



## MPLAB® Harmony 之学习篇（二十二）

### -- 如何在 Harmony 中配置 PIC32MZ DA 的图形显示功能

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#### 一、 简介：

PIC32MZ DA 系列 MCU 是 Microchip 针对图形显示应用专门研发的一系列高性能 32 位 MCU，其面向图形显示独有的设计包括：

- 独立的显示控制器（GLCD）；
- 独立的 2D 图形处理器（2D-GPU）；
- 大容量 DDR2 RAM，支持 32 MB 内置或者 128 MB 外扩 DDR2。

这些独有的设计，使 PIC32MZ DA 系列 MCU 特别适合于 800 x 600 分辨率以下的图形显示应用。

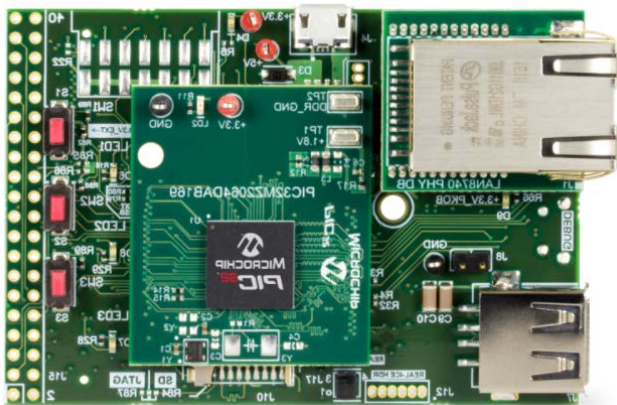
同时，Microchip 提供的 MPLAB X + Harmony 平台可以帮助用户通过直接勾选的方式生成硬件驱动、常用库、协议栈和服务的代码，非常便捷，即使对于 PIC32MZ DA 图形显示这样的应用也可以轻松完成。

本文介绍一种基于 MPLAB X + Harmony 下应用 PIC32MZ DA 图形开发的基本方法和流程。

#### 二、 硬件工具和软件平台：

硬件：

1. PIC32MZ Embedded Graphics with Stacked DRAM (DA) Starter Kit





## 2. MEB II



### 软件:

MPLAB X: v4.05 或者更新

XC32: v1.44 或者更新

Harmony: v2.05 或者更新, PIC32MZ DA 只有在 Harmony 2.X 以上的版本才支持。

### 调试工具

ICD 3

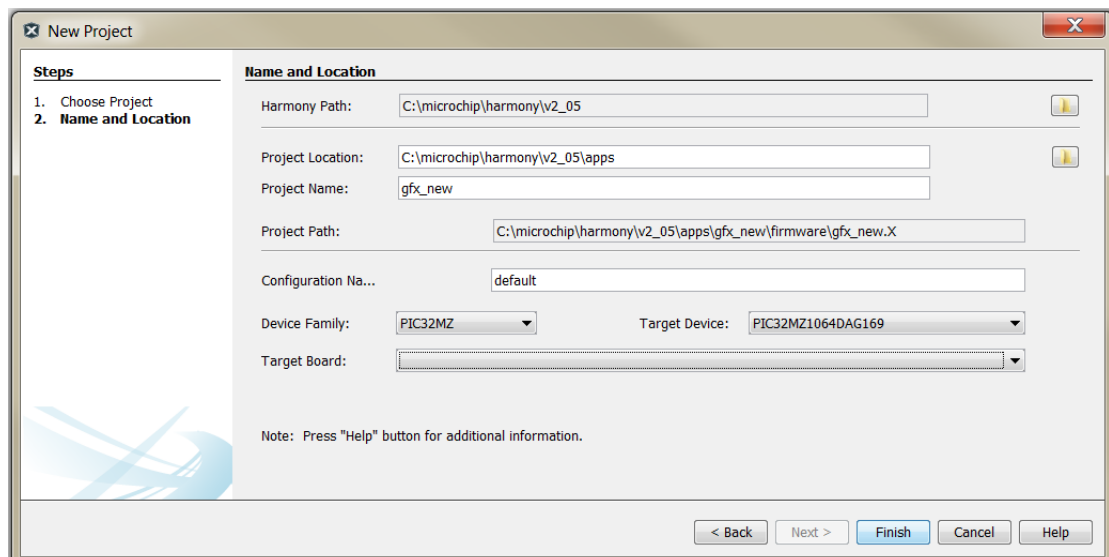
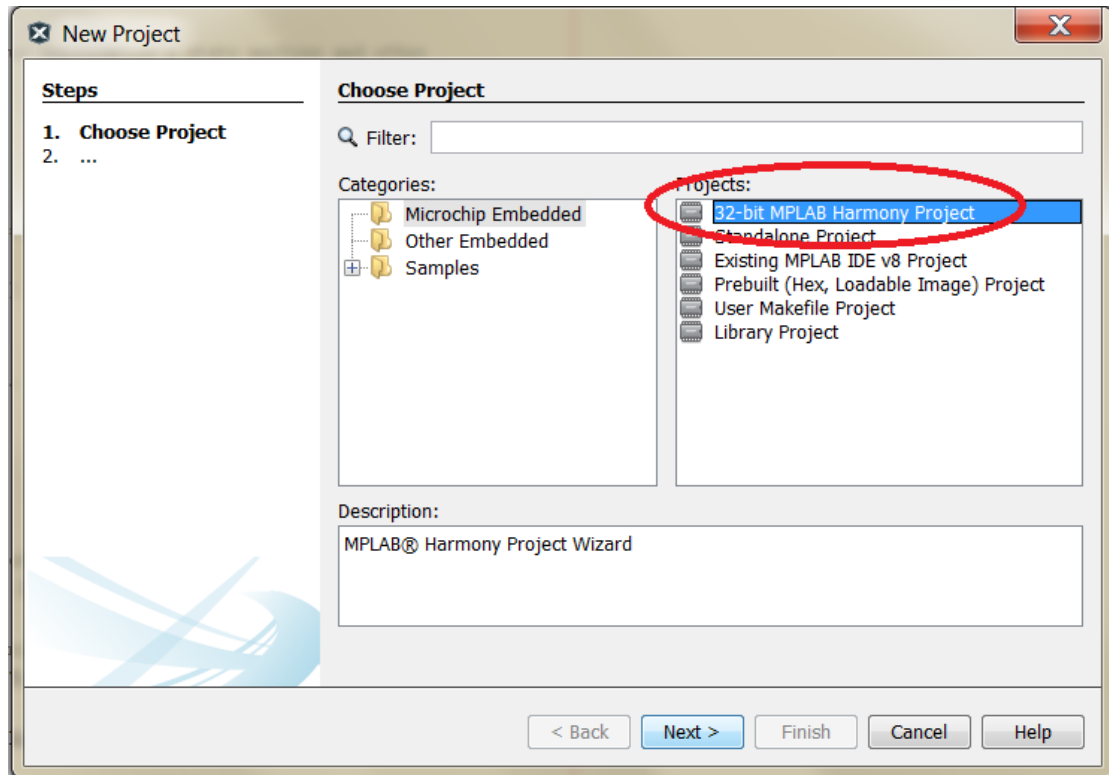




