



MICROCHIP

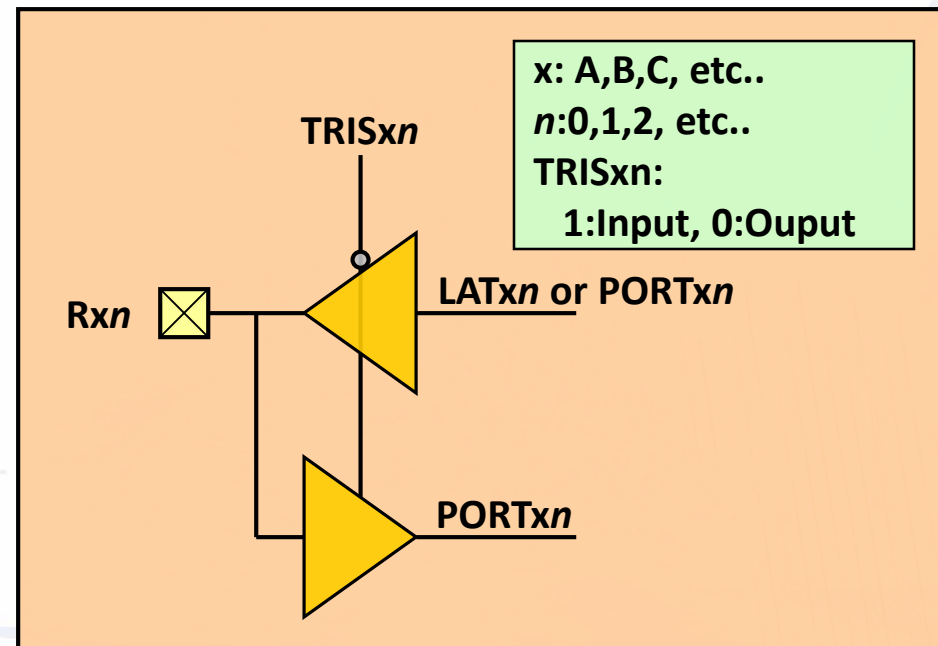
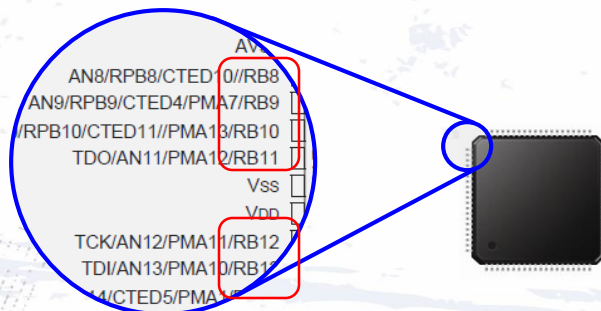
Regional Training Centers

Section 5

GPIO Architecture

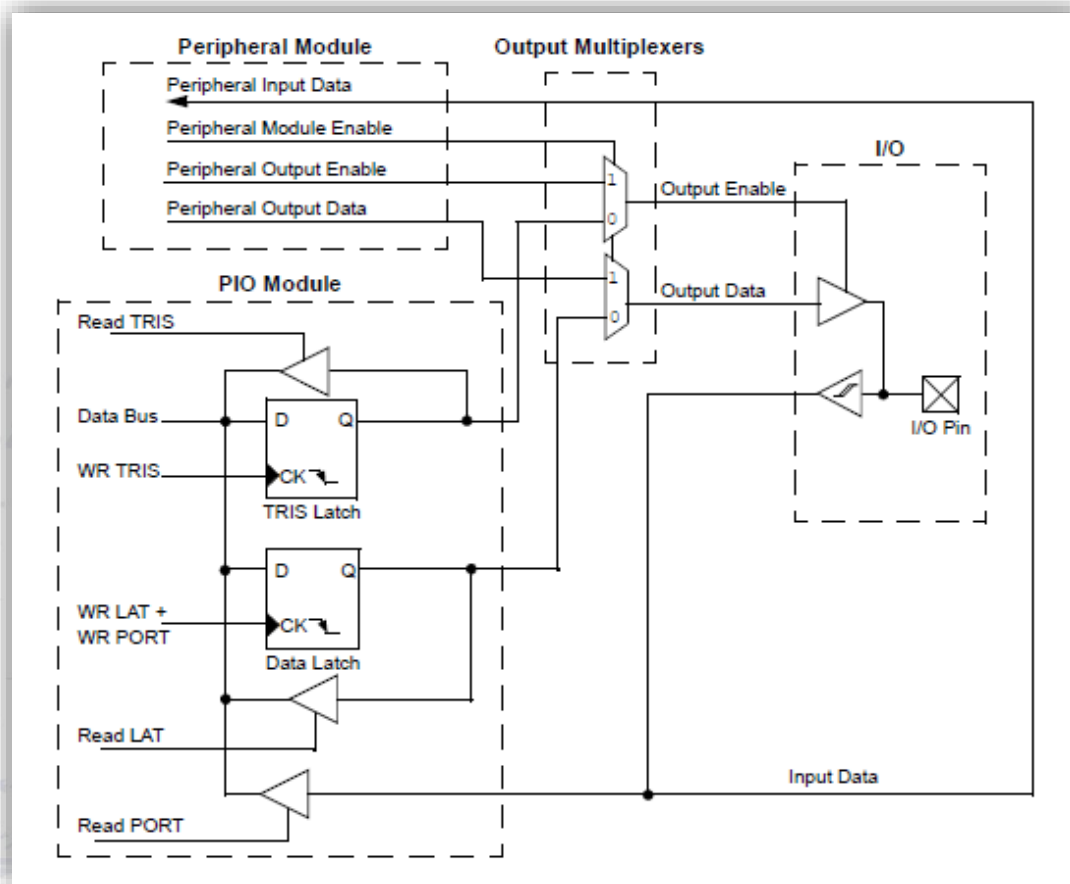
GPIO Block Diagram

- Please refer to the block diagram, this is the concept for programming model. The real and detail block diagram please refer to the following slide.
- **TRIS:** use to determine in or out. 1 for input, 0 for output.
- **LAT:** set output drive value for Output pins.
- **PORT:** reaction logical level from Input pins.



GPIO Block Diagram

◆ PIC24FJGB Family GPIO Block Diagram



Lab1 GPIO Output



Lab1 GPIO Output

- ◆ Try to use MCC to generate your first MCC style code and control GPIO base on MCC style.
- ◆ Try to set **RB7** to digital output mode and output high, low level and toggle level (period around 500ms ~ 1S), individually.
- ◆ Please connect **RB7** to **LED(D1)** to observe pin status.

