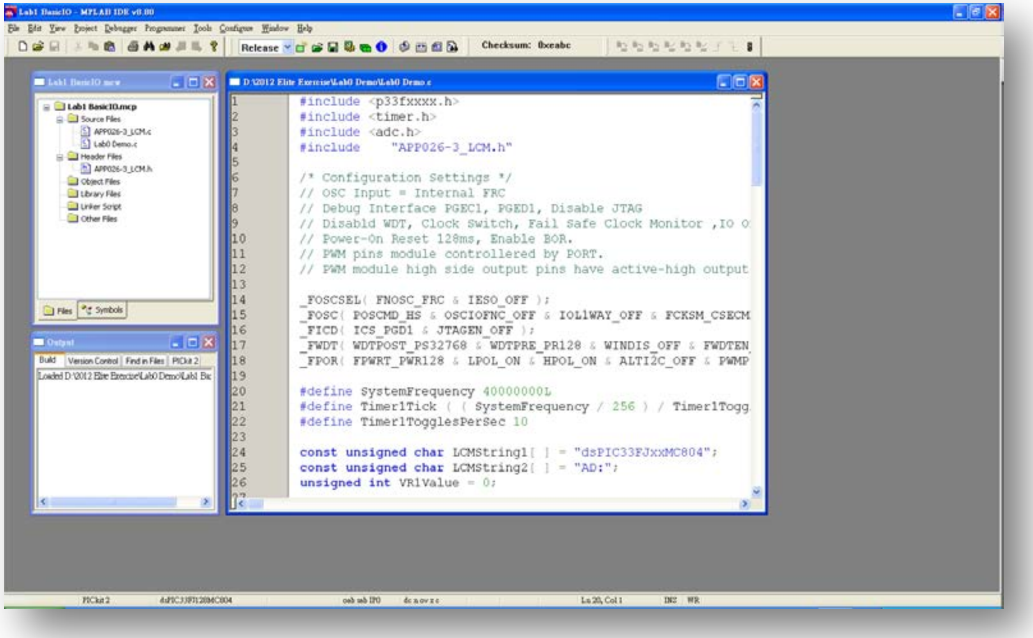
MICROCHIP

Regional Training Centers

Section 2
IDE, Compiler, MCC & Development Tools Introduction

MPLAB® IDE

- Microchip提供的整合式開發環境, 支援全系列8-Bits, 16-Bits及32-Bits的MCU。所有的MCU都可透過相同的環境開發。最終版本是v8.92(不再更新, 以MPLAB X IDE取代)。
- 可整合各式的組譯器/編譯器(MPLAB C, Hi-TECH C, etc.),開發工具(PICkit3, ICD3, Real ICE, etc..) 。



```
#include <p33fxxxx.h>
#include <timer.h>
#include <adc.h>
#include    "APP026-3_LCM.h"

/* Configuration Settings */
// OSC Input = Internal FRC
// Debug Interface PGEC1, PGED1, Disable JTAG
// Disabld WDT, Clock Switch, Fail Safe Clock Monitor ,IO O
// Power-On Reset 128ms, Enable BOR.
// PWM pins module controllered by PORT.
// PWM module high side output pins have active-high output

_FOSCSEL( FNOSC_FRC & IESO_OFF );
_FOSC( POSCMD_HS & OSCIOFNC_OFF & IOL1WAY_OFF & FCKSM_CSECM
_FICD( ICS_PGD1 & JTAGEN_OFF );
_FWDT( WDTPOST_PS32768 & WDTPRE_PR128 & WINDIS_OFF & FWDTEN_
_FPOR( FPWRT_PWR128 & LPOL_ON & HPOL_ON & ALTI2C_OFF & PWMP

#define SystemFrequency 40000000L
#define Timer1Tick ( ( SystemFrequency / 256 ) / Timer1Togg
#define Timer1TogglesPerSec 10

const unsigned char LCMString1[ ] = "dsPIC33FJxxMC804";
const unsigned char LCMString2[ ] = "AD:";
unsigned int VR1Value = 0;
```

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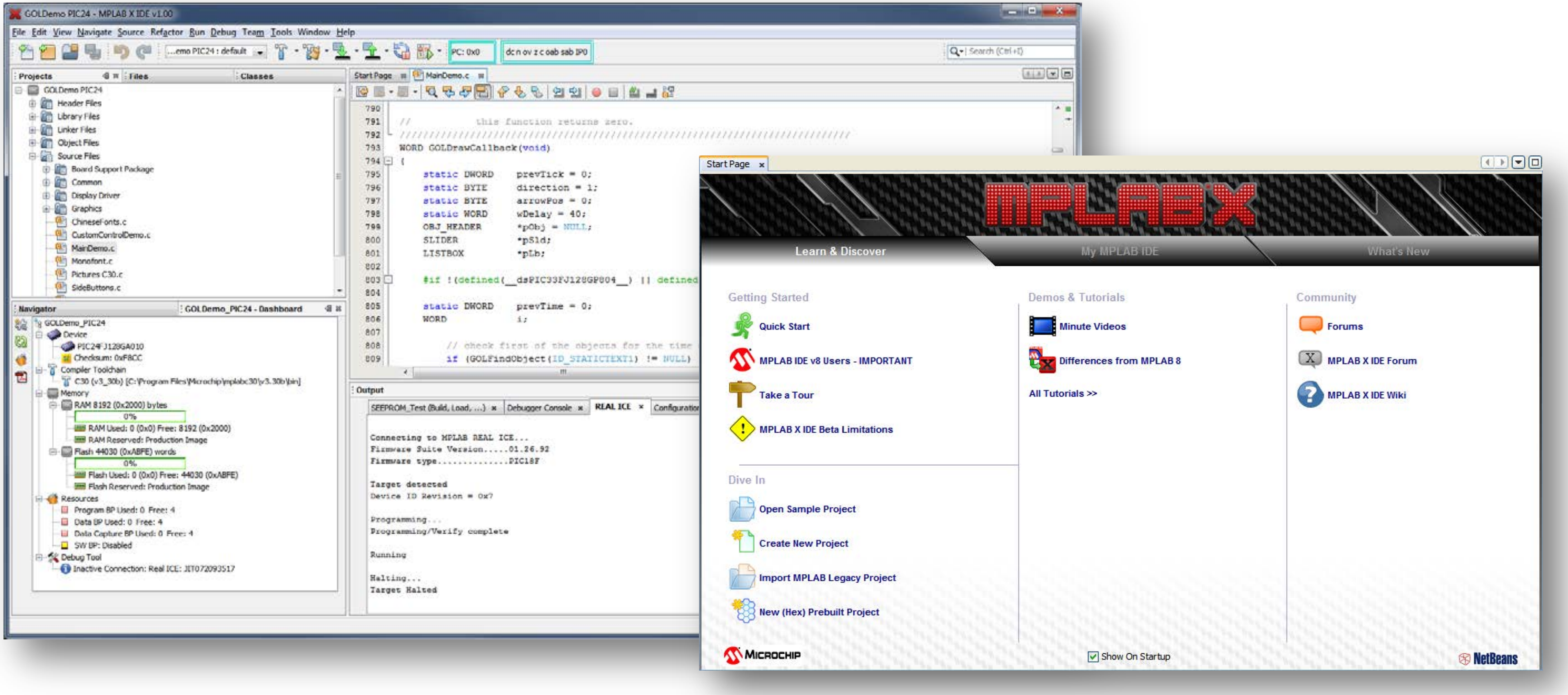
MPLAB® X IDE

- 新一代的整合式開發環境, 可支援全系列MCU, 擁有許便利的功能與特徵。Java Base, 可以跨平台, 目前最新的版本是v3.05。
- 不支援ICD2, ICE2000/4000, ProMATE II, PICStart Plus.

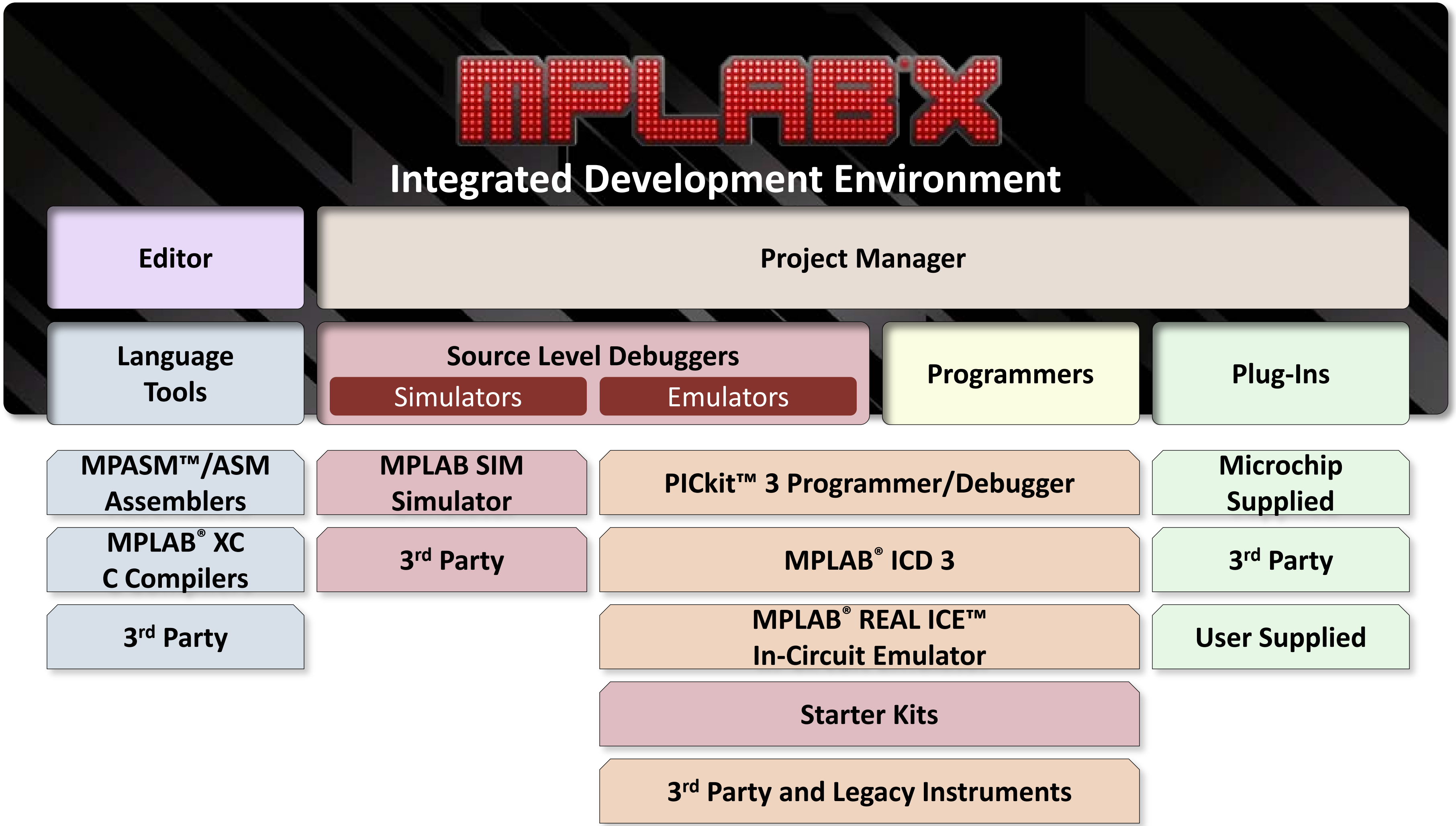


```
//              this function returns zero.
////////////////////////////////////////////////////////////////////////////////
WORD GOLDrawCallback(void)
{
    static DWORD    prevTick = 0;
    static BYTE     direction = 1;
    static BYTE     arrowPos = 0;
    static WORD     wDelay = 40;
    OBJ_HEADER      *pObj = NULL;
    SLIDER          *pSld;
    LISTBOX         *pLb;

    #if !(defined(__dsPIC33FJ128GP804__) || defined

    static DWORD    prevTime = 0;
    WORD            i;

        // check first of the objects for the time
        if (GOLFindObject(ID_STATICTEXT1) != NULL)
```