### 三、 步骤:

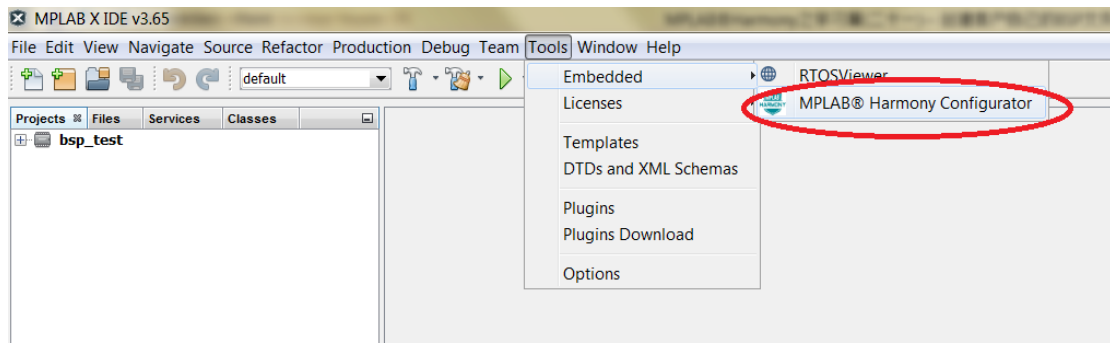
#### (一)，建立一个 Harmony 工程，命名为“gfx\_new”