◆ **How to start ?**

Lab1 GPIO Output

Step 1

- Create New Project again

Project Name : **Lab1_GPIOOutput**

Project Location : **C:\PIC24_Exercises\Exams**

New Project

Steps

1. Choose Project
2. Select Device
3. Select Header
4. Select Tool (Optional)
5. Select Plugin Board
6. Select Compiler
7. Select Project Name and Folder

MPLAB X IDE

Select Project Name and Folder

Project Name: Lab1_GPIOOutput

Project Location: C:\PIC24_Exercises\Exams\ Browse...

Project Folder: C:\PIC24_Exercises\Exams\Lab1_GPIOOutput.X

☐ Overwrite existing project.

☐ Also delete sources.

☒ Set as main project

☐ Use project location as the project folder

Encoding: UTF-8

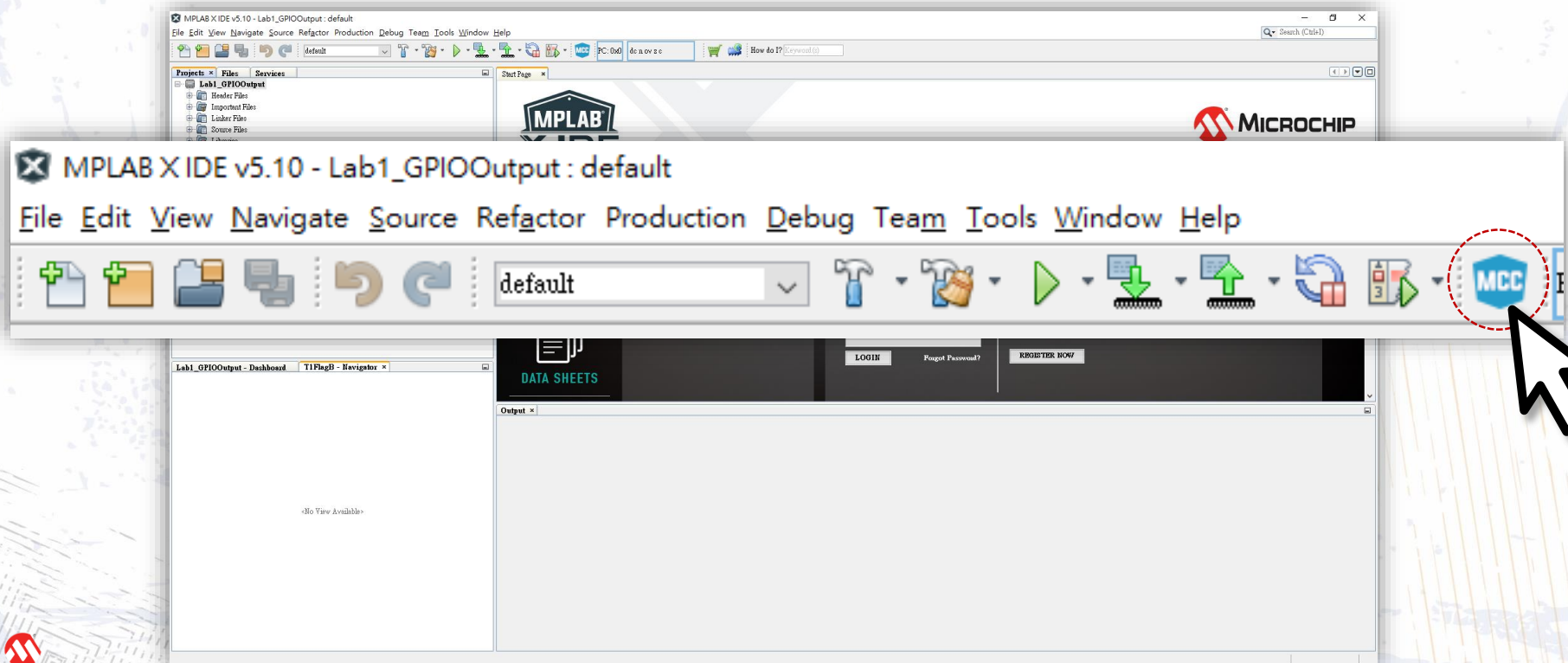
< Back Next > Finish Cancel Help

Lab1 GPIO Output

Step 2

Execute MCC

Select **Tools** ► **Embedded** ► **MPLAB Code Configurator**
or Click **icon** 



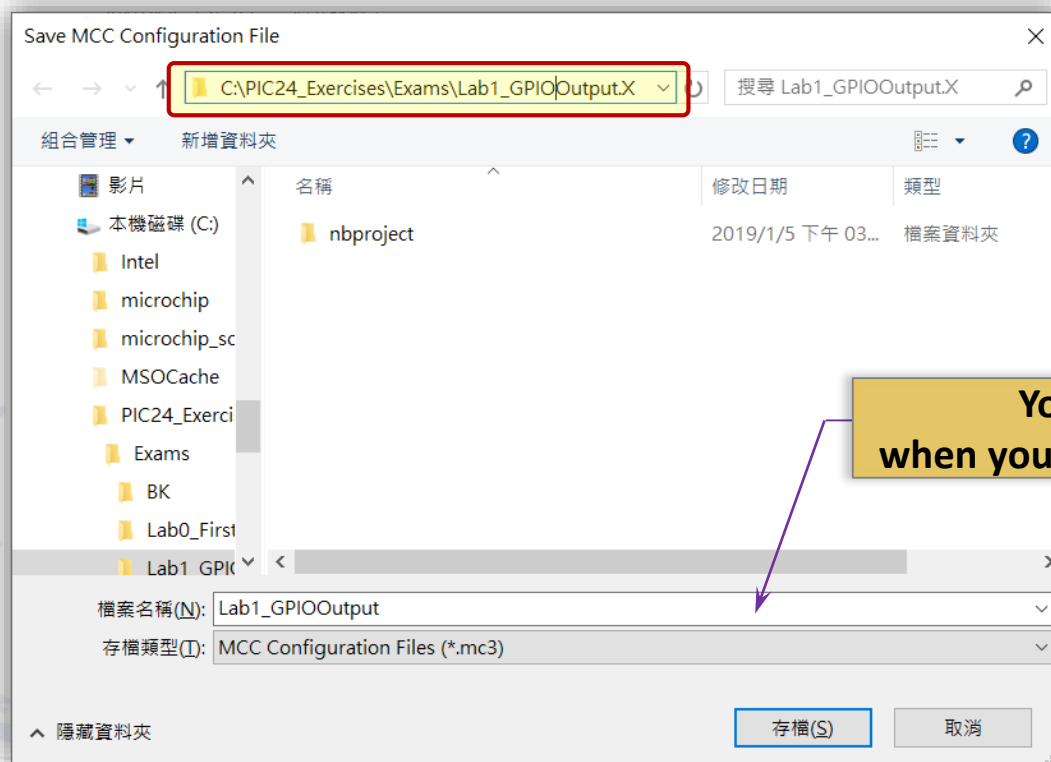
Lab1 GPIO Output

Step 3

Save MCC Configuration File

Select save directory at your project folder.

