

MPLAB® Harmony 3 之基础篇（13）

-- 如何创建支持 USB HID 设备的应用

Microchip Technology Inc.
MCU32 产品部

一、 简介

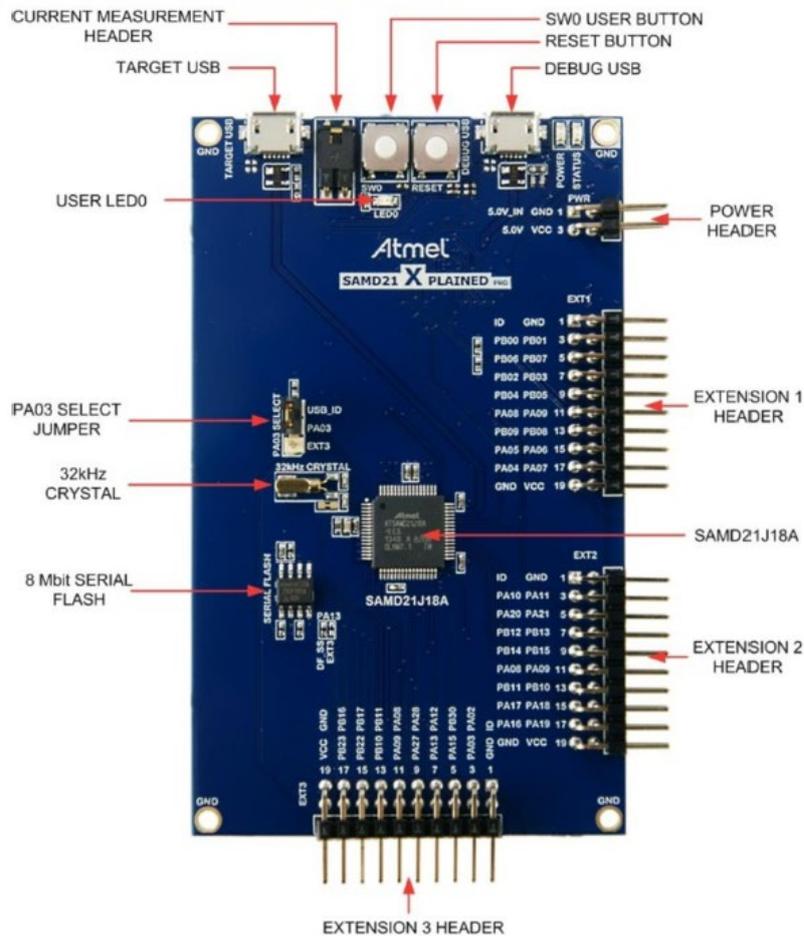
本文主要介绍如何利用 MPLAB X IDE 创建一个工程，利用 MPLAB Harmony 3 Configurator(MHC)添加 USB HID 外设驱动到工程文件，并利用 MHC 的配置工具 (CLOCK, PIN 等)完成 USB 外设的配置。添加 APP 到工程文件，调用 USB HID API 完成通过 HID 输入和输出的功能。

二、 硬件工具和软件平台

硬件: SAM D21 Xplained Board

http://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-42220-SAMD21-Xplained-Pro_User-Guide.pdf

Figure 1-1. SAM D21 Xplained Pro Evaluation Kit Overview



软件(开发工具和环境的安装和使用，见
 “MPLAB® Harmony 3 之基础篇 (01) —— Harmony 3 开发环境搭建”
 “MPLAB® Harmony 3 之基础篇 (02) —— 了解 MHC”