在 MPLAB X 中选择 File->New Project，建立一个 32 位 Harmony 的工程，并将工程命名，选择相应的芯片。

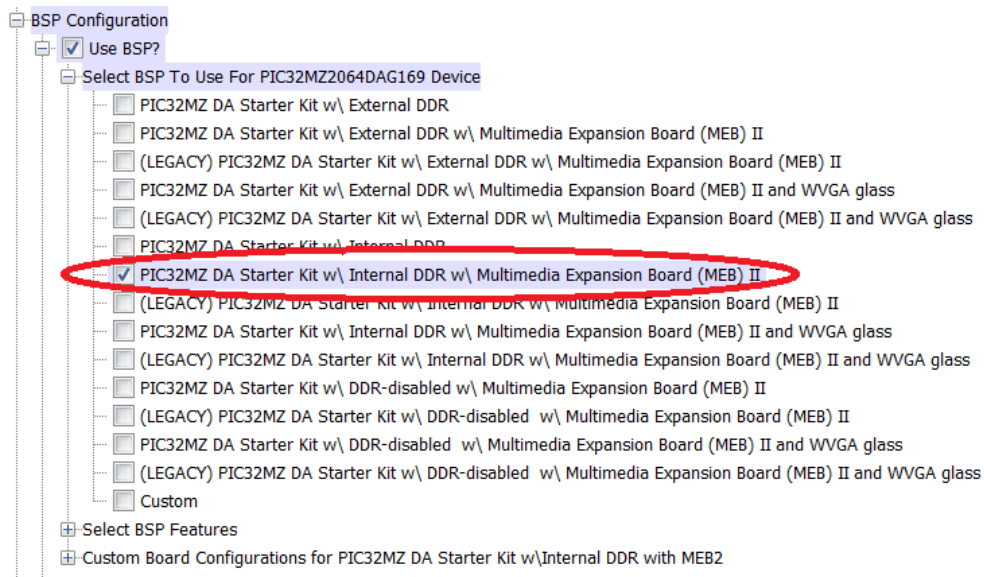




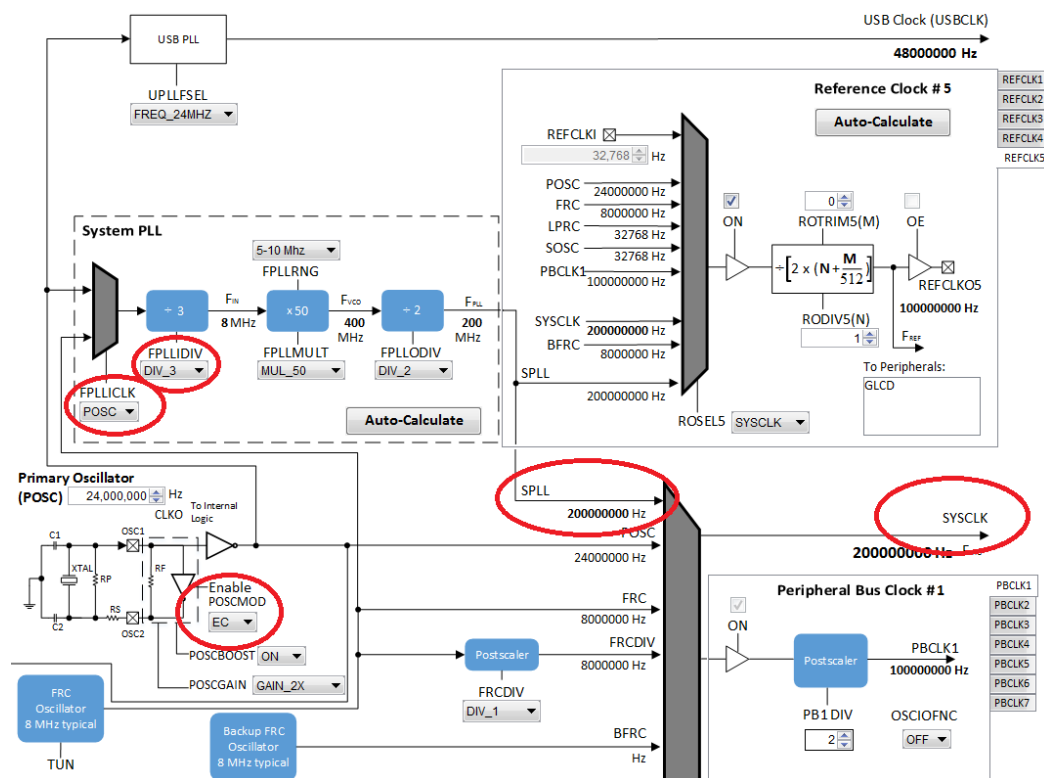
(二)，打开 MHC 工具，对工程进行配置。



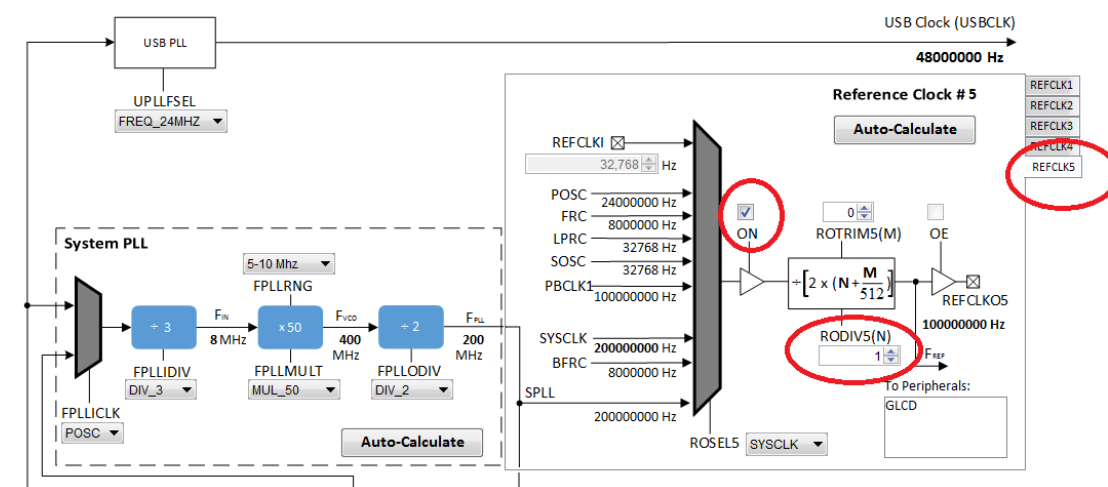
(三)，通过 MHC 工具，选择 BSP。



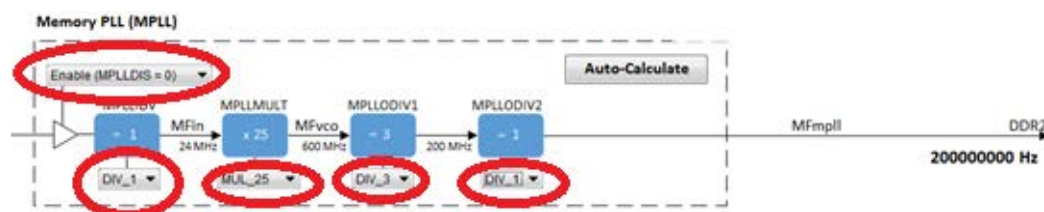
(四)，通过 MHC 中的 clock diagram 配置主时钟 SYSCLK。



(五)，通过 MHC 中的 clock diagram 配置 RFCLK5，该时钟为 GLCD 提供基准。



(六)，通过 MHC 中的 clock diagram 配置 MPPLL，该时钟为 DDR2 提供基准。





(七), 通过 MHC 中的 Graphic Display 配置液晶显示。

Use Graphics Stack?

Graphics Display

Select Display Type **PDA TM4301B 4.3-inch 480x272 (WQVGA) with PCAP**

Resolution

Orientation 0

The Graphics Library is expected to handle orientation in the current release. For Aria, orientation can be adjusted from within Graphics Composer

Data Width 16

Horizontal Settings

Vertical Settings

Inverting Level Shift 0

Pixel Clock Factor 0

LCD Type GFX\_LCD\_TFT

Backlight Settings

Touch Settings

Polarity

Use Data Enable?

Use Reset?

Use Chip Select?

(八), 通过 MHC 中的 Harmony Framework Configuration 配置 Graphics Controller 和 Graphics Processor。

Graphics Controller

Select Controller Type **GLCD**

GLCD

Driver Implementation STATIC

Pixel Clock Settings

Master Clock (MHz) 100

Pixel Clock Prescaler 4

Driver Settings

Frame Buffer Memory Location DDR2 RAM

Max Layer Count 3

Frame Buffers Per Layer 2

Frame Buffer Color Mode RGBA\_8888

Use All RGB Pins?

Base Layer Background Color (RGBA8888 Hex Format) 0xFFFFFFFF00

Graphics Processor

Select Processor Type **NANO 2D**

(九), 通过 MHC 中的 Harmony Framework Configuration 使能触摸功能。

Timing Controller

Graphics Options

Enable Draw Pipeline

Enable Alpha Blending

Enable Bounds Clipping

Enable Color Conversion

Enable Color Masking

Enable Layer Clipping

Enable Orientation and Mirroring

Use Harmony Graphics Composer Suite?

Middleware

Use Graphics Utilities Library?

Use Aria User Interface Library?

Generate Events?

Generate Macros?

**Enable Touch?**

Enable Demo Mode?