SEEPROM_Test (Build, Load, ...) | Debugger Console | REAL ICE | Configuration

```
Connecting to MPLAB REAL ICE...
Firmware Suite Version.....01.26.92
Firmware type..............PIC18F

Target detected
Device ID Revision = 0x7

Programming...
Programming/Verify complete

Running

Halting...
Target Halted
```

MPLAB® X IDE Overview



MPLAB X

Integrated Development Environment

Editor

Project Manager

Language Tools
- MPASM™/ASM Assemblers
- MPLAB® XC C Compilers
- 3rd Party

Source Level Debuggers
- Simulators
  - MPLAB SIM Simulator
  - 3rd Party
- Emulators

Programmers
- PICkit™ 3 Programmer/Debugger
- MPLAB® ICD 3
- MPLAB® REAL ICE™ In-Circuit Emulator
- Starter Kits
- 3rd Party and Legacy Instruments

Plug-Ins
- Microchip Supplied
- 3rd Party
- User Supplied

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MPLAB XC16

- 新一代的C Compiler, 支援Microchip 16-Bits MCU。架構於GCC Compiler, 採用GNU General Public License (GPL)。

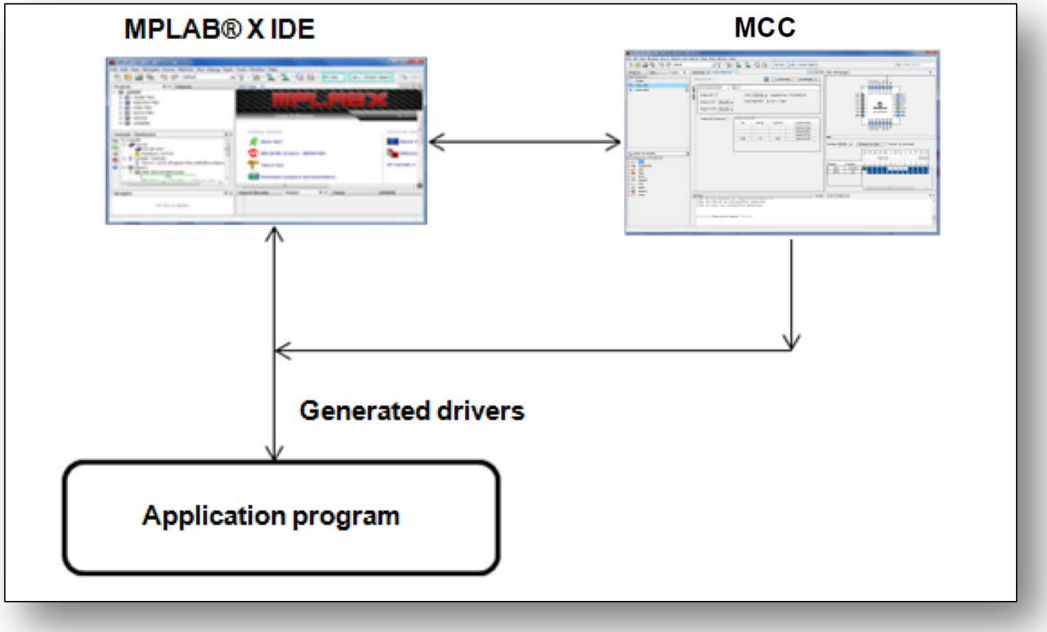
  * GPL:使用者可以自由執行/複製/修改/改進再公開
- 支援PIC24/dsPIC30/dsPIC33全系列MCU, MPLAB XC16可整合於MPLAB IDE / MPLAB X IDE中。
- 提供標準C Functions(printf, scanf, etc..), 週邊函式庫, 數學運算函數等。
- 可至Microchip網站, 取得免費版本。http://www.microchip.com/xc16

About XC Compiler Version

- MPLAB XC Compiler提供四種不同版本的C Compiler:
    - 標準版(Standard) (Standard Compiler Workstation License, 495 USD)
      付費版本,擁有完整編譯功能及最佳化(Optimizations)的功能,可跟精簡版相比,最高可以減少20%~25%的記憶體空間。
    - 專業版(Pro) (Pro Compiler Workstation License, 995 USD)
      付費版本,擁有完整編譯功能及最佳化(Optimizations)的功能,可跟精簡版相比,最高可以減少50%的記憶體空間。
    - 精簡版(Lite)
      免費版本,擁有完整編譯功能, 與正式版唯一的差異,就是沒有完整的最佳化功能,只擁有Level 1最佳化功能。
    - 評估版(Evaluation)
      免費版本, 安裝後60天內,具有標準版的所有功能,60天後自動變成精簡版。
- 需要付費的標準版(Standard) 跟專業版(Pro), 其授權區分成Workstation License跟Network Server License兩種。

MPLAB® Code Configurator

- MPLAB Code Configurator, MCC。是一個圖形化的程式碼設定工具。透過MCC可以圖形化的方式, 快速的產生周邊模組的初始化。除此之外, 許多常用控制函數MCC也會一併產生。
- 透過MCC可以大幅加快程式式的設計流程, 並減少重複性的程式碼撰寫工作。
- MCC套件以 Plug-in 的方式, 整合到MPLAB X IDE 中。
- MCC目前支援大部分的 Microchip 8 Bits與16 Bits MCU。



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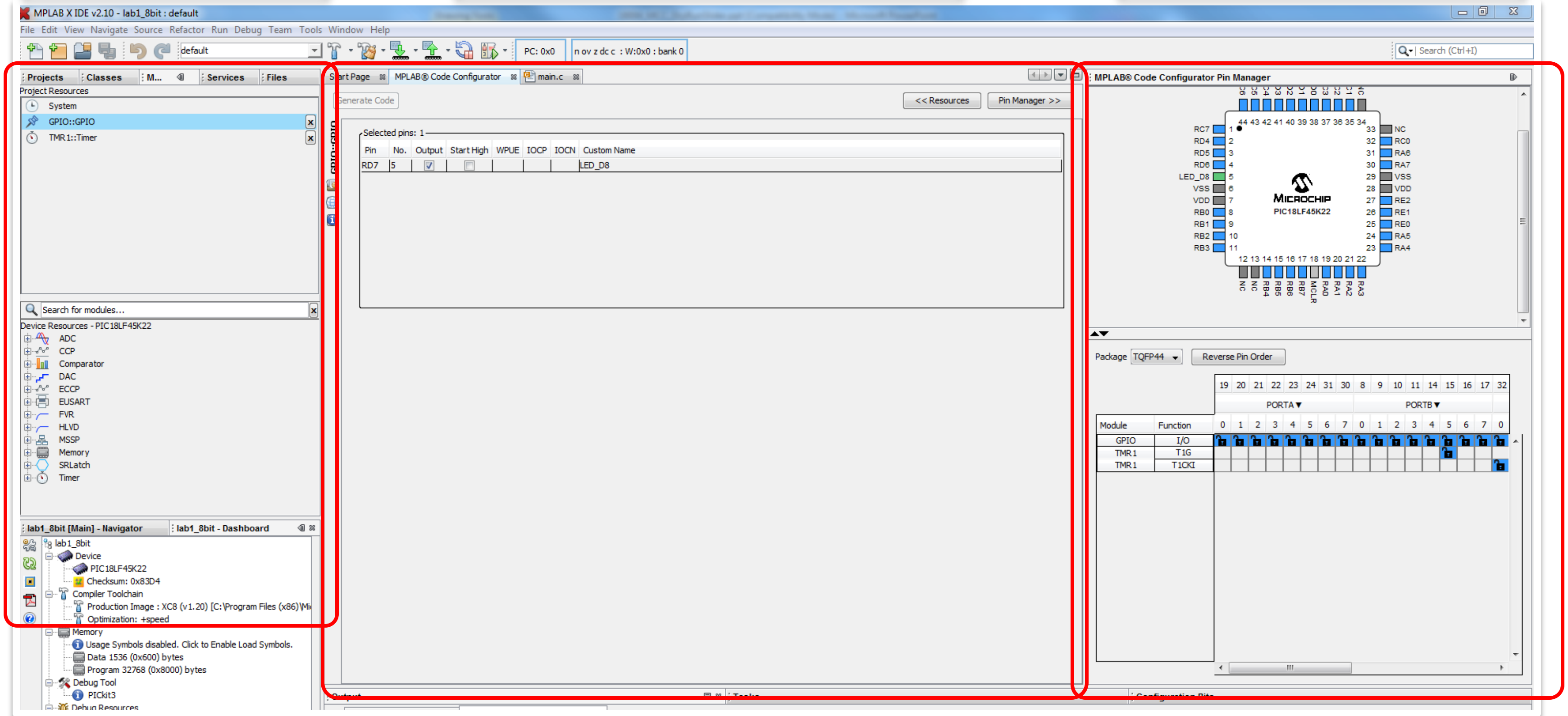
MCC Quick View

- **MCC的設定畫面, 可以大致上分成三個部分**

資源區　　建構區　　接腳管理區



Project Resources
- System
- GPIO::GPIO
- TMR1::Timer

Search for modules...