E.g. **C:\PIC24_Exercises\Exams\Lab1_GPIOOutput.X**



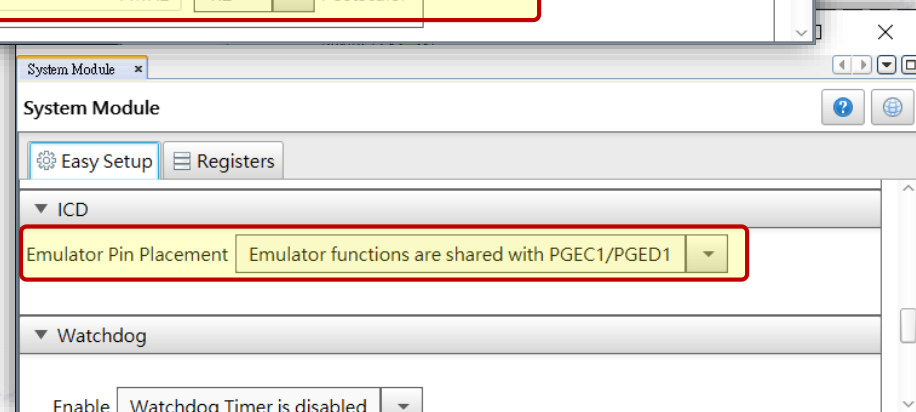
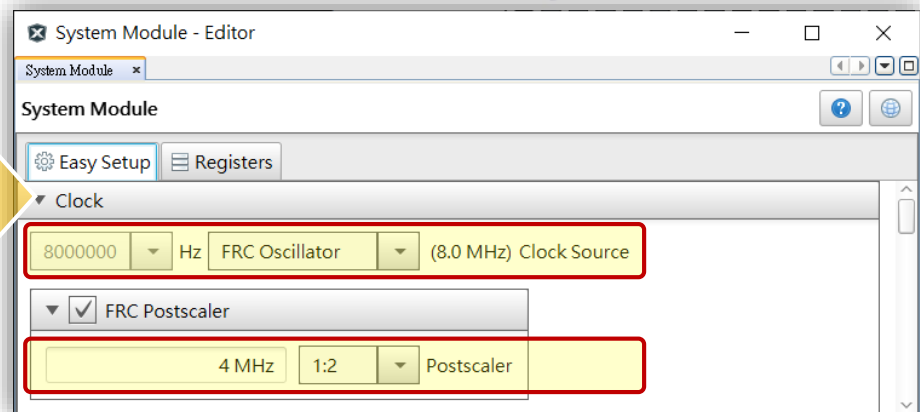
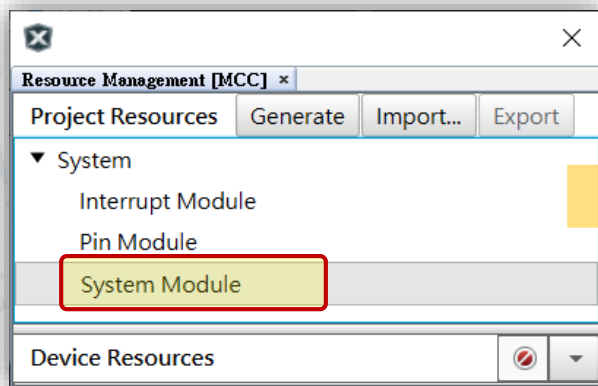
Lab1 GPIO Output

Step 4

◆ Set System Clock & Debug Interface.