Widget Flags

Tools



(十)，通过 MHC 中配置 I2C 用于触摸芯片消息的读取。

The screenshot shows the MHC configuration window for the I2C module. The 'I2C' section is expanded, and the 'Use I2C Driver?' checkbox is checked. The 'Driver Implementation' is set to 'DYNAMIC'. The 'Interrupt Mode' checkbox is checked. The 'Number of I2C Driver Clients' is set to 1, and the 'Number of I2C Driver Instances' is set to 1. The 'Include Force Write I2C Function (Master Mode Only - Ignore NACK from Slave)' checkbox is unchecked. The 'I2C Driver Instance 0' section is expanded, and the 'Use Bit Bang I2C Implementation?' checkbox is checked. The 'I2C Module ID' is set to 'I2C\_ID\_1'. The 'Operation Mode' is set to 'DRV\_I2C\_MODE\_MASTER'. The 'Bit Bang Timer Source' is set to 'TMR\_ID\_9'. The 'I2C CLOCK FREQUENCY (Hz)' is set to 50000. The 'I2C Interrupt Priority' is set to 'INT\_PRIORITY\_LEVEL3'. The 'I2C Interrupt Sub-priority' is set to 'INT\_SUBPRIORITY\_LEVEL0'.

(十一)，通过 MHC 中配置触摸芯片驱动，注意配置外部中断引脚。

The screenshot shows the MHC configuration window for the Touch Drivers module. The 'Touch Drivers' section is expanded, and the 'Use MXT336T Driver?' checkbox is checked. The 'I2C driver module index' is set to 'DRV\_I2C\_INDEX\_0'. The 'Task Queue Size' is set to 9. The 'Number of Instances' is set to 1, and the 'Number of Clients' is set to 5. The 'Interrupt Mode' checkbox is checked. The 'Interrupt Source' is set to 'EXTERNAL INTERRUPT'. The 'External Interrupt Source' is set to 'INT\_SOURCE\_EXTERNAL\_4'. The 'Change Notification Pin Channel' is set to 'PORT\_CHANNEL\_B'. The 'Change Notification Pin Number' is set to 'PORTS\_BIT\_POS\_1'. The 'Mxt Task Queue Size' is set to 1. The 'Number of Mxt Instances' is set to 1, and the 'Number of Mxt Clients' is set to 1. The 'MXT336T driver module index' is set to 'DRV\_MAXTOUCH\_INDEX\_0'. The 'GENERIC' and 'Touch (Deprecated)' sections are collapsed.



(十二) ，通过 MHC 中配置 Pin Setting 配置触摸芯片的外部中断引脚，注意配置外部中断引脚。

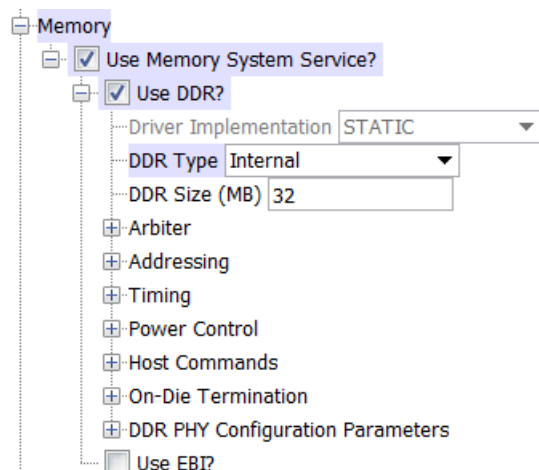
MPLAB® Harmony Configurator\*

Order: Pins Table View

Options\* Clock Diagram x Pin Diagram x **Pin Settings x**

Pin Number	Pin ID	Voltage Tolerance	Name	Function	Direction (TRIS)
A1	NC				In
A2	VBUS				In
A3	RF2	5V		Available	In
A4	RE1			Available	In
A5	RG15			Available	In
A6	RF13			Available	In
A7	RC3			Available	In
A8	RC2			Available	In
A9	RB8			Available	In
A10	RB3			Available	In
A11	RA5			Available	In
A12	RB4			Available	In
A13	RB2		BSP_BT_PIN	GPIO_OUT	Out
B1	D-				In
B2	VUSB3V3				In
B3	RE4		CAMERA_ENABLE	GPIO_OUT	Out
B4	VDD				In
B5	RG8			Available	In
B6	VDD				In
B7	RC1			Available	In
B8	RC4			Available	In
B9	RB1		MXT336_TOUCH_INT	INT4	n/a
B10	RB15			Available	In

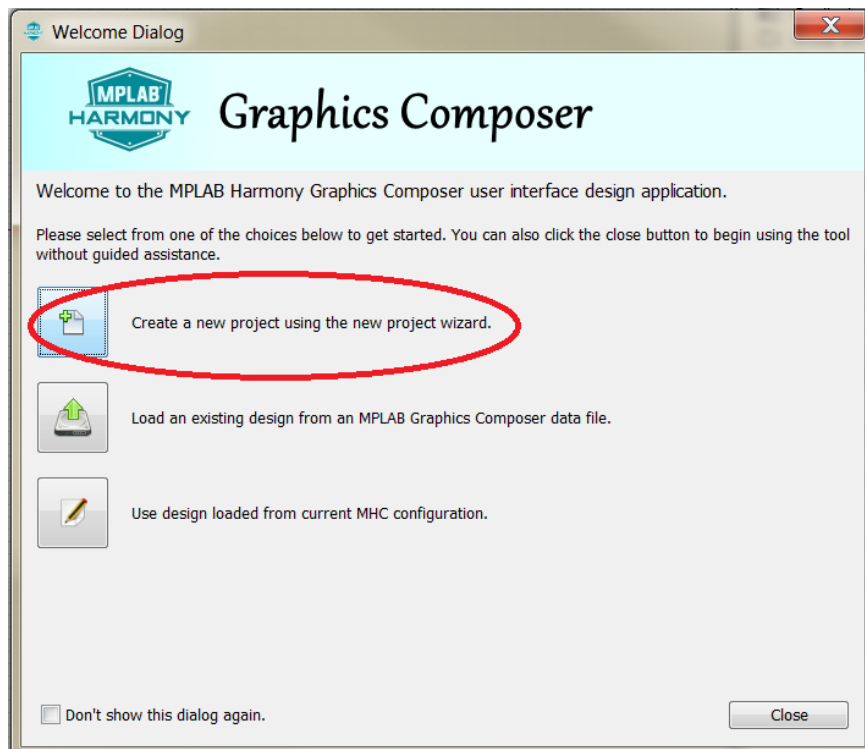
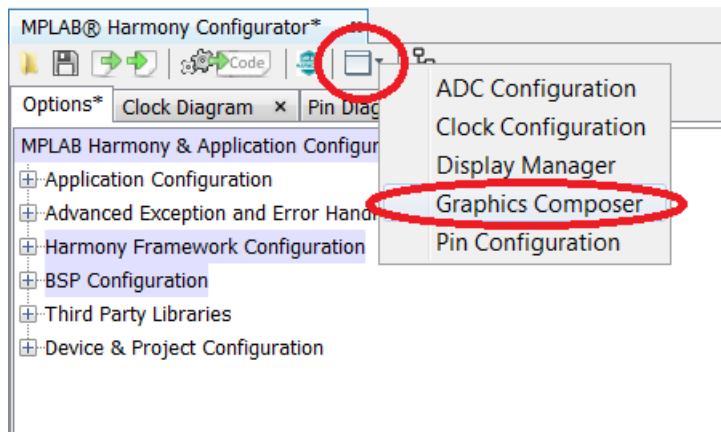
(十三) ，通过 MHC 中的 System Service 配置 Memory。