Device Resources - PIC18LF45K22
- ADC
- CCP
- Comparator
- DAC
- ECCP
- EUSART
- FVR
- HLVD
- MSSP
- Memory
- SRLatch
- Timer

lab1_8bit [Main] - Navigator | lab1_8bit - Dashboard

- lab1_8bit
  - Device
    - PIC18LF45K22
    - Checksum: 0x83D4
  - Compiler Toolchain
    - Production Image : XC8 (v1.20) [C:\Program Files (x86)\Mi
    - Optimization: +speed
  - Memory
    - Usage Symbols disabled. Click to Enable Load Symbols.
    - Data 1536 (0x600) bytes
    - Program 32768 (0x8000) bytes
  - Debug Tool
    - PICkit3
  - Debug Resources

Selected pins: 1

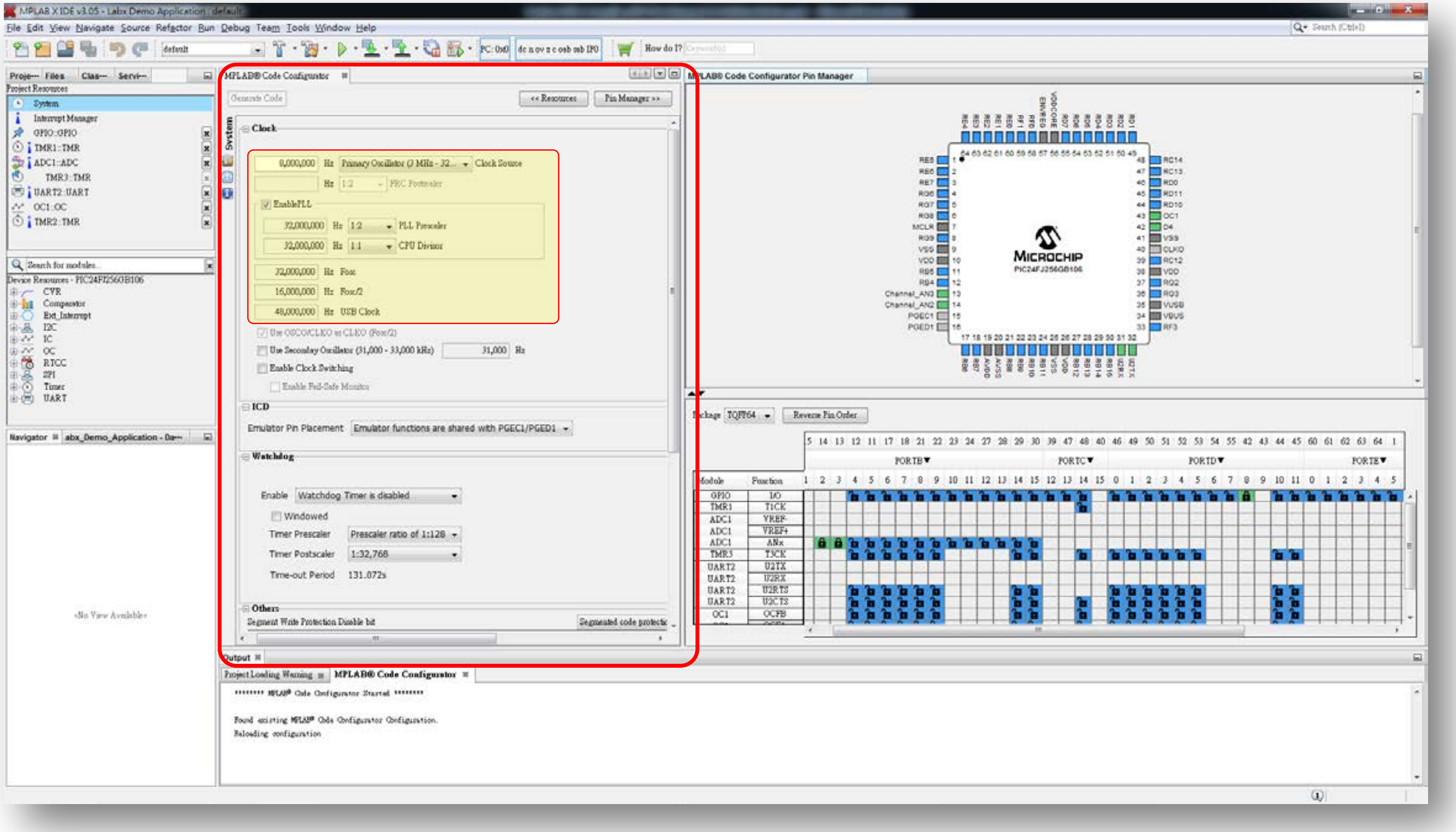
Pin	No.	Output	Start High	WPUE	IOCP	IOCN	Custom Name
RD7	5	☑	☐				LED_D8

Package TQFP44　Reverse Pin Order

		19	20	21	22	23	24	31	30	8	9	10	11	14	15	16	17	32
		PORTA▼								PORTB▼								
Module	Function	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0
GPIO	I/O	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓	🔓
TMR1	T1G														🔓			
TMR1	T1CKI																	🔓

MCC Quick View

- 圖形化設定系統時脈, Configuration Word設定更直覺。



Clock

8,000,000	Hz	Primary Oscillator (2 MHz - 32...	Clock Source
	Hz	1:2	FRC Postscaler

☑ EnablePLL

32,000,000	Hz	1:2	PLL Prescaler
32,000,000	Hz	1:1	CPU Divisor

32,000,000	Hz	Fosc
16,000,000	Hz	Fosc/2
48,000,000	Hz	USB Clock

☑ Use OSCO/CLKO as CLKO (Fosc/2)

☐ Use Secondary Oscillator (31,000 - 33,000 kHz) 31,000 Hz

☐ Enable Clock Switching

☐ Enable Fail-Safe Monitor

ICD

Emulator Pin Placement: Emulator functions are shared with PGEC1/PGED1

Watchdog

Enable: Watchdog Timer is disabled

☐ Windowed

Timer Prescaler: Prescaler ratio of 1:128

Timer Postscaler: 1:32,768

Time-out Period: 131.072s

Others

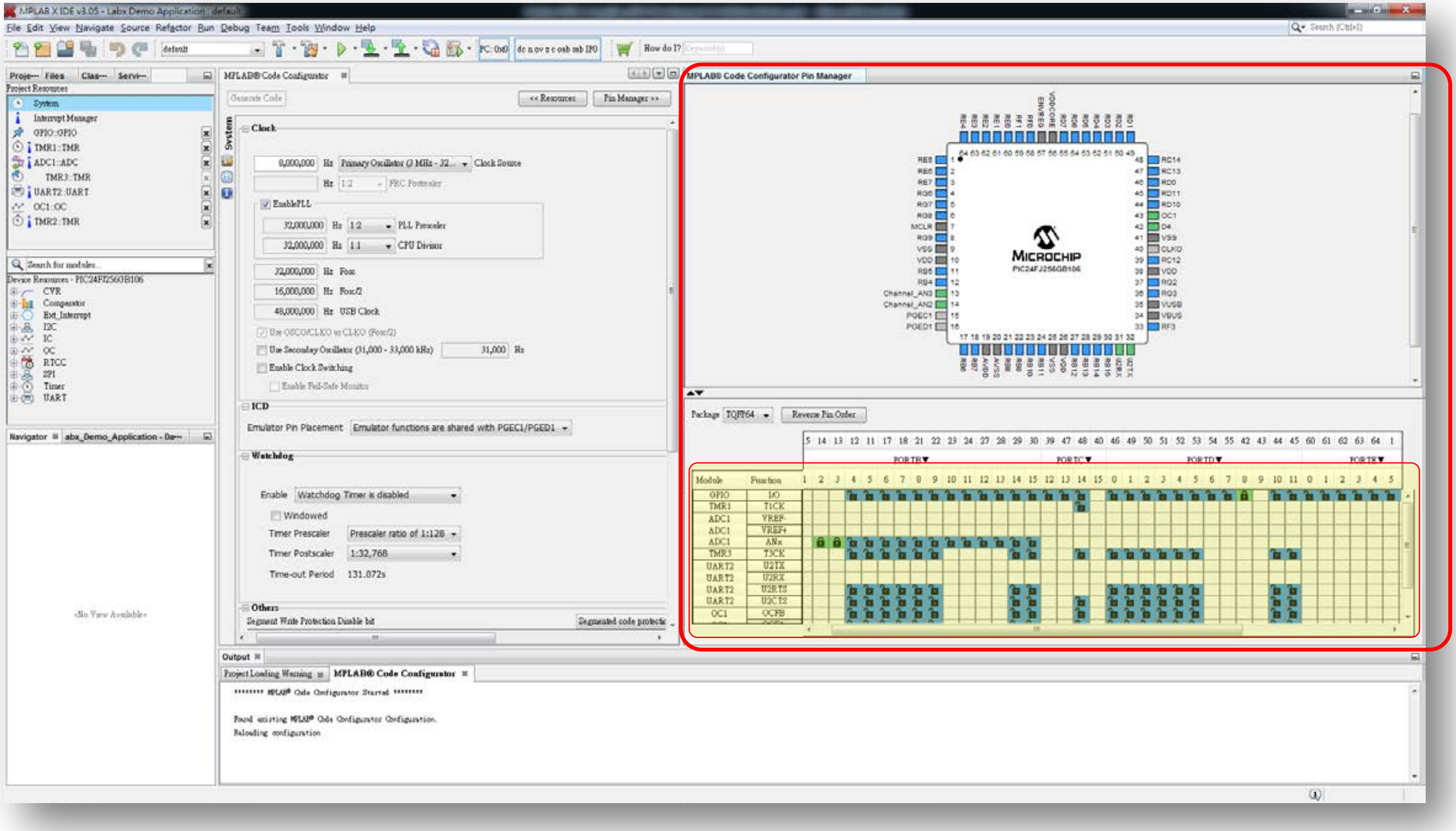
Segment Write Protection Disable bit: Segmented code protectio

```
******** MPLAB® Code Configurator Started ********

Found existing MPLAB® Code Configurator Configuration.
Reloading configuration
```

MCC Quick View

- 圖形化接腳指定, 衝突一目了然, 自動產生對應的PPS程式碼。



Clock

0,000,000 Hz Primary Oscillator (3 MHz - 32... Clock Source

Hz 1:2 FRC Postscaler

☑ EnablePLL

32,000,000 Hz 1:2 PLL Prescaler

32,000,000 Hz 1:1 CPU Divisor

32,000,000 Hz Fosc

16,000,000 Hz Fosc/2

48,000,000 Hz USB Clock

☑ Use OSCO/CLKO as CLKO (Fosc/2)