System Module ► Clock ► FRC Oscillator, Postscaler:1:2

System Module ► ICD ► PGEC1/PGED1

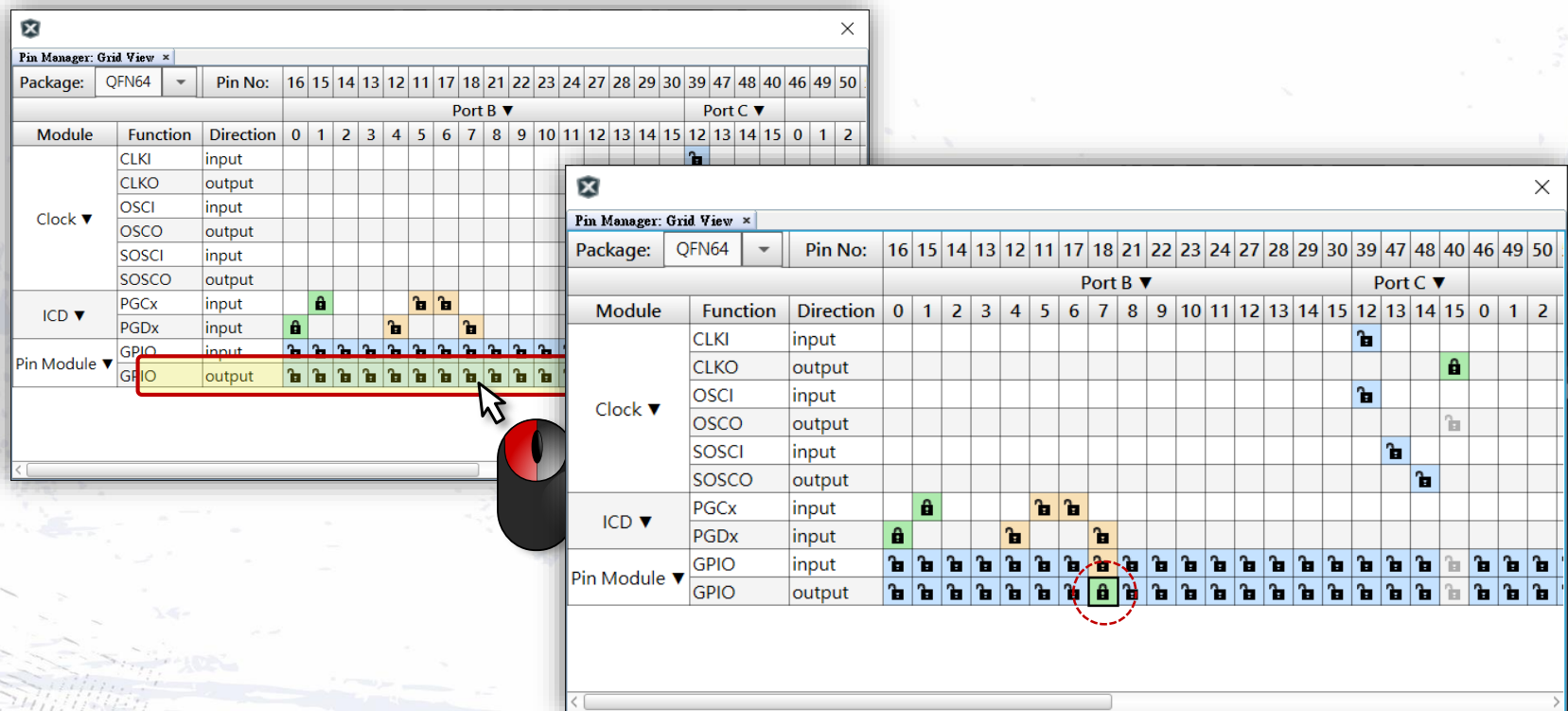


Step 5

- ## Set RB7 to digital output mode

Pin Manager :

Gird View ► Click RB7 to lock to GPIO output

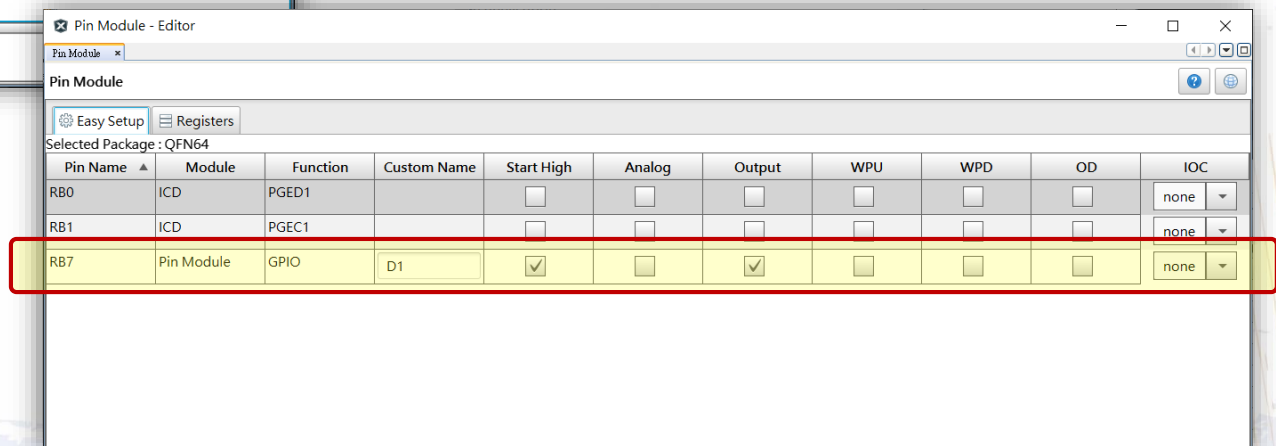
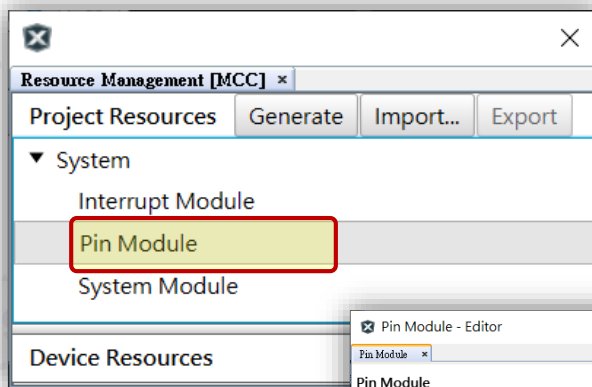


Lab1 GPIO Output

Step 6

Set Alias for RB7

uncheck Analog, check Output & Start high
Alias (Custom Name) : D1



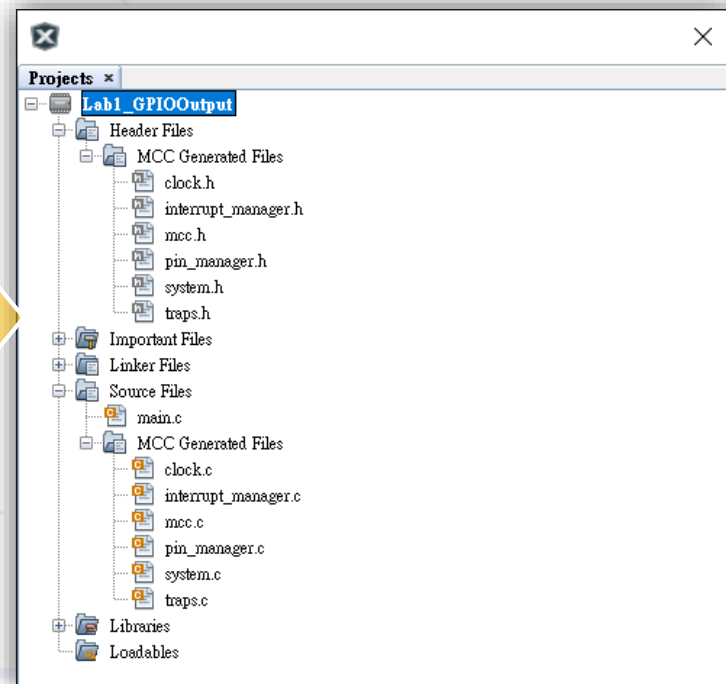
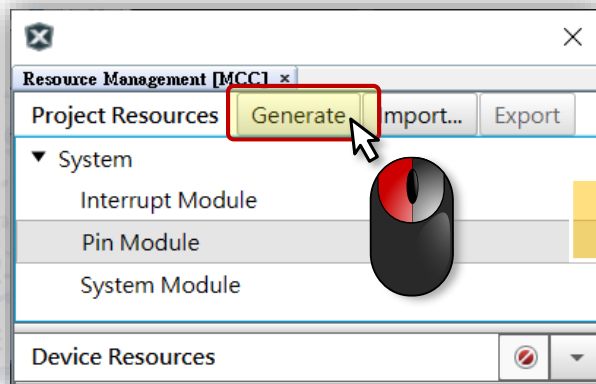
Lab1 GPIO Output

Step 7

Generate Code

Click Generate Code Button to generate your first MCC's style Project.