(十四) ，通过 MHC 的 Graphics Composer 创建一个 UI。



New Project Wizard

## MPLAB HARMONY Graphics Composer

**Color Mode**

Memory Size

Project Type

Finish

**Color Mode Selection**

Select the color mode to use for this project. The color mode determines the color depth, pixel storage format, and memory requirements for the design.

**Not all display devices and display drivers support all color modes. You must ensure that your display device and driver support the selected color mode**

<input type="radio"/>	GS_8	8 bits	Greyscale
<input type="radio"/>	RGB_332	8 bits	3 bits red, 3 bits green, 2 bits blue
<input type="radio"/>	RGB_565	16 bits	5 bits red, 6 bits green, 5 bits red
<input type="radio"/>	RGBA_5551	16 bits	5 bits red, 5 bits green, 5 bits blue, 1 bit alpha
<input type="radio"/>	RGB_888	24 bits	8 bits red, 8 bits green, 8 bits blue
<input checked="" type="radio"/>	RGBA_8888	32 bits	8 bits red, 8 bits green, 8 bits blue, 8 bits alpha
<input type="radio"/>	ARGB_8888	32 bits	8 bits alpha, 8 bits red, 8 bits green, 8 bits blue

☐ Use Global Color Palette The global color palette provides the means to use both 8 bit frame buffers and display 16-32 bit color depth. The limitation is that the color palette of the design is limited to 256 colors. The display driver

Estimated size of a single frame buffer (bytes): 522240

**Note: Your display driver may require additional configuration in MHC beyond what is shown here.**

Next Cancel

New Project Wizard

## MPLAB HARMONY Graphics Composer

**Color Mode**

**Memory Size**

Project Type

Finish

**Memory Size Configuration**

Use the controls below to configure the amount of flash memory you want to use for memory consumption analysis. Additional memory sources can be added through the "Memory Location" configuration window.

Flash Memory Size (bytes):

Previous Next Cancel

New Project Wizard

**MPLAB HARMONY** Graphics Composer

Color Mode  
Memory Size  
**Project Type**  
Finish

New Project Contents

Select from one of the choices below regarding the state of the new project.

☒ Start a new project using a completely blank design.

☐ Start a new project using a basic template. This template includes a single screen, a few widgets, images, strings, and a default font.

Previous Next Cancel

New Project Wizard

**MPLAB HARMONY** Graphics Composer

Color Mode  
Memory Size  
Project Type  
**Finish**

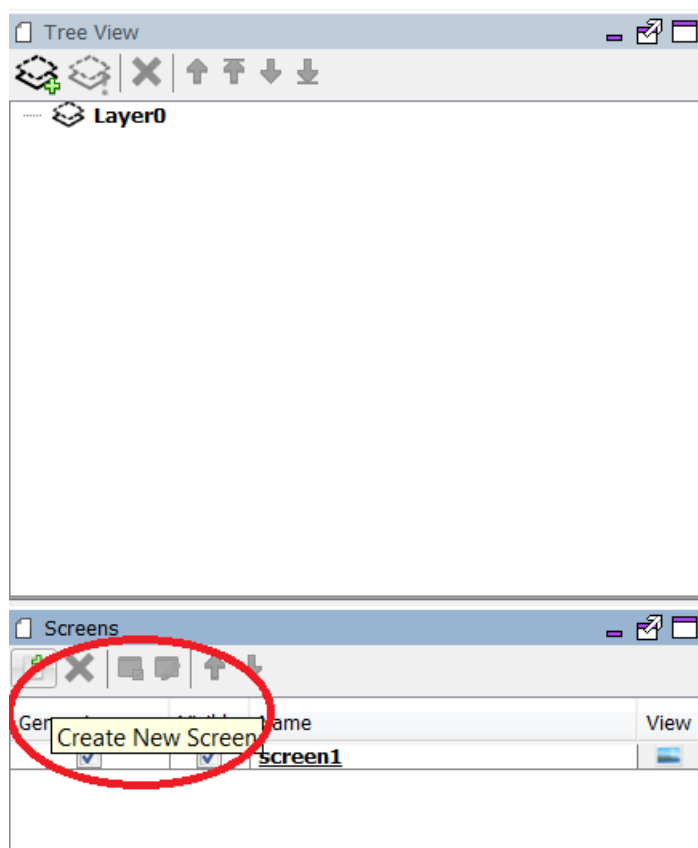
Finish

MPLAB Harmony Graphics Composer is now ready to create your graphics design project. Please click "Finish" to continue.