☐ Use Secondary Oscillator (31,000 - 33,000 kHz) 31,000 Hz

☐ Enable Clock Switching

☐ Enable Fail-Safe Monitor

ICD

Emulator Pin Placement: Emulator functions are shared with PGEC1/PGED1

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Enable: Watchdog Timer is disabled

☐ Windowed

Timer Prescaler: Prescaler ratio of 1:128

Timer Postscaler: 1:32,768

Time-out Period: 131.072s

Others

Segment Write Protection Disable bit: Segmented code protectio

Package: TQFP64

Module	Function
GPIO	I/O
TMR1	T1CK
ADC1	VREF-
ADC1	VREF+
ADC1	ANx
TMR3	T3CK
UART2	U2TX
UART2	U2RX
UART2	U2RTS
UART2	U2CTS
OC1	OCFB

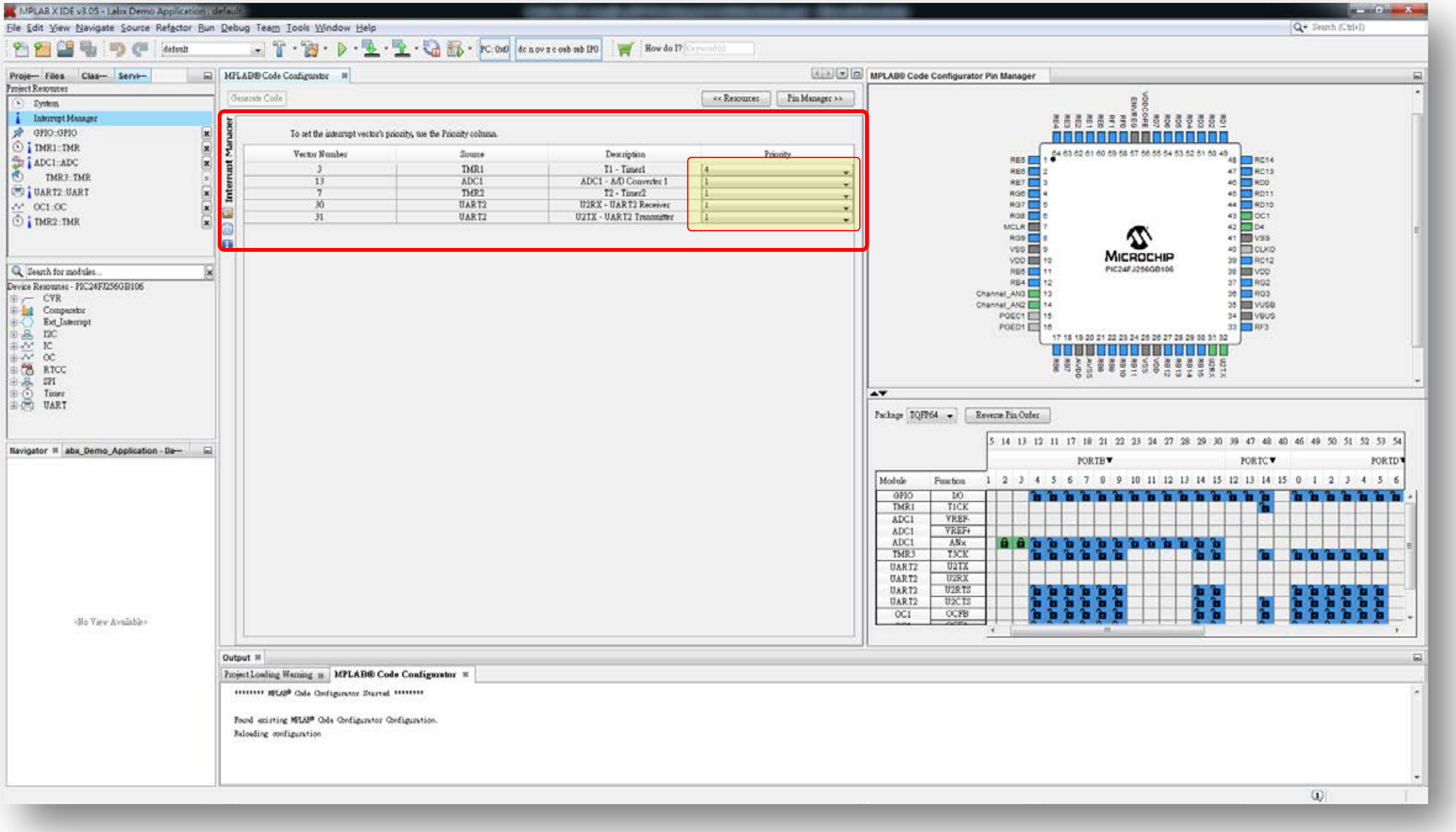
Output – MPLAB® Code Configurator

```
******** MPLAB® Code Configurator Started ********

Found existing MPLAB® Code Configurator Configuration.
Reloading configuration
```

MCC Quick View

- 圖形化中斷介面, 更易於管理, 中斷相關函式會自動產生,不需要擔心語法錯誤與遺漏問題。



MPLAB X IDE v3.05 - Labx Demo Application : default
File Edit View Navigate Source Refactor Run Debug Team Tools Window Help
MPLAB® Code Configurator
Generate Code
<< Resources
Pin Manager >>
Interrupt Manager
MPLAB® Code Configurator Pin Manager
Output

To set the interrupt vector's priority, use the Priority column.

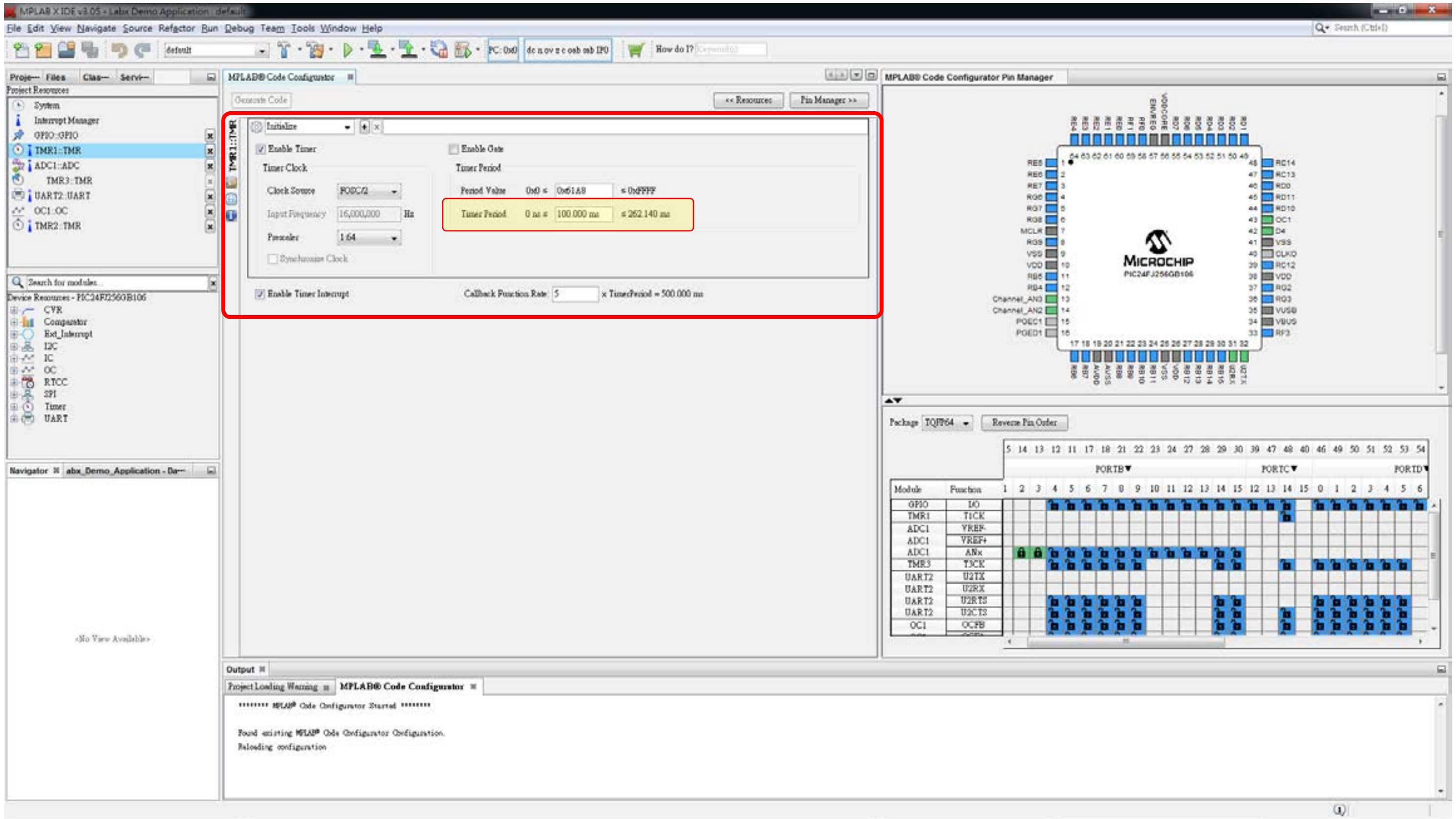
Vector Number	Source	Description	Priority
3	TMR1	T1 - Timer1	4
13	ADC1	ADC1 - A/D Converter 1	1
7	TMR2	T2 - Timer2	1
30	UART2	U2RX - UART2 Receiver	1
31	UART2	U2TX - UART2 Transmitter	1

```
******** MPLAB® Code Configurator Started ********

Found existing MPLAB® Code Configurator Configuration.
Reloading configuration
```