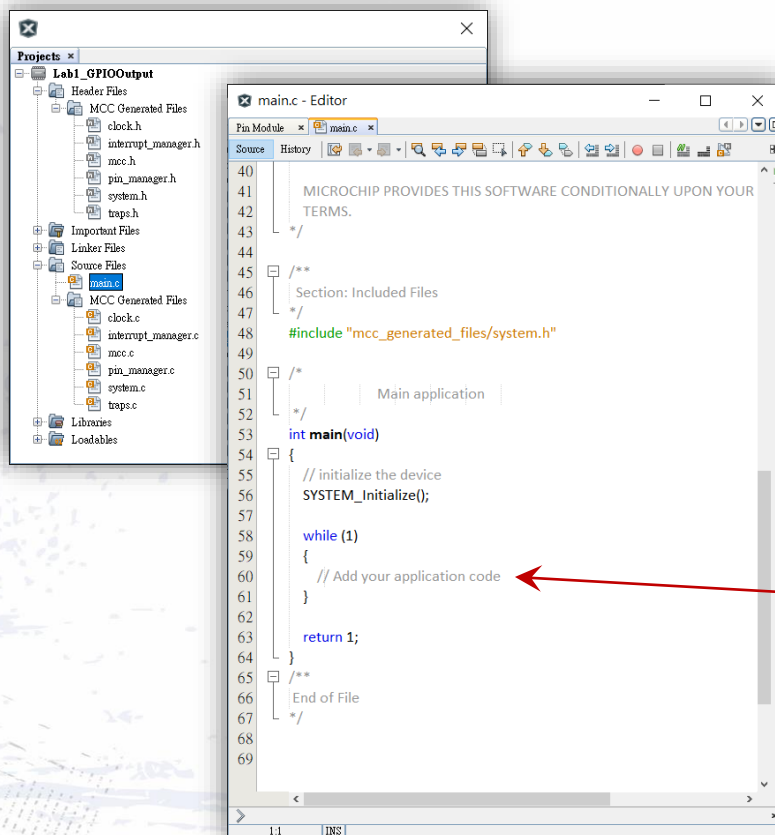
All files generate by MCC include main.c automatically.



Lab1 GPIO Output

Step 8

- Try to add code to main function
Double Click **main.c** to view & add below code to main().



Add below code to main()

```
#include "mcc_generated_files/system.h"
#include "mcc_generated_files/pin_manager.h"

unsigned long i = 0;

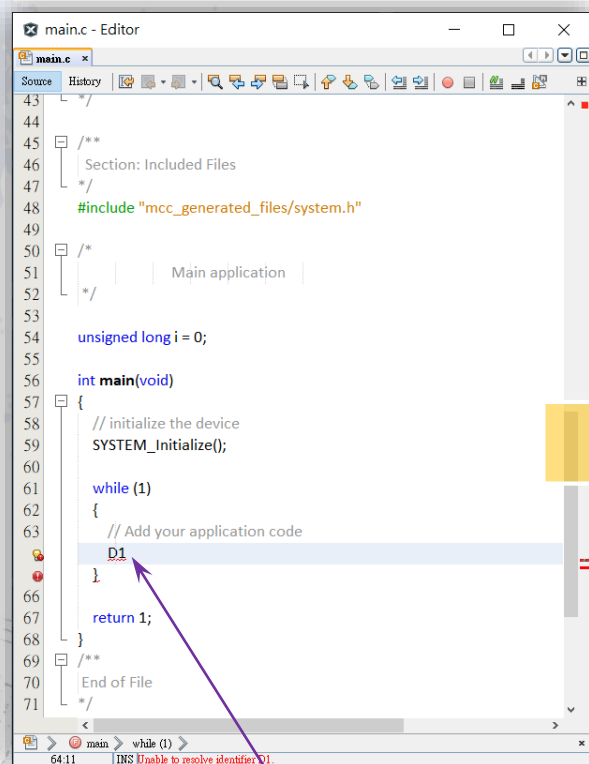
int main(void)
{
    // initialize the device
    SYSTEM_Initialize();

    while (1)
    {
        // Add your application code
        D1_Toggle();
        for (i = 0; i < 80000; i++);
    }
    return -1;
}
```

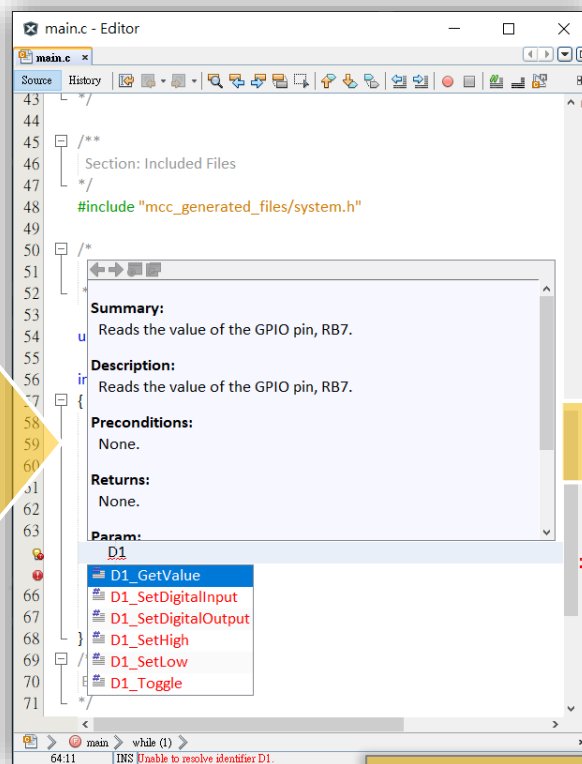
MPLAB X IDE Hints

Hot key “Ctrl+Alt+\\”