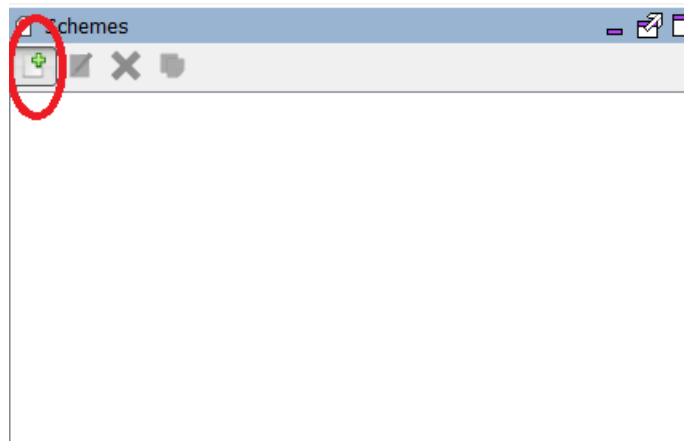
Previous Finish Cancel

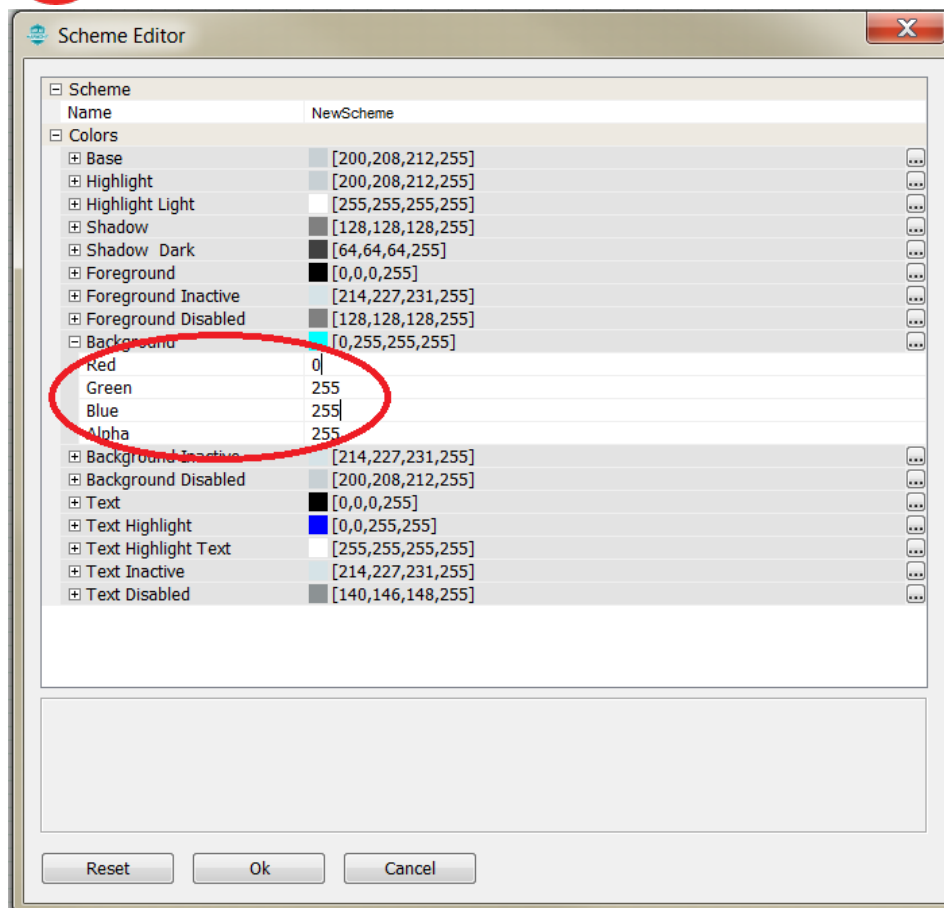


(十五) 创建新的页面和层。

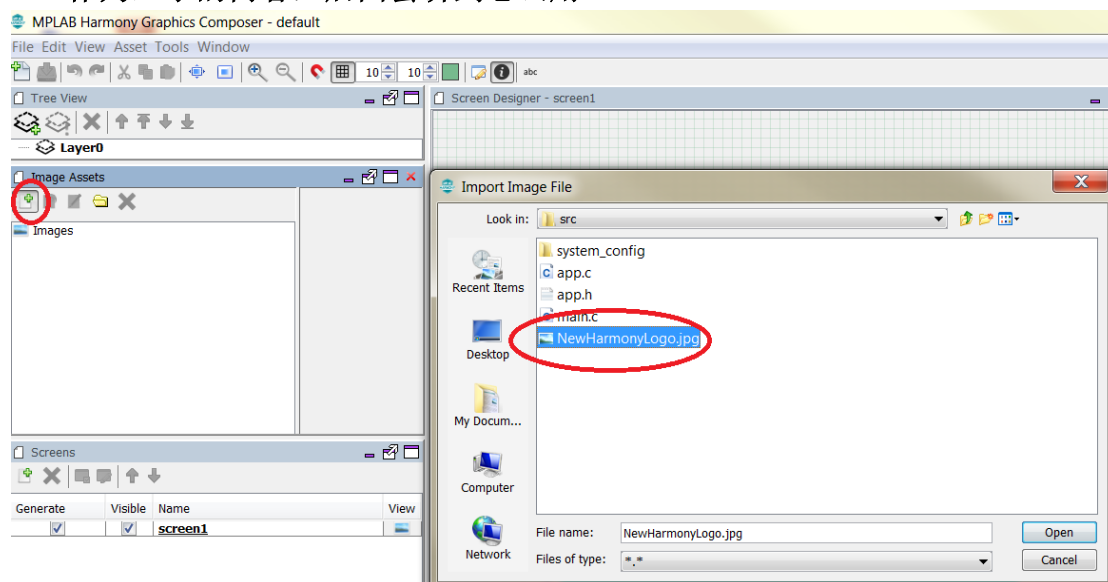