MCC Quick View

- 周邊模組得設定更加直覺, Timer設定不再需要繁複的計算。



Initialize

☑ Enable Timer

☐ Enable Gate

Timer Clock

Clock Source: FOSC/2

Input Frequency: 16,000,000 Hz

Prescaler: 1:64

☐ Synchronize Clock

Timer Period

Period Value: 0x0 ≤ 0x61A8 ≤ 0xFFFF

Timer Period: 0 ns ≤ 100.000 ms ≤ 262.140 ms

☑ Enable Timer Interrupt

Callback Function Rate: 5 x TimerPeriod = 500.000 ms

Package: TQFP64

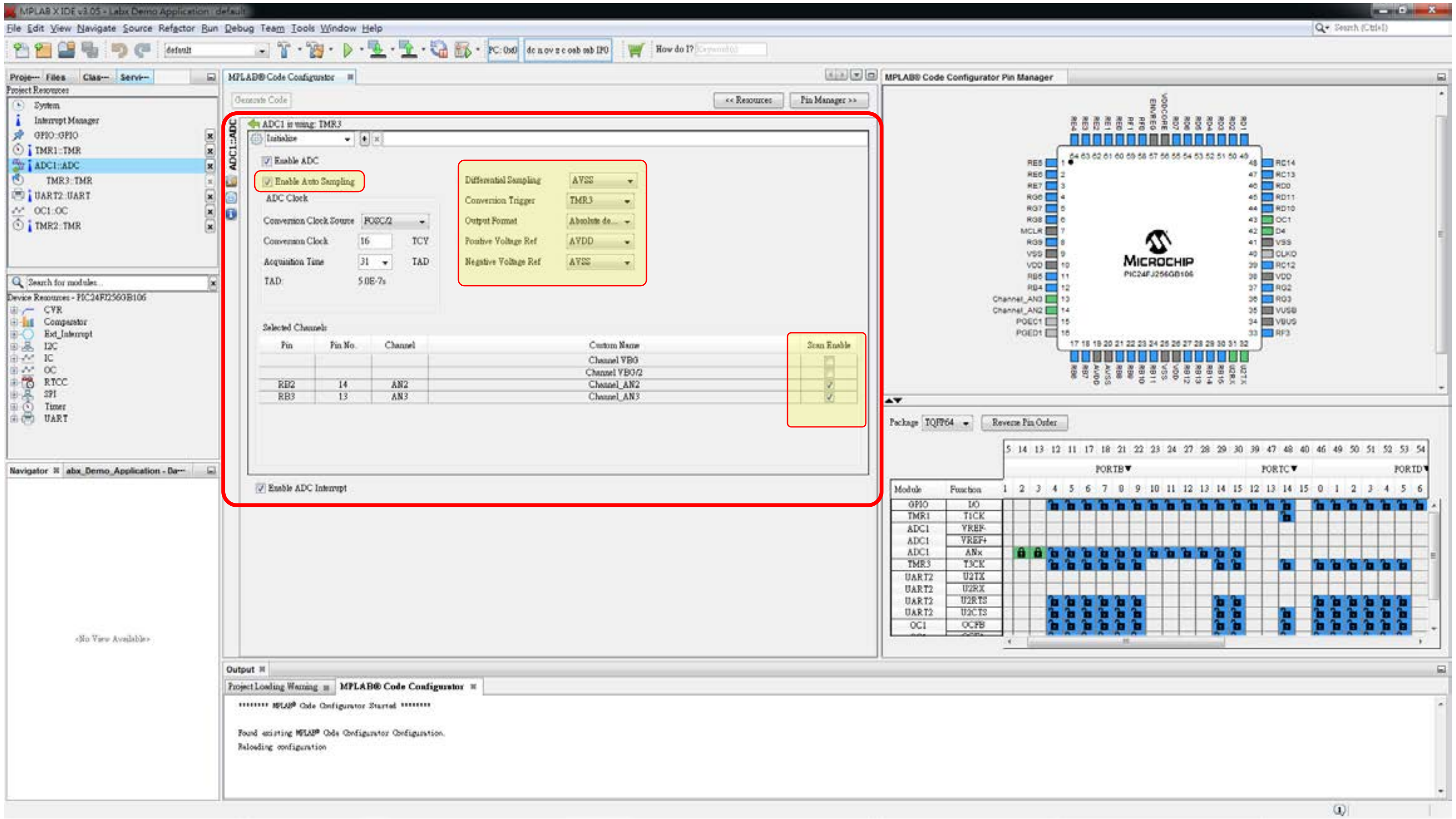
Output — Project Loading Warning — MPLAB® Code Configurator

```
******** MPLAB® Code Configurator Started ********

Found existing MPLAB® Code Configurator Configuration.
Reloading configuration
```

MCC Quick View

- ADC設定只需透過滑鼠點選, 接腳類比模式自動設定, 觸發與掃描模式皆可設定。



ADC1 is using: TMR3

☑ Enable ADC

☑ Enable Auto Sampling

ADC Clock

Conversion Clock Source: FOSC/2

Conversion Clock: 16 TCY

Acquisition Time: 31 TAD

TAD: 5.0E-7s

Differential Sampling: AVSS

Conversion Trigger: TMR3

Output Format: Absolute de...

Positive Voltage Ref: AVDD

Negative Voltage Ref: AVSS

Selected Channels

Pin	Pin No.	Channel	Custom Name	Scan Enable
			Channel VBG	☐
			Channel VBG/2	☐
RB2	14	AN2	Channel_AN2	☑
RB3	13	AN3	Channel_AN3	☑

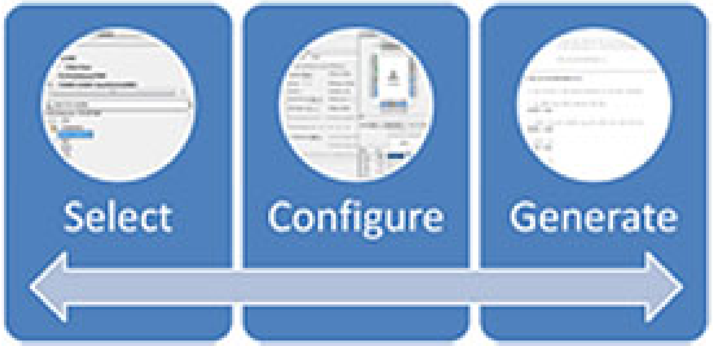
☑ Enable ADC Interrupt

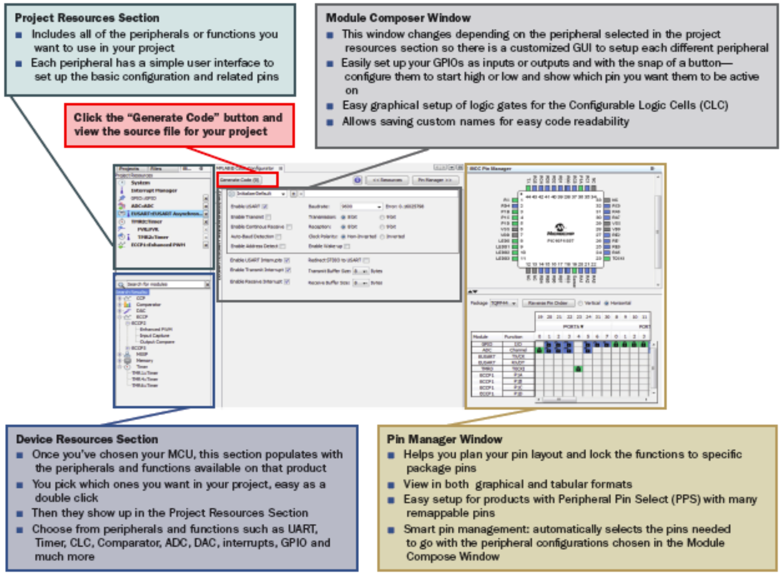
```
******** MPLAB® Code Configurator Started ********

Found existing MPLAB® Code Configurator Configuration.
Reloading configuration
```

MCC Quick View

- 更多的功能, 在後續的內容中可以看到更多…





Project Resources Section

- Includes all of the peripherals or functions you want to use in your project
- Each peripheral has a simple user interface to set up the basic configuration and related pins

Click the "Generate Code" button and view the source file for your project

Module Composer Window

- This window changes depending on the peripheral selected in the project resources section so there is a customized GUI to setup each different peripheral
- Easily set up your GPIOs as inputs or outputs and with the snap of a button—configure them to start high or low and show which pin you want them to be active on
- Easy graphical setup of logic gates for the Configurable Logic Cells (CLC)
- Allows saving custom names for easy code readability

Device Resources Section

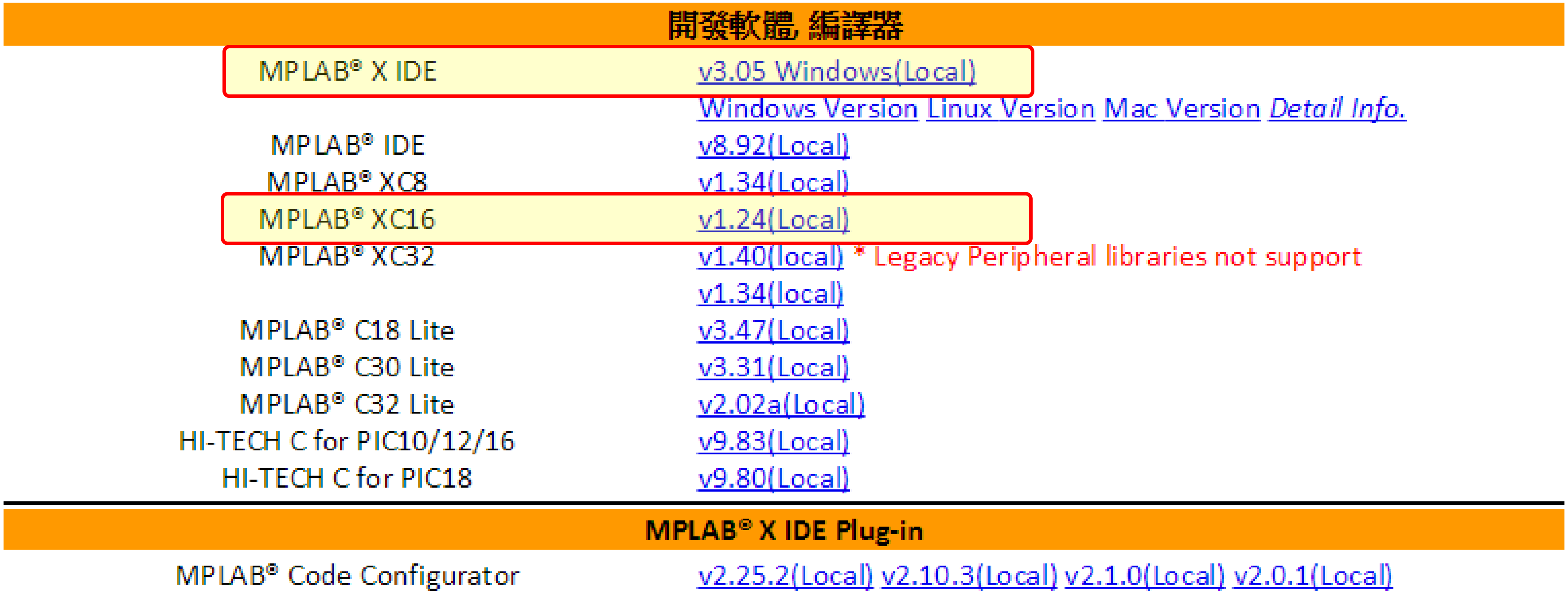
- Once you've chosen your MCU, this section populates with the peripherals and functions available on that product
- You pick which ones you want in your project, easy as a double click
- Then they show up in the Project Resources Section
- Choose from peripherals and functions such as UART, Timer, CLC, Comparator, ADC, DAC, interrupts, GPIO and much more