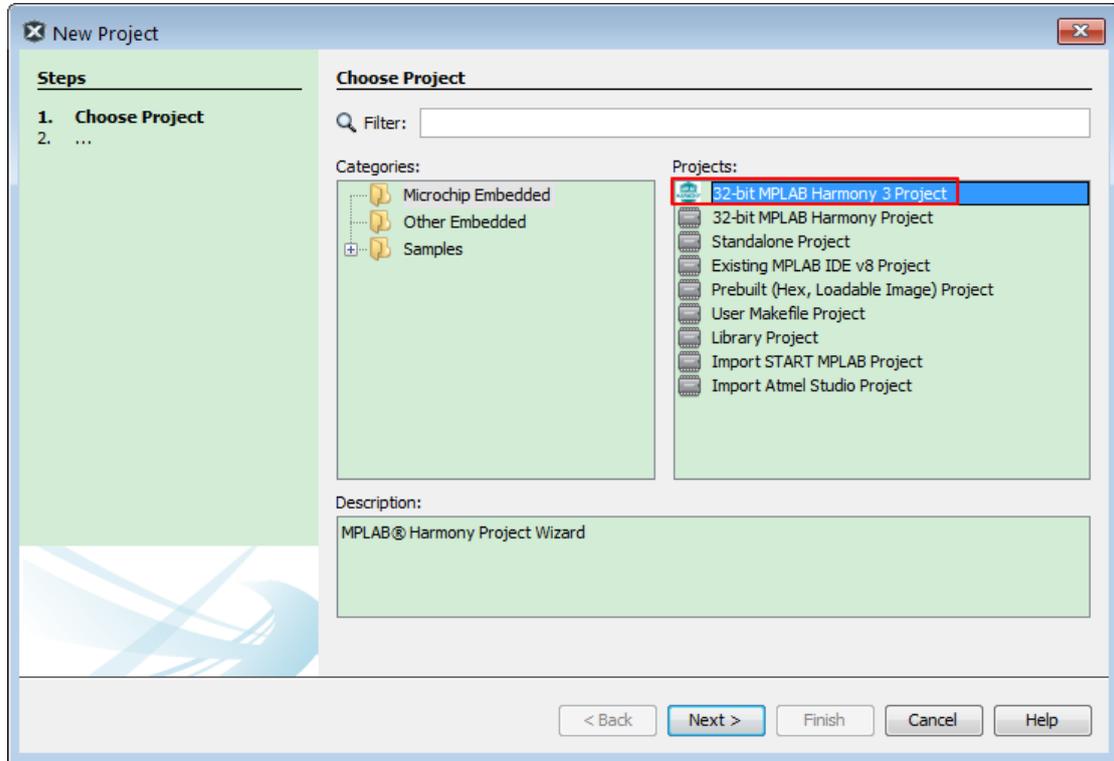
MPLAB X IDE: v5.10 或者更新
 XC32: v2.10 或者更新
 Harmony 3: v3.10 或者更新

三、 详细步骤

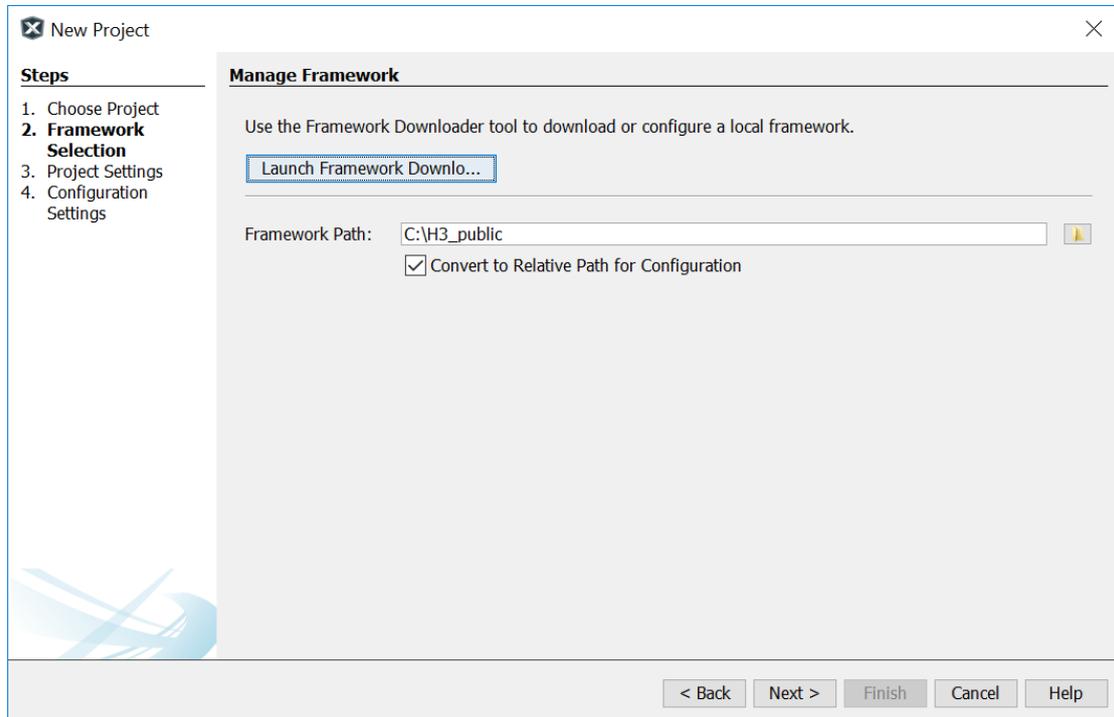
接下来我们就可以用 MPLAB X IDE 和 MHC 一步步地创建和配置 USB HID 外设驱动的程序。