(十六) 增加显示风格，并进行编辑。

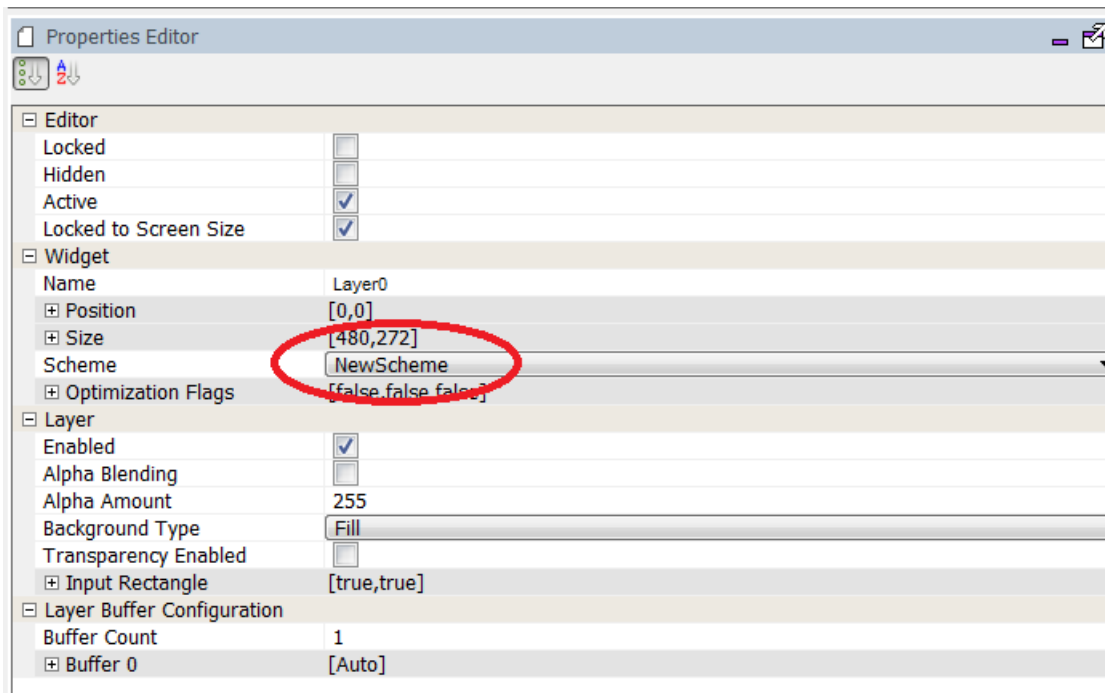




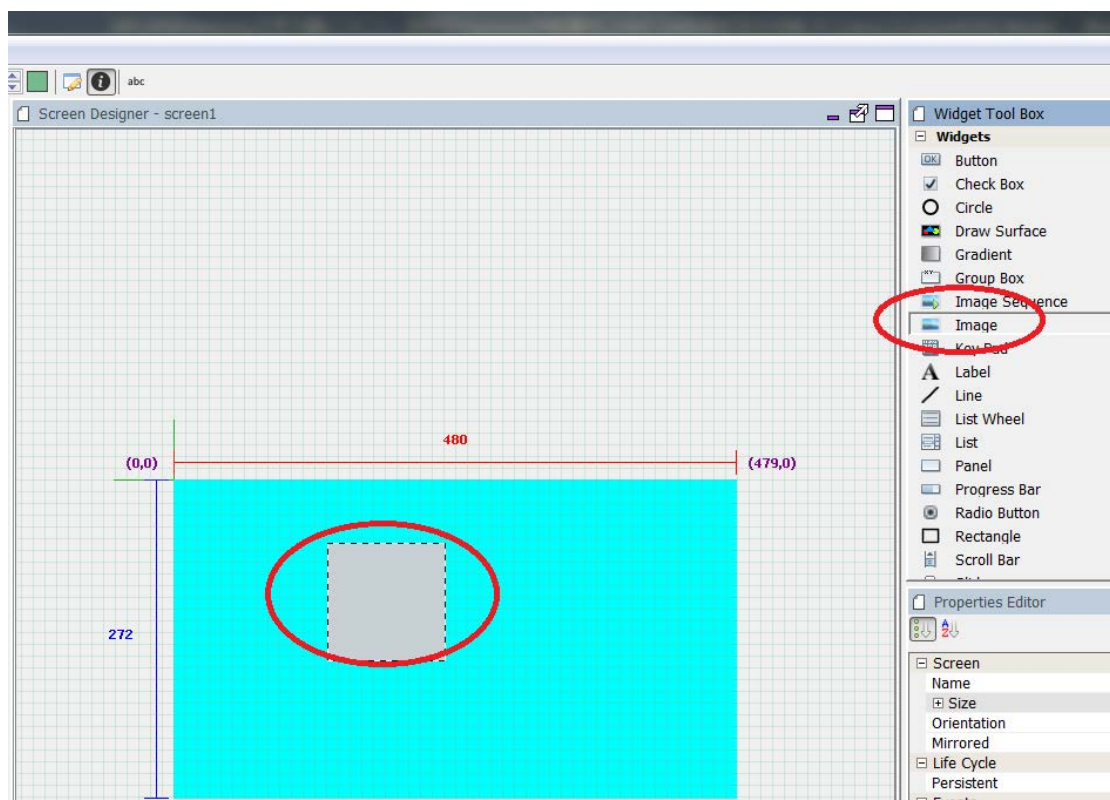
(十七) ，在资源 **Asset** 中增加内容，本例程增加一张图片，这些资源文件可以作为显示的内容，后面会讲到怎么用。