Pin Manager Window

- Helps you plan your pin layout and lock the functions to specific package pins
- View in both graphical and tabular formats
- Easy setup for products with Peripheral Pin Select (PPS) with many remappable pins
- Smart pin management: automatically selects the pins needed to go with the peripheral configurations chosen in the Module Compose Window

Tools Installation

- 開發工具可以使用 Microchip RTC 教育訓練光碟或至以下連結取得 http://www.microchip.com.tw/Data_CD/
- **MPLAB X IDE v3.05**
  MPLAB XC16 v1.24

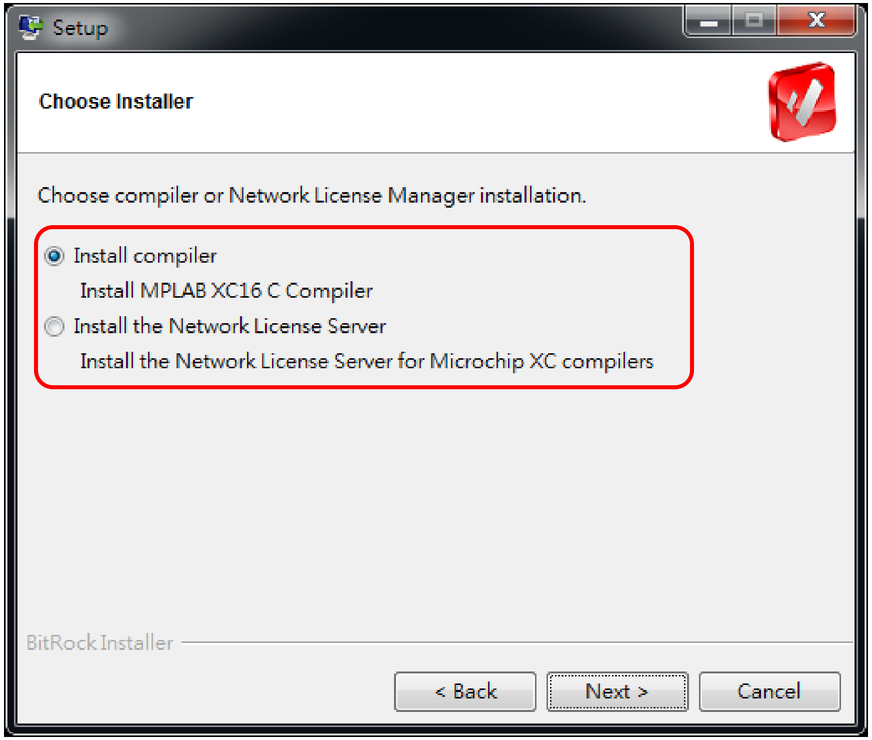


開發軟體, 編譯器	
MPLAB® X IDE	v3.05 Windows(Local)
	Windows Version Linux Version Mac Version *Detail Info.*
MPLAB® IDE	v8.92(Local)
MPLAB® XC8	v1.34(Local)
MPLAB® XC16	v1.24(Local)
MPLAB® XC32	v1.40(local) * Legacy Peripheral libraries not support
	v1.34(local)
MPLAB® C18 Lite	v3.47(Local)
MPLAB® C30 Lite	v3.31(Local)
MPLAB® C32 Lite	v2.02a(Local)
HI-TECH C for PIC10/12/16	v9.83(Local)
HI-TECH C for PIC18	v9.80(Local)
MPLAB® X IDE Plug-in	
MPLAB® Code Configurator	v2.25.2(Local) v2.10.3(Local) v2.1.0(Local) v2.0.1(Local)

Regional Training Centers

MPLAB XC16 Install

- MPLAB IDE安裝時, 並不會安裝MPLAB XC16。必須自行安裝。
- MPLAB XC16安裝時, 預設都是精簡版。如果要使用其他版本, 必須透過後續的線上註冊來改變(專業版, 標準版必須付費, 評估版必須線上申請)。
- 本次課程會使用v1.24的精簡版, 預設安裝路徑為 C:\Program Files\Microchip\XC16\v1.24\



Choose Installer

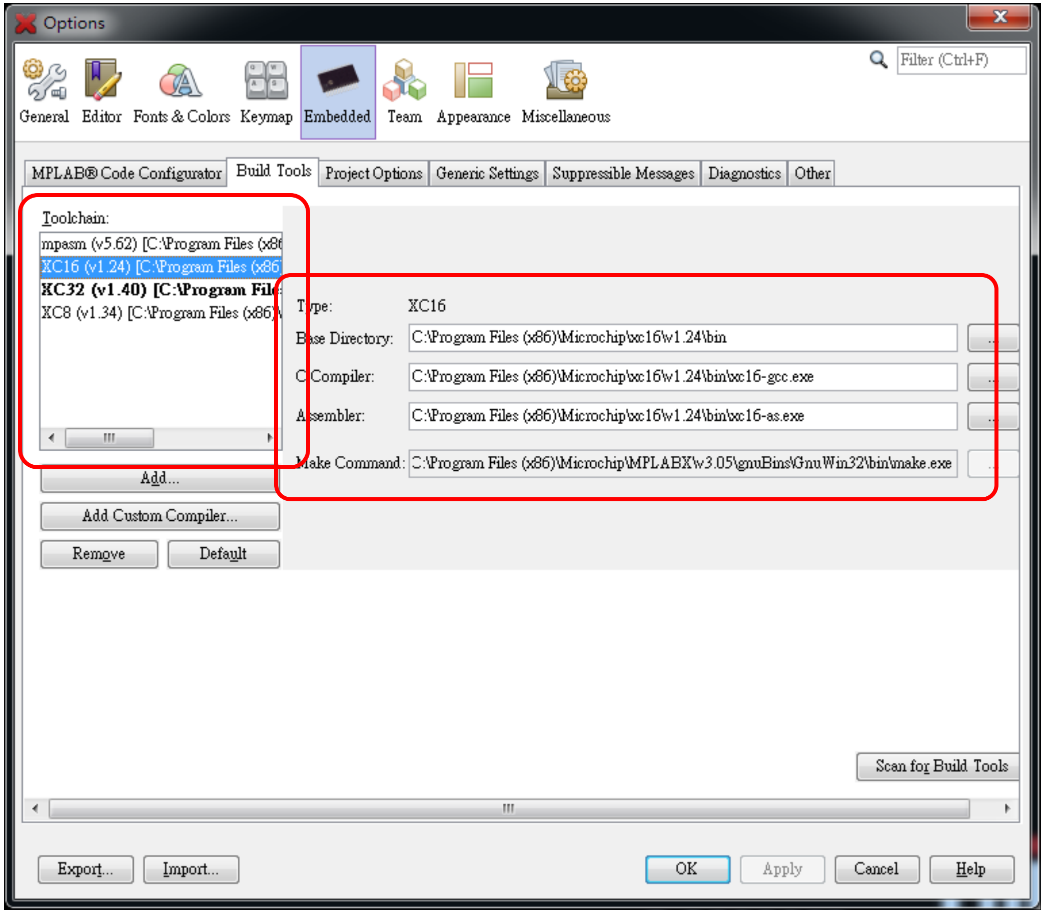
Choose compiler or Network License Manager installation.

● Install compiler
  Install MPLAB XC16 C Compiler

○ Install the Network License Server
  Install the Network License Server for Microchip XC compilers

Install Status Check

- 安裝完成後, 可以使用MPLAB X IDE功能表中的Tools\Options來確認。
- 先選擇Tools\Options, 然後點選 “Embedded”, 再選擇 “Build Tools”，確認 XC16 已正確安裝。

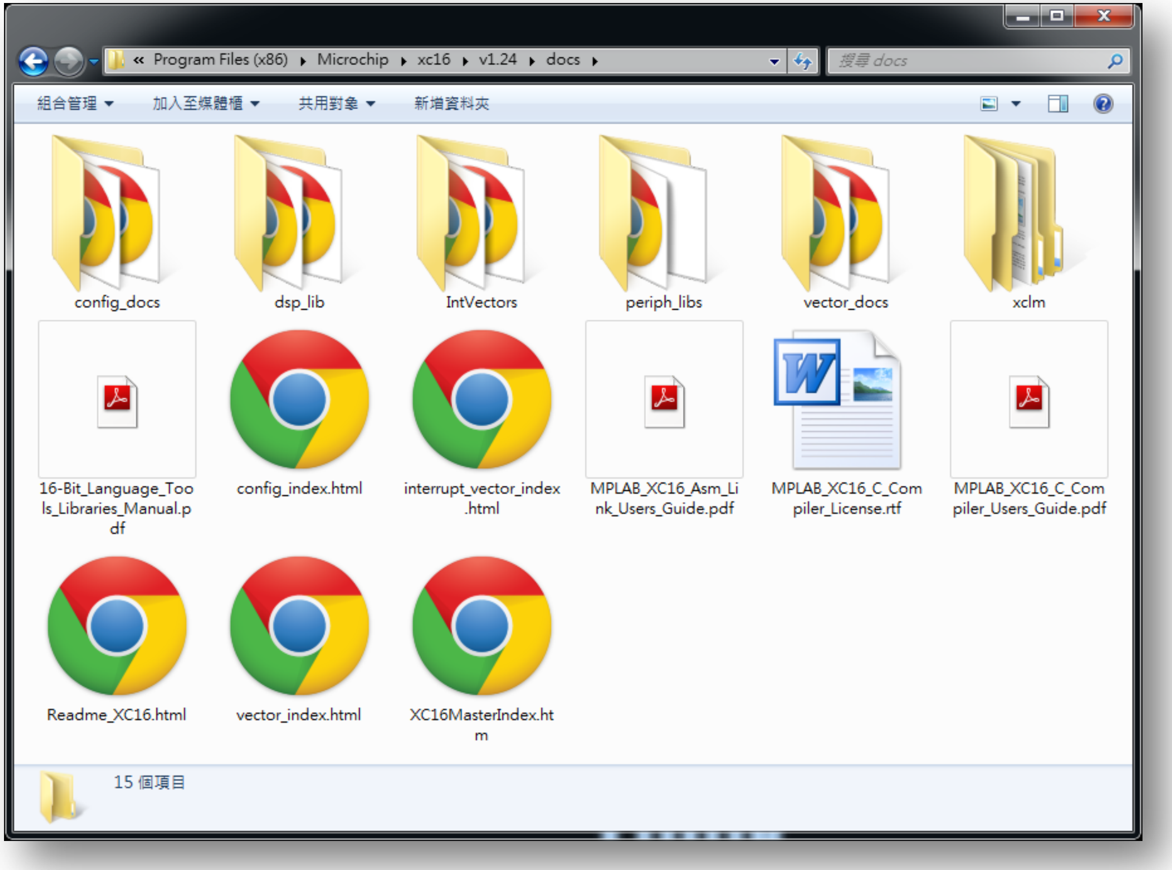


Toolchain:
mpasm (v5.62) [C:\Program Files (x8
XC16 (v1.24) [C:\Program Files (x86
XC32 (v1.40) [C:\Program Fil
XC8 (v1.34) [C:\Program Files (x86)\