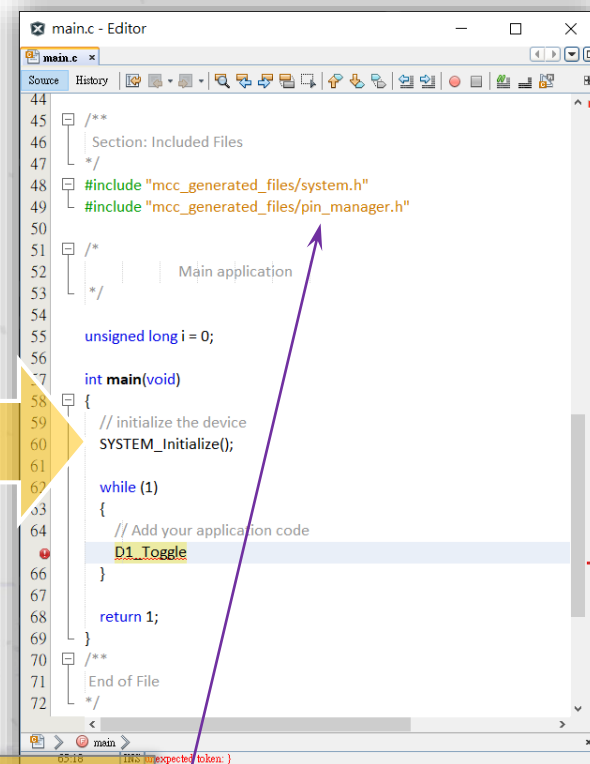
Type D1 first then use “Ctrl+Alt+\\” to find you want.



```
43  */
44
45  /**
46   Section: Included Files
47   */
48   #include "mcc_generated_files/system.h"
49
50  /**
51   Main application
52   */
53
54   unsigned long i = 0;
55
56   int main(void)
57   {
58   // initialize the device
59   SYSTEM_Initialize();
60
61   while (1)
62   {
63   // Add your application code
64   D1
65   }
66
67   return 1;
68  }
69  /**
70   End of File
71  */
```



```
43  */
44
45  /**
46   Section: Included Files
47   */
48   #include "mcc_generated_files/system.h"
49
50  /**
51   Main application
52   */
53
54   unsigned long i = 0;
55
56   int main(void)
57   {
58   // initialize the device
59   SYSTEM_Initialize();
60
61   while (1)
62   {
63   // Add your application code
64   D1
65   }
66
67   return 1;
68  }
69  /**
70   End of File
71  */
```




```
44
45  /**
46   Section: Included Files
47   */
48   #include "mcc_generated_files/system.h"
49   #include "mcc_generated_files/pin_manager.h"
50
51  /**
52   Main application
53   */
54
55   unsigned long i = 0;
56
57   int main(void)
58   {
59   // initialize the device
60   SYSTEM_Initialize();
61
62   while (1)
63   {
64   // Add your application code
65   D1_Toggle
66   }
67
68   return 1;
69  }
70  /**
71   End of File
72  */
```

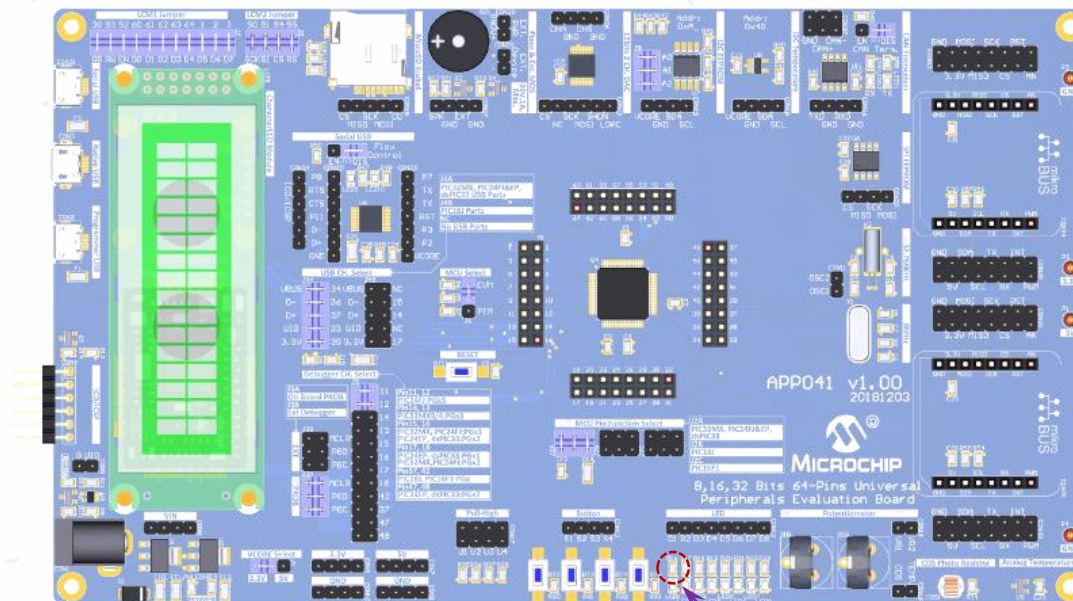
Ctrl+Alt+\\

Add header file
automatically.

Lab1 GPIO Output

Step 9 & Result

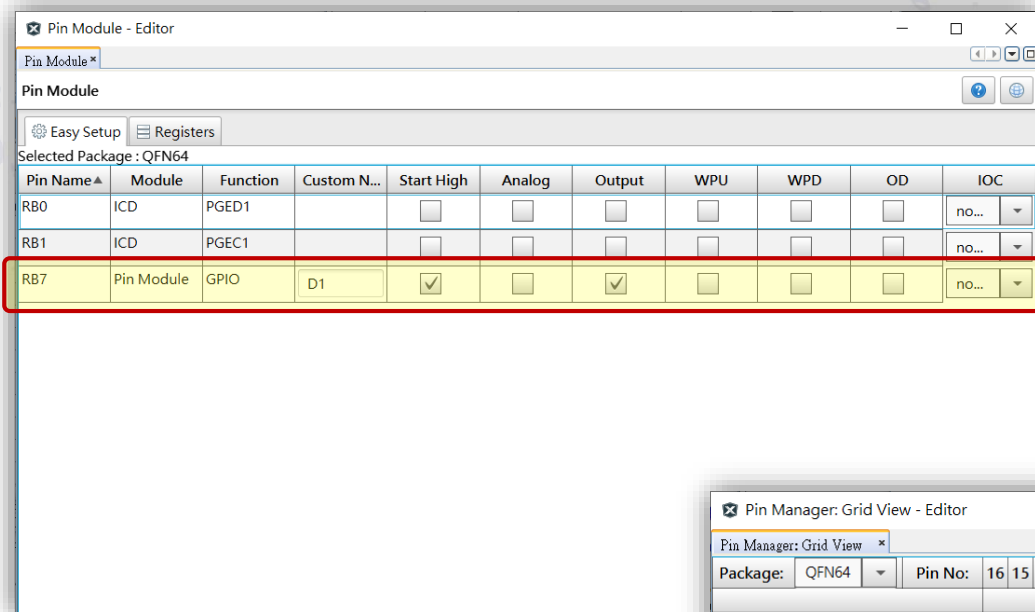
- Try to program your code to your target board.
Select **Make and Program Device Main Project** icon 
Make sure Programming/Verify complete
- Please connect **RB7** to **LED(D1)** to observe LED status.