(十八) ，对相应的显示层选择风格。

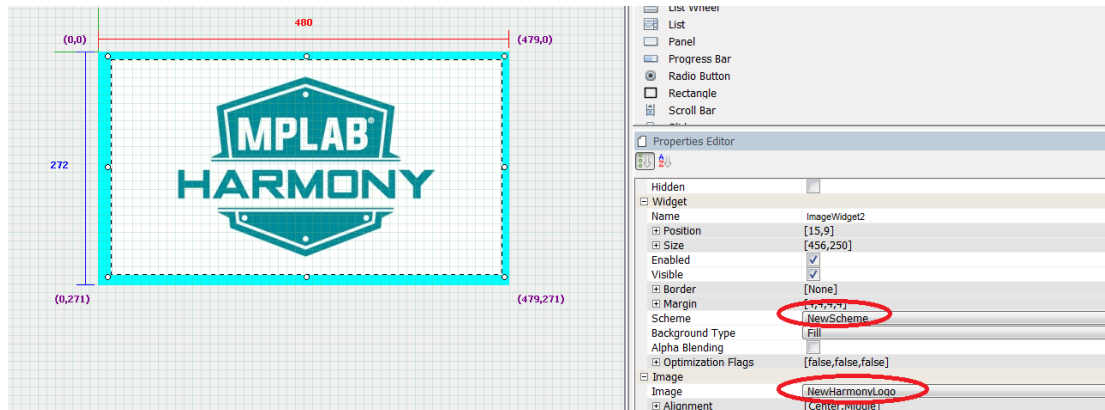


(十九) ，在页面上增加一个 Image 控件。

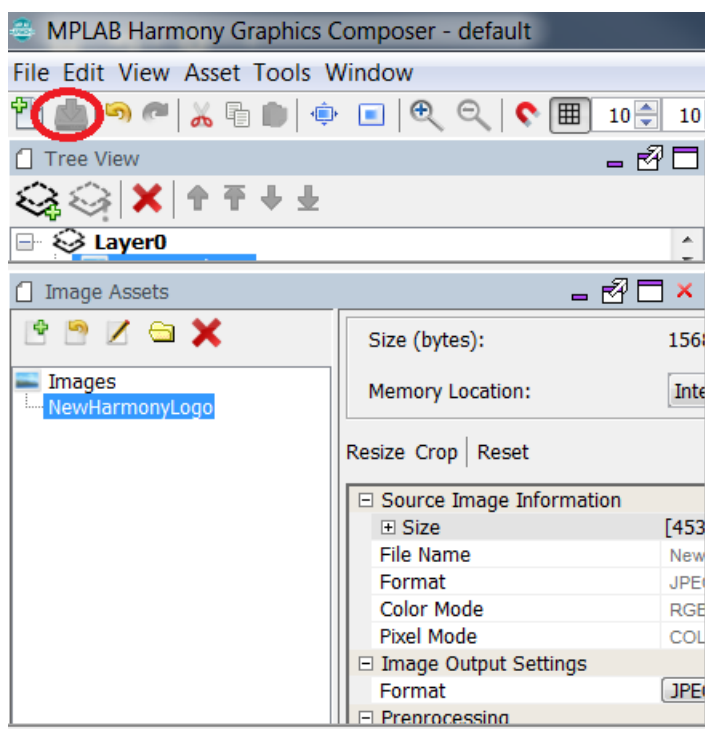




(二十) ，选择 Image 的属性，主要是设置风格，设置需要显示的图片，图片的内容可以从 Asset 增加的 Image 中选择。

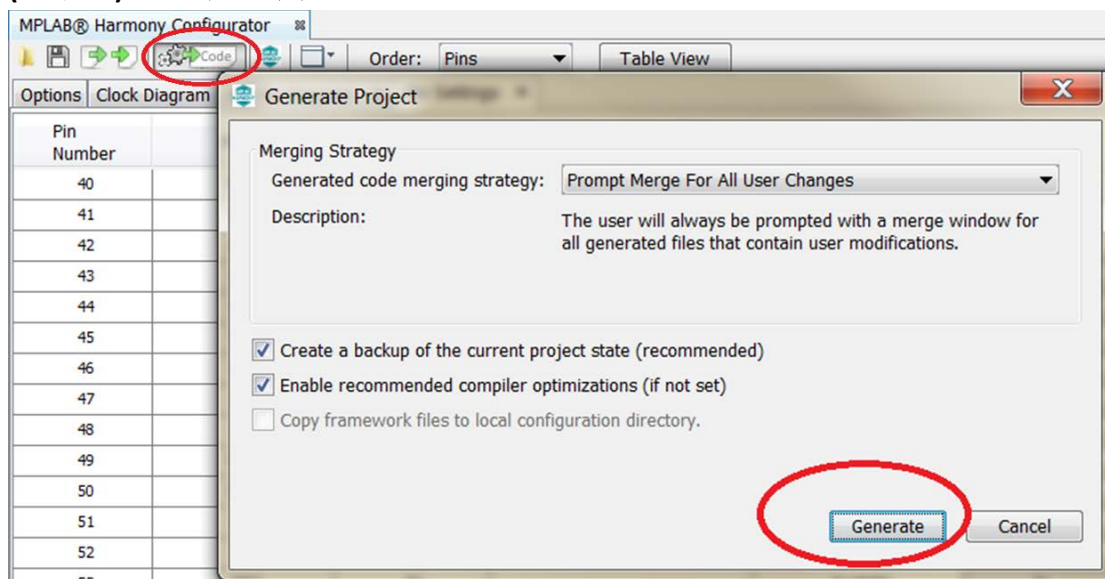


(二十一) ，不要忘记保存一下你的页面设计。





(二十二) ，产生代码。



(二十三) ，通过这些步骤你已经建立了一个基于 **Harmony** 的项目，该项目配置了 **PIC32MZ DA** 的显示和触摸，你可以基于该项目开发你的显示页面了。



#### 四、 总结：

PIC32MZ DA 是一款非常适合显示的高性能 MCU 系列，Microchip 从 Harmony V2.0 版本开始支持 PIC32MZ DA。本文介绍了在 Harmony 环境下应用 PIC32MZ DA 建立图形开发项目，其中涉及到如何使能 LCD 控制器，如何使能图形加速器和 DDR 控制器，同时也介绍了如何配置液晶控制器的时钟和 DDR 的时钟。

最后我们建立了一个例程，虽然只是一个简单的图片显示，但是为你开启了一扇进入 Harmony 图形开发环境的大门，希望你可以在 Harmony 的开发环境中受益匪浅。





## 五、 附件：



gfx\_new.zip

注：附件中的工程在 C:\microchip\harmony\v2\_05\apps 路径下经过测试。