Type: XC16
Base Directory: C:\Program Files (x86)\Microchip\xc16\v1.24\bin
C Compiler: C:\Program Files (x86)\Microchip\xc16\v1.24\bin\xc16-gcc.exe
Assembler: C:\Program Files (x86)\Microchip\xc16\v1.24\bin\xc16-as.exe
Make Command: C:\Program Files (x86)\Microchip\MPLABX\v3.05\gnuBins\GnuWin32\bin\make.exe

MPLAB XC16’s Documents

- MPLAB XC16的相關文件,可以 C:\Program Files\Microchip\XC16\vx.xx\docs\裡找到。


« Program Files (x86) ▸ Microchip ▸ xc16 ▸ v1.24 ▸ docs ▸
搜尋 docs
組合管理 ▾
加入至媒體櫃 ▾
共用對象 ▾
新增資料夾
config_docs
dsp_lib
IntVectors
periph_libs
vector_docs
xclm
16-Bit_Language_Tools_Libraries_Manual.pdf
config_index.html
interrupt_vector_index.html
MPLAB_XC16_Asm_Link_Users_Guide.pdf
MPLAB_XC16_C_Compiler_License.rtf
MPLAB_XC16_C_Compiler_Users_Guide.pdf
Readme_XC16.html
vector_index.html
XC16MasterIndex.htm
15 個項目

MCC Installation

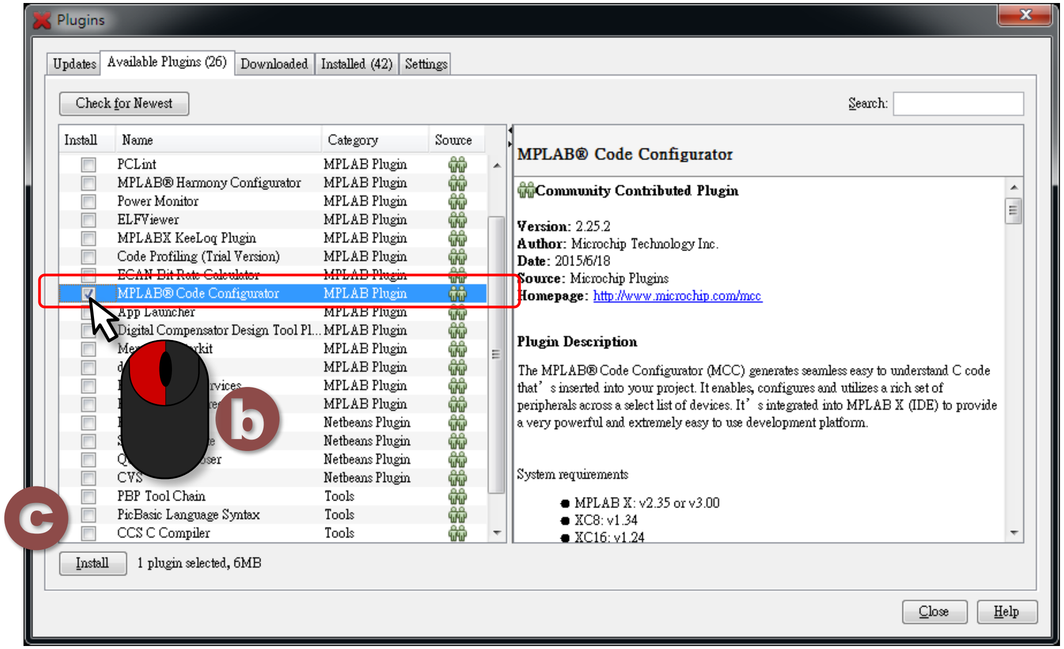
- MCC的安裝，可以使用**線上安裝**或離線安裝方式。

線上安裝

a **功能表** 選擇
- **Tools ▸ Plugins**
- **Available Plugins**

b 選擇
- **MPLAB Code Configurator**

c 選擇
- **Install**



Plugins

Updates | Available Plugins (26) | Downloaded | Installed (42) | Settings

Check for Newest

Search:

Install	Name	Category	Source
☐	PCLint	MPLAB Plugin	
☐	MPLAB® Harmony Configurator	MPLAB Plugin	
☐	Power Monitor	MPLAB Plugin	
☐	ELFViewer	MPLAB Plugin	
☐	MPLABX KeeLoq Plugin	MPLAB Plugin	
☐	Code Profiling (Trial Version)	MPLAB Plugin	
☐	ECAN Bit Rate Calculator	MPLAB Plugin	
☑	MPLAB® Code Configurator	MPLAB Plugin	
☐	App Launcher	MPLAB Plugin	
☐	Digital Compensator Design Tool Pl...	MPLAB Plugin	
☐	Me[illegible]kit	MPLAB Plugin	
☐	d[illegible]	MPLAB Plugin	
☐	[illegible]rvices	MPLAB Plugin	
☐	[illegible]re	MPLAB Plugin	
☐	[illegible]	Netbeans Plugin	
☐	S[illegible]e	Netbeans Plugin	
☐	Q[illegible]oser	Netbeans Plugin	
☐	CVS	Netbeans Plugin	
☐	PBP Tool Chain	Tools	
☐	PicBasic Language Syntax	Tools	
☐	CCS C Compiler	Tools	

Install 1 plugin selected, 6MB

MPLAB® Code Configurator

Community Contributed Plugin

Version: 2.25.2
Author: Microchip Technology Inc.
Date: 2015/6/18
Source: Microchip Plugins
Homepage: http://www.microchip.com/mcc

Plugin Description

The MPLAB® Code Configurator (MCC) generates seamless easy to understand C code that's inserted into your project. It enables, configures and utilizes a rich set of peripherals across a select list of devices. It's integrated into MPLAB X (IDE) to provide a very powerful and extremely easy to use development platform.

System requirements

- MPLAB X: v2.35 or v3.00
- XC8: v1.34
- XC16: v1.24

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MCC Installation

- MCC的安裝，可以使用線上安裝或**離線安裝**方式。

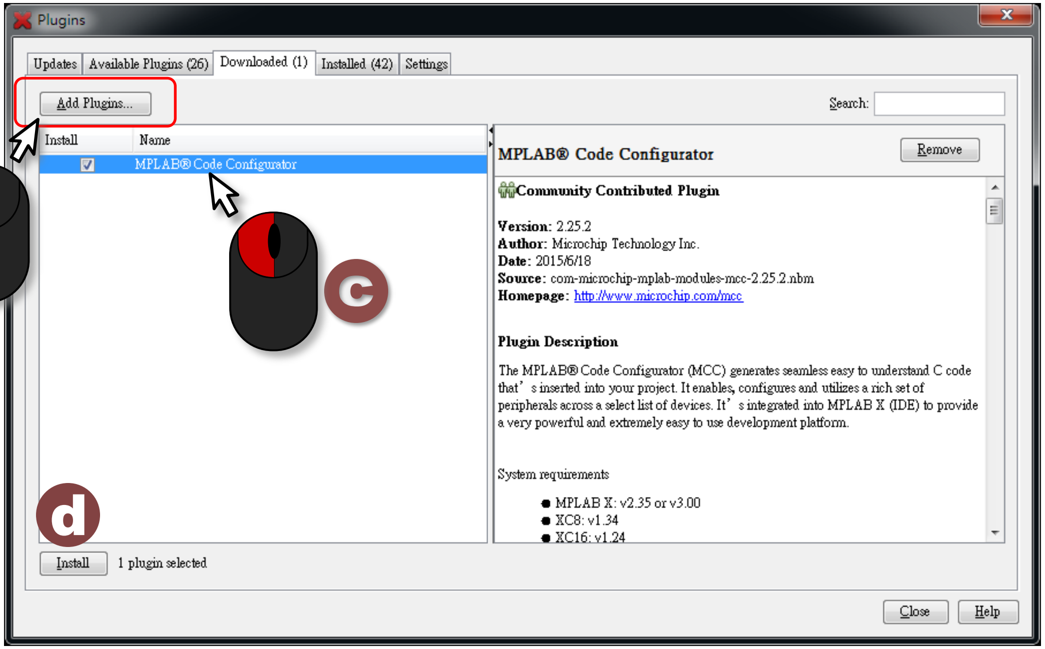
離線安裝

a **功能表** 選擇
- ▸ **Tools ▸ Plugins**
- ▸ **Downloaded**

b 選擇
- ▸ **Add Plugins**,並指定檔案

c 選擇
- ▸ **MPLAB Code Configurator**

d 選擇
- ▸ **Install**



MPLAB® Code Configurator

Community Contributed Plugin

Version: 2.25.2
Author: Microchip Technology Inc.
Date: 2015/6/18
Source: com-microchip-mplab-modules-mcc-2.25.2.nbm
Homepage: http://www.microchip.com/mcc