LED1 Toggle !

Lab1 – GPIO Output

MCC's Setting & Code Example

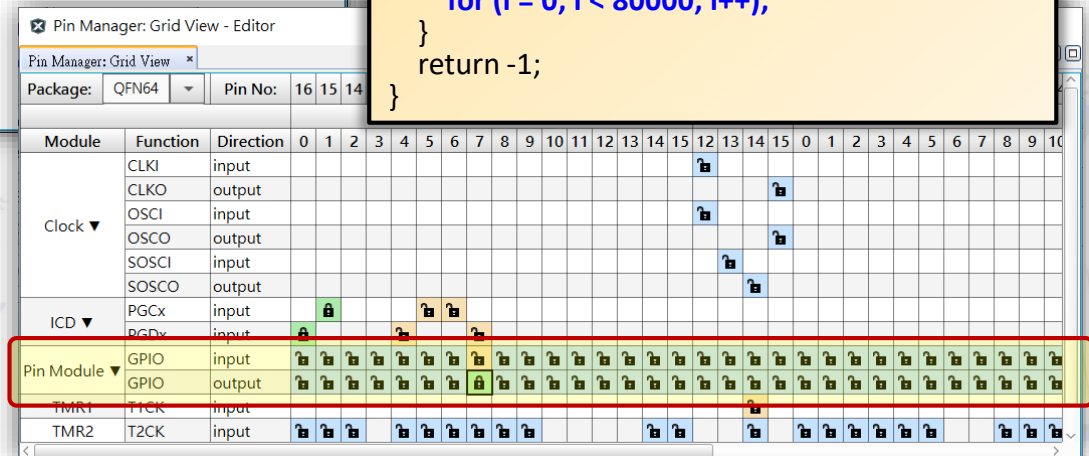


```
#include "mcc_generated_files/system.h"
#include "mcc_generated_files/pin_manager.h"

unsigned long i = 0;

int main(void)
{
    // initialize the device
    SYSTEM_Initialize();

    while (1)
    {
        // Add your application code
        D1_Toggle();
        for (i = 0; i < 80000; i++);
    }
    return -1;
}
```



Lab1 GPIO Output

Review

- Open **pin_manager.h** & **pin_manager.c**
- Try to find D1xxxx relate function & definition at **pin_manager.h**

```
114 @Returns
115 None.
116
117 @Param
118 None.
119
120
121 @Example
122 <code>
123 // Toggle RB7
124 D1_Toggle();
125 </code>
126
127
128 #define D1_Toggle() _LATB7 ^= 1
129
130 @Summary
131 Reads the value of the GPIO pin, RB7.
132
133 @Description
134 Reads the value of the GPIO pin, RB7.
135
136 @Preconditions
137 None.
138
139 @Returns
140 None.
141
142 @Param
143 None.
```

```
56 Section: Driver Interface Function Definitions
57 */
58 void PIN_MANAGER_Initialize(void)
59 {
60     /* Setting the Output Latch SFR(s)
61     *****
62     LATB = 0x0080;
63     LATC = 0x0000;
64     LATD = 0x0000;
65     LATE = 0x0000;
66     LATF = 0x0000;
67     LATG = 0x0000;
68     */
69
70     /* Setting the GPIO Direction SFR(s)
71     *****
72     TRISB = 0xFF7F;
73     TRISC = 0x7000;
74     TRISD = 0x00FF;
75     TRISE = 0x00FF;
76     TRISF = 0x003B;
77     TRISG = 0x03CC;
78     */
79
80     /* Setting the Weak Pull Up and Weak Pull Down SFR(s)
81     *****
82     CNPD1 = 0x0000;
83     CNPD2 = 0x0000;
84     CNPD3 = 0x0000;
85     */
86 }
```

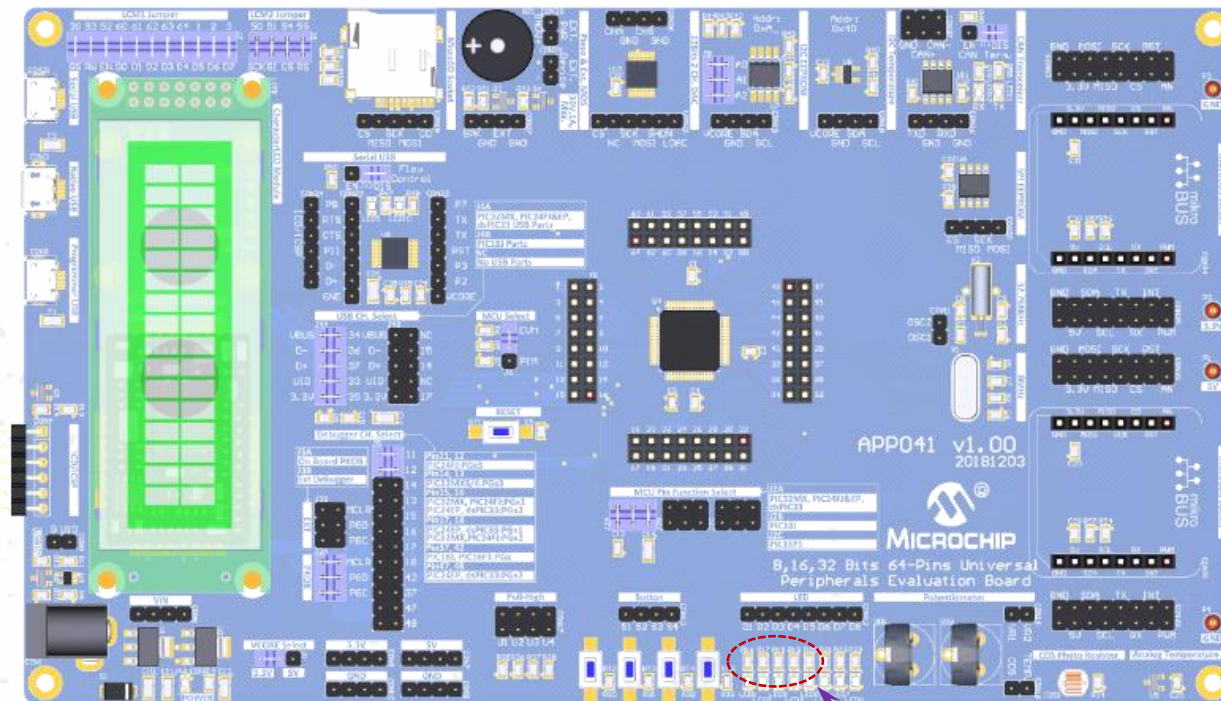
Lab2 Multi-GPIO Output



Lab2 Multi-GPIO Output

- Try to set more GPIO pins to digital output mode and toggle levels (period around 500ms ~ 1S), individually.
- RB7 -> LED1(D1)
RB8 -> LED2(D2)
RB9 -> LED3(D3)
RB10 -> LED4(D4)
- Let's go!**

Lab2 Multi-GPIO Output Result



LEDs Control by Software Delay.

