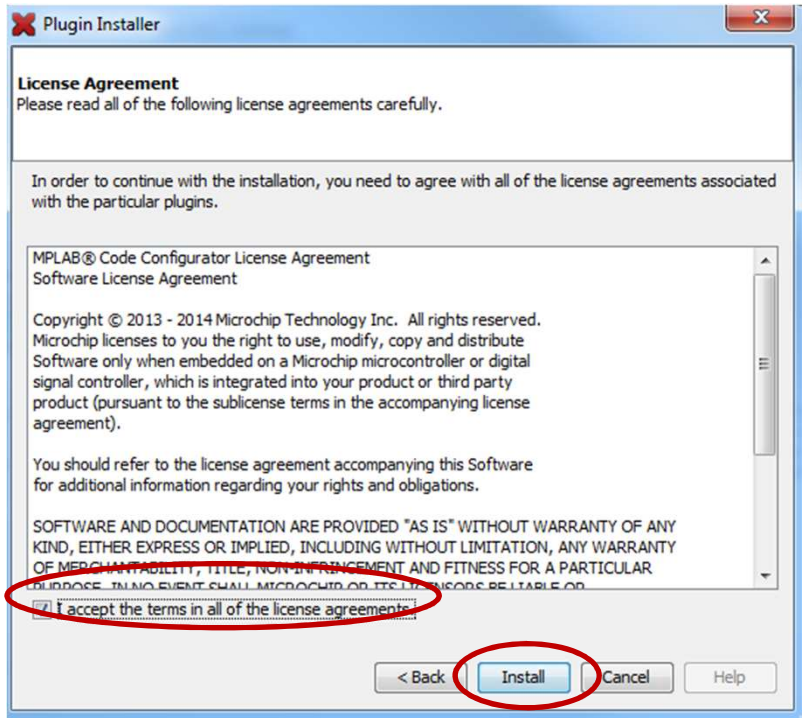
Normal Plugin Installation
continued

- Select MPLAB Code Configurator
- Click Install



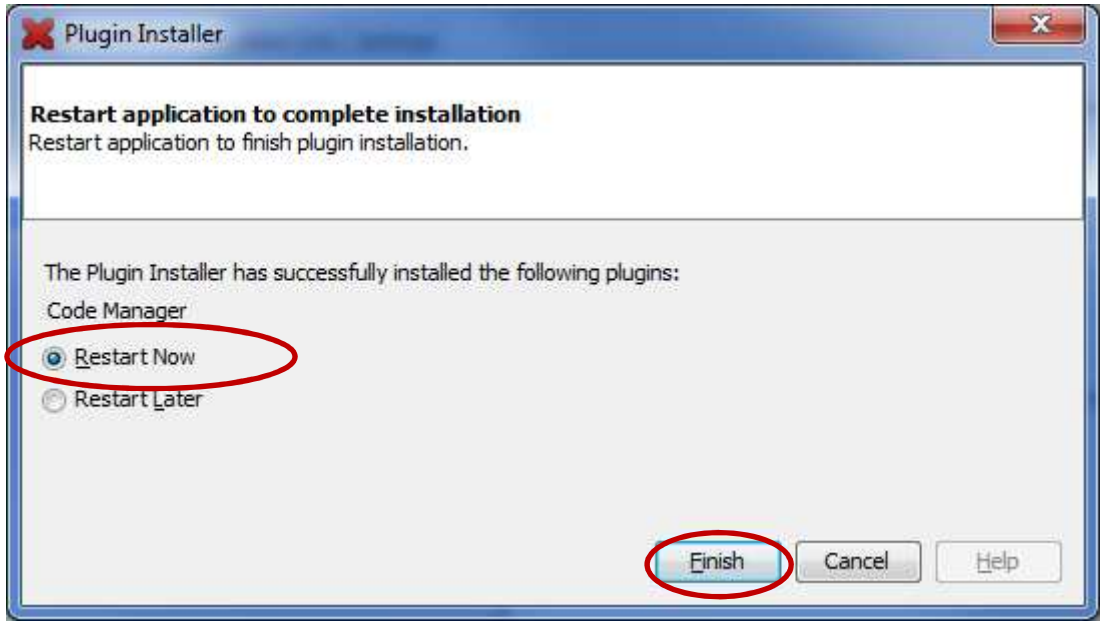
Normal Plugin Installation
continued

- **Accept and Install License Agreement**



Normal Plugin Installation
continued

- **Select “Restart Now”**
- **Click Finish**



- **Proceed to the Labs**

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