Plugin Description

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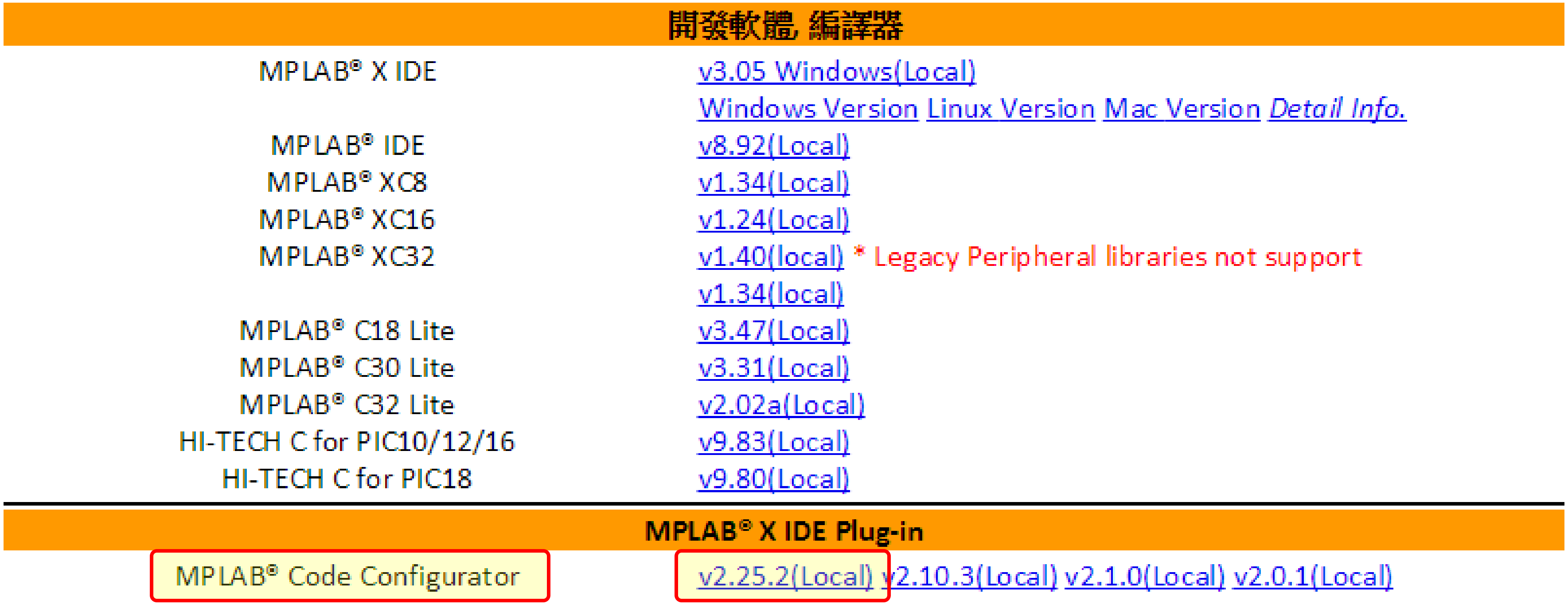
- XC16: v1.24

MCC Plug-in Download

- MCC離線安裝的檔案可以使用 Microchip RTC 教育訓練光碟或至以下連結取得 http://www.microchip.com.tw/Data_CD/
- **MPLAB Code Configurator v2.25.2**



開發軟體 編譯器

MPLAB® X IDE	v3.05 Windows(Local) Windows Version Linux Version Mac Version *Detail Info.*
MPLAB® IDE	v8.92(Local)
MPLAB® XC8	v1.34(Local)
MPLAB® XC16	v1.24(Local)
MPLAB® XC32	v1.40(local) * Legacy Peripheral libraries not support v1.34(local)
MPLAB® C18 Lite	v3.47(Local)
MPLAB® C30 Lite	v3.31(Local)
MPLAB® C32 Lite	v2.02a(Local)
HI-TECH C for PIC10/12/16	v9.83(Local)
HI-TECH C for PIC18	v9.80(Local)

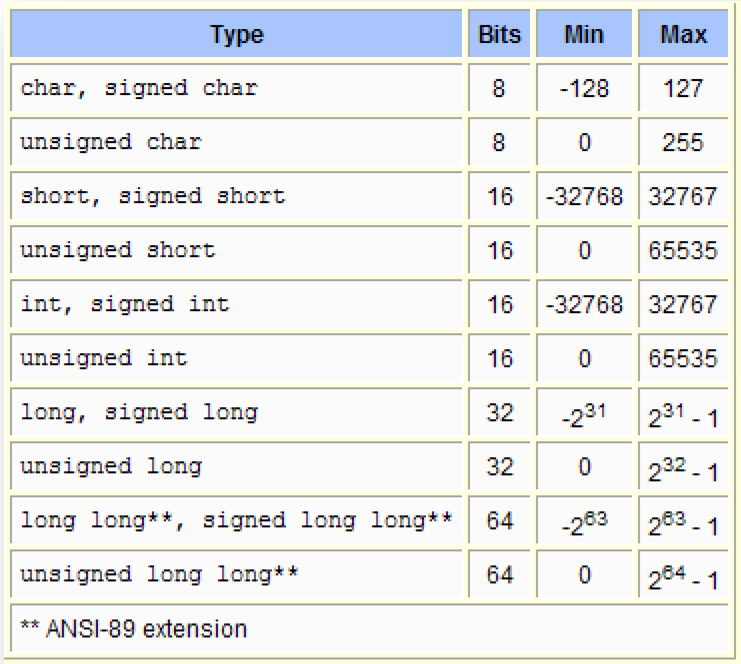
MPLAB® X IDE Plug-in

MPLAB® Code Configurator	v2.25.2(Local) v2.10.3(Local) v2.1.0(Local) v2.0.1(Local)

MPLAB XC16’s Data Type

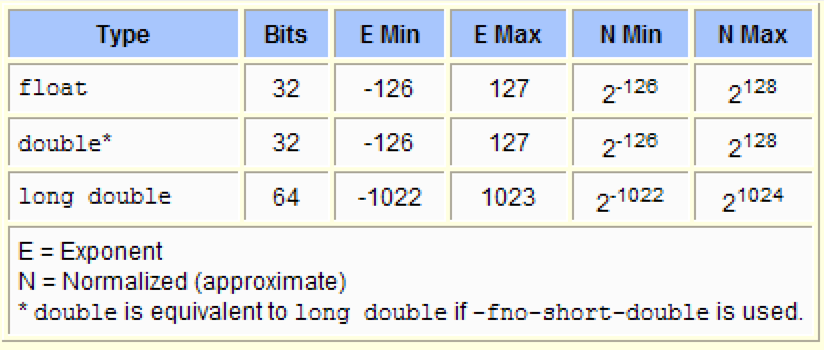
- 資料型別(Data Type)是用來定義資料存放時所佔記憶體的大小及其被處理的方式,MPLAB XC16支援以下幾種資料型別(Data Type):

整數(Integer)資料型別



Type	Bits	Min	Max
`char, signed char`	8	-128	127
`unsigned char`	8	0	255
`short, signed short`	16	-32768	32767
`unsigned short`	16	0	65535
`int, signed int`	16	-32768	32767
`unsigned int`	16	0	65535
`long, signed long`	32	-2^{31}	$2^{31}-1$
`unsigned long`	32	0	$2^{32}-1$
`long long**, signed long long**`	64	-2^{63}	$2^{63}-1$
`unsigned long long**`	64	0	$2^{64}-1$
** ANSI-89 extension			

浮點數(Float)資料型別



Type	Bits	E Min	E Max	N Min	N Max
`float`	32	-126	127	2^{-126}	2^{128}
`double*`	32	-126	127	2^{-126}	2^{128}
`long double`	64	-1022	1023	2^{-1022}	2^{1024}

E = Exponent
N = Normalized (approximate)
* double is equivalent to `long double` if `-fno-short-double` is used.

Access SFRs

- 每個特殊功能暫存器(Special Function Register)都有特定的名稱與位址。MPLAB XC16為了使用SFRs, 必需使用MCU的標頭檔(Header File)來定義其名稱與,並利用連結檔(Linker Script File, *.gld)來定義其位址, 才可以正確存取SFRs。
- 要使用到SFRs時,必須先含入(include)對應MCU的標頭檔(Header File)。例如:

```
 #include <p33fj128mc804.h>
#include <p24fj256gb106.h>
```

- 標頭檔(Header File)的檔案命名方式並非所有使用者都很熟悉,因此建議可直接含入(include)通用標頭檔(Generic Header File),由MPLAB XC16自己來尋找正確的標頭檔(Header File)。

```
 #include <p33fxxxx.h> // for dsPIC33
#include <p24fxxxx.h> // for PIC24
```

Access SFRs

- 透過MCU標頭檔(Header File)與連結檔(Linker Script File, *.gld)的定義,才可以正確的存取SFRs。例如:

  TRISD = 0xFFFE;

  LATD = 0x0001;

- MCU標頭檔(Header File)中, 也定義了各個SFRs的結構, 因此也可以透過結構, 存取SFRs內的特定成員**(*SFRNAME*bits.*BITNAME*)**。如:

  TRISDbits.TRISD0 = 0;

  LATDbits.LATD0 = 1;

- TRISD及TRISDbits都參考到同一SFRs的位址(透過Linker Script指定)。因此操作TRISD或TRISDbits對得到相同的結果。
- 每個SFRs的結構型態定義都不同,建議直接打開標頭檔(Header File)來觀察看看。

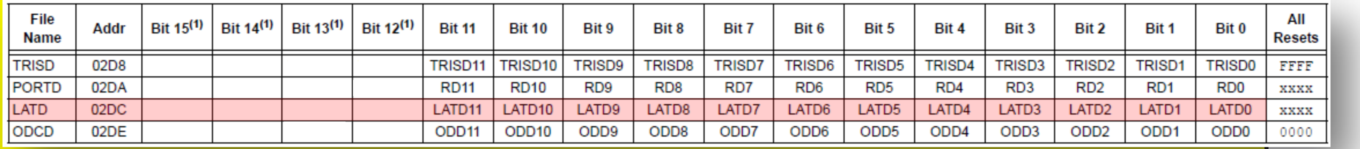
MCU’s Header File

- p24fj256gb106.h MCU標頭檔(Head File)的內容片段

  C:\Program Files (x86)\Microchip\xc16\v1.24\support\PIC24F\h\

```
extern volatile unsigned int  LATD __attribute__((__sfr__));

typedef struct tagLATDBITS
{
   unsigned LATD0:1;
   unsigned LATD1:1;
   unsigned LATD2:1;
   unsigned LATD3:1;
   unsigned LATD4:1;
   unsigned LATD5:1;
   unsigned LATD6:1;
   unsigned LATD7:1;
   unsigned LATD8:1;
   unsigned LATD9:1;
   unsigned LATD10:1;
   unsigned LATD11:1;
}LATDBITS;
extern volatile LATDBITS LATDbits __attribute__((__sfr__));
```



File Name	Addr	Bit 15(1)	Bit 14(1)	Bit 13(1)	Bit 12(1)	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	All Resets
TRISD	02D8					TRISD11	TRISD10	TRISD9	TRISD8	TRISD7	TRISD6	TRISD5	TRISD4	TRISD3	TRISD2	TRISD1	TRISD0	FFFF
PORTD	02DA					RD11	RD10	RD9	RD8	RD7	RD6	RD5	RD4	RD3	RD2	RD1	RD0	xxxx
LATD	02DC					LATD11	LATD10	LATD9	LATD8	LATD7	LATD6	LATD5	LATD4	LATD3	LATD2	LATD1	LATD0	xxxx
ODCD	02DE					ODD11	ODD10	ODD9	ODD8	ODD7	ODD6	ODD5	ODD4	ODD3	ODD2	ODD1	ODD0	0000