Lab2 Multi-GPIO Output

MCC's Setting & Code Example

Pin Module - Editor

Pin Module

Easy Setup Registers

Selected Package : QFN64

Pin Name	Module	Function	Custom N...	Start High	Analog	Output	WPU	WPD	OD	IOC
RB0	ICD	PGED1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB1	ICD	PGEC1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB7	Pin Module	GPIO	D1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB8	Pin Module	GPIO	D2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB9	Pin Module	GPIO	D3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB10	Pin Module	GPIO	D4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...

```
#include "mcc_generated_files/system.h"
#include "mcc_generated_files/pin_manager.h"
```

```
int main(void)
{
    // initialize the device
    SYSTEM_Initialize();

    while (1)
    {
        // Add your application code
        D1_Toggle();
        D2_Toggle();
        D3_Toggle();
        D4_Toggle();
        for (i = 0; i < 80000; i++);
    }
    return -1;
}
```

Pin Manager: Grid View - Editor

Pin Manager: Grid View

Package: QFN64 Pin No: 16 15 14

Module	Function	Direction	0	1	2
Clock	CLKI	input			
	CLKO	output			
	OSCI	input			
	OSCO	output			
	SOSCI	input			
	SOSCO	output			
ICD	PGCx	input			
	PGDx	input			
Pin Module	GPIO	input			
	GPIO	output			
TMR1	T1CK	input			
TMR2	T2CK	input			

Lab3 GPIO Input

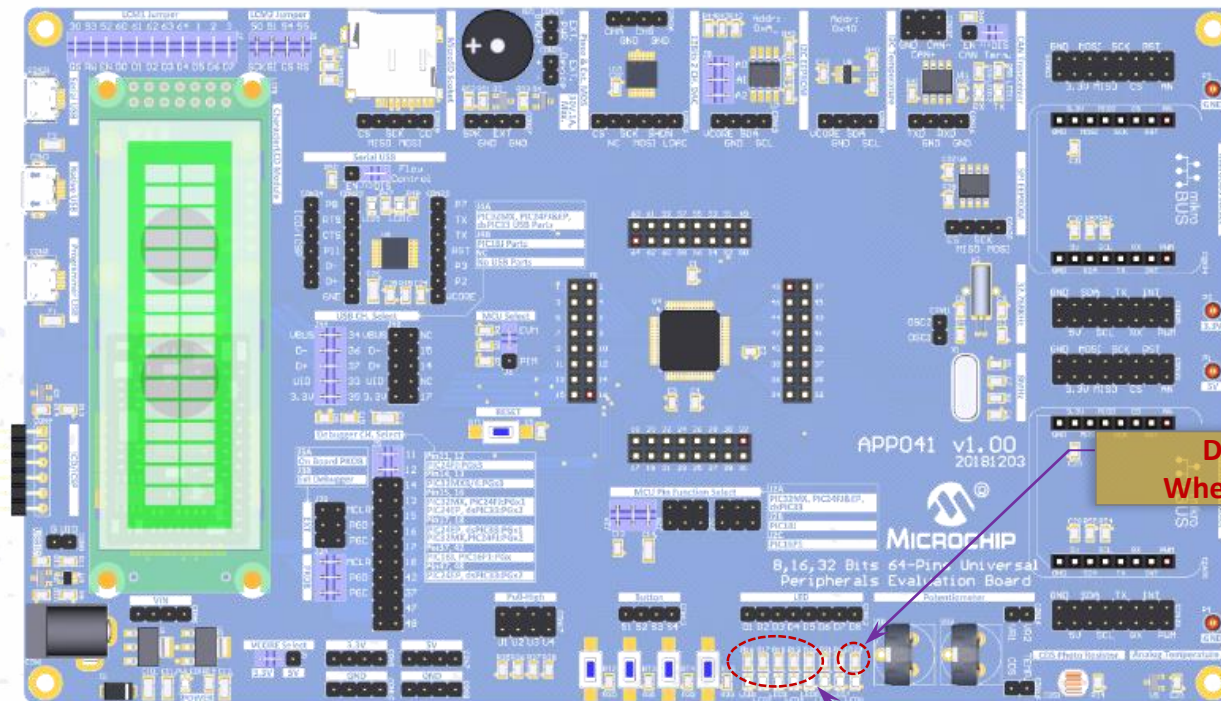


Lab3 GPIO Input

- Try to set **RC13** to digital input to get button status.
- Try to do that to get button status then control another led status.
S1 Pressed -> D8 Light
S1 Released -> D8 Dark
- Please connect **RC13** to **Button(S1)**, **RB14** to **LED(D8)**.
- Let's go!**

Lab3 GPIO Input

Result



D8 Turn On,
When S1 Pressed.

LEDs Control by Software Delay.

Lab3 GPIO Input

MCC's Setting & Code Example

Pin Module - Editor

Pin Module

Easy Setup Registers

Selected Package : QFN64

Pin Name	Module	Function	Custom N...	Start High	Analog	Output	WPU	WPD	OD	IOC
RB0	ICD	PGED1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB1	ICD	PGEC1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB7	Pin Module	GPIO	D1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB8	Pin Module	GPIO	D2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB9	Pin Module	GPIO	D3	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB10	Pin Module	GPIO	D4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RB14	Pin Module	GPIO	D8	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...
RC13	Pin Module	GPIO	S1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	no...

Pin Manager: Grid View - Editor

Pin Manager: Grid View

Module	Function	Direction	0	1	2
Clock	CLKI	input			
	CLKO	output			
	OSCI	input			
	OSCO	output			
	SOSCI	input			
	SOSCO	output			
ICD	PGCx	input			
	PGDx	input			
Pin Module	GPIO	input			
	GPIO	output			
TMR1	T1CK	input			
TMR2	T2CK	input			
TMR3	T3CK	input			

```
int main(void)
{
    // initialize the device
    SYSTEM_Initialize();

    while (1)
    {
        // Add your application code
        if(i++>80000)
        {
            D1_Toggle();

            ...
            i = 0;
        }

        if(S1_GetValue())
            D8_SetLow();
        else
            D8_SetHigh();
    }

    return -1;
}
```