注：以下 MHC 配置里没有特别标注出来的地方，说明使用的是默认选项。

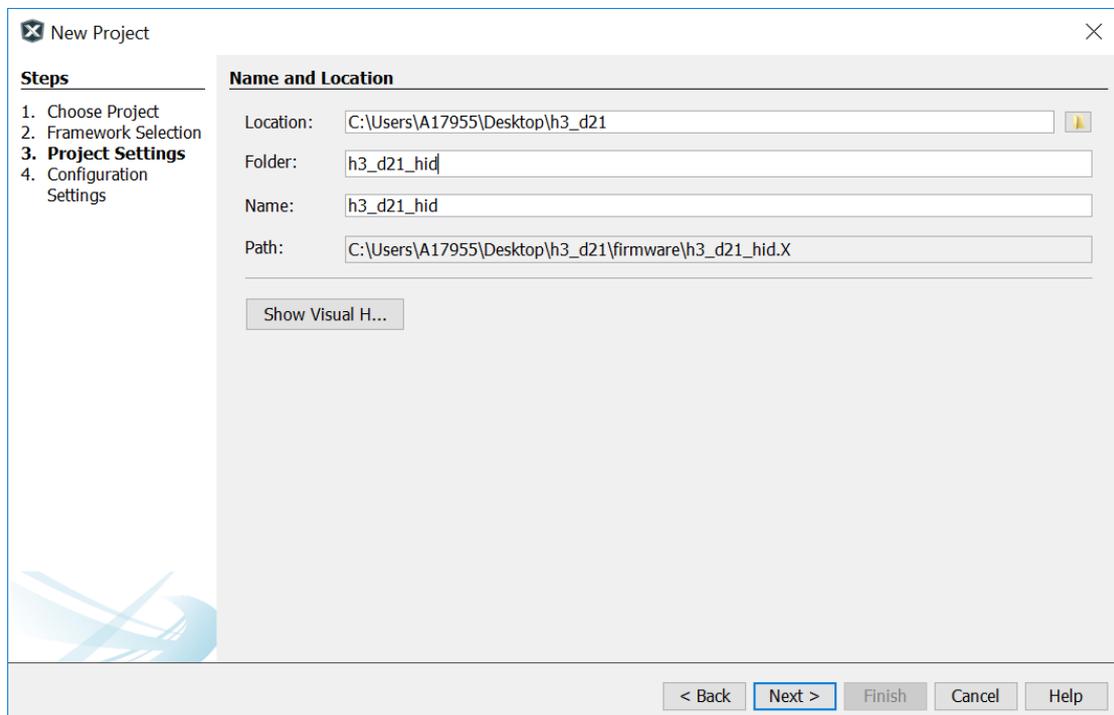
(一) 在 MPLAB X 里新建一个 Harmony 3 项目
在 MPLAB X IDE 里点击 File > New Project:



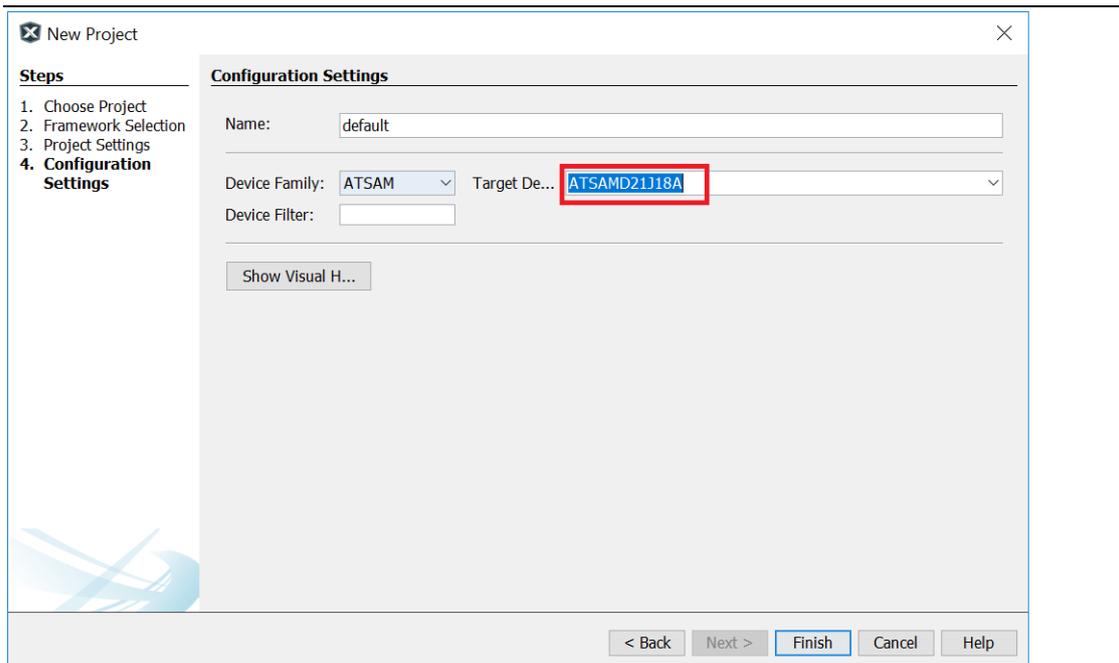
选择“32-bit MPLAB Harmony Project”，然后点击“Next”按钮。



选择“Harmony Framework”路径，然后点击“Next”按钮。



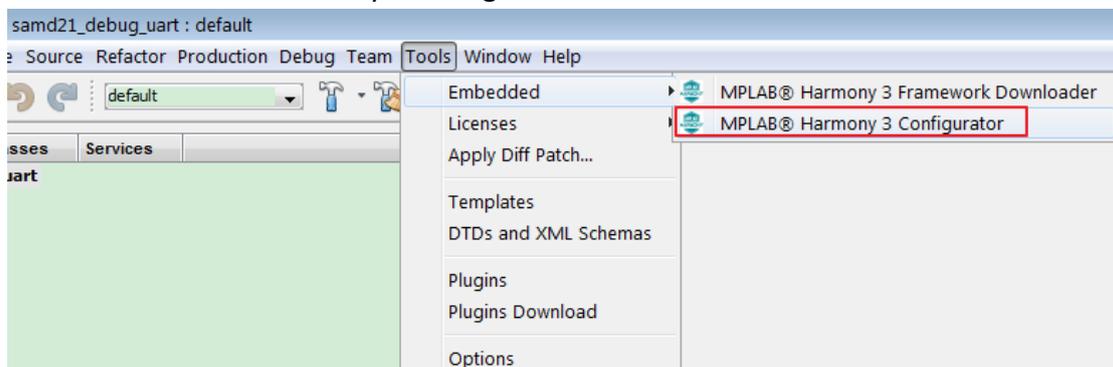
填写项目名称，本示例使用“h3_d21_hid”，然后点击“Next”按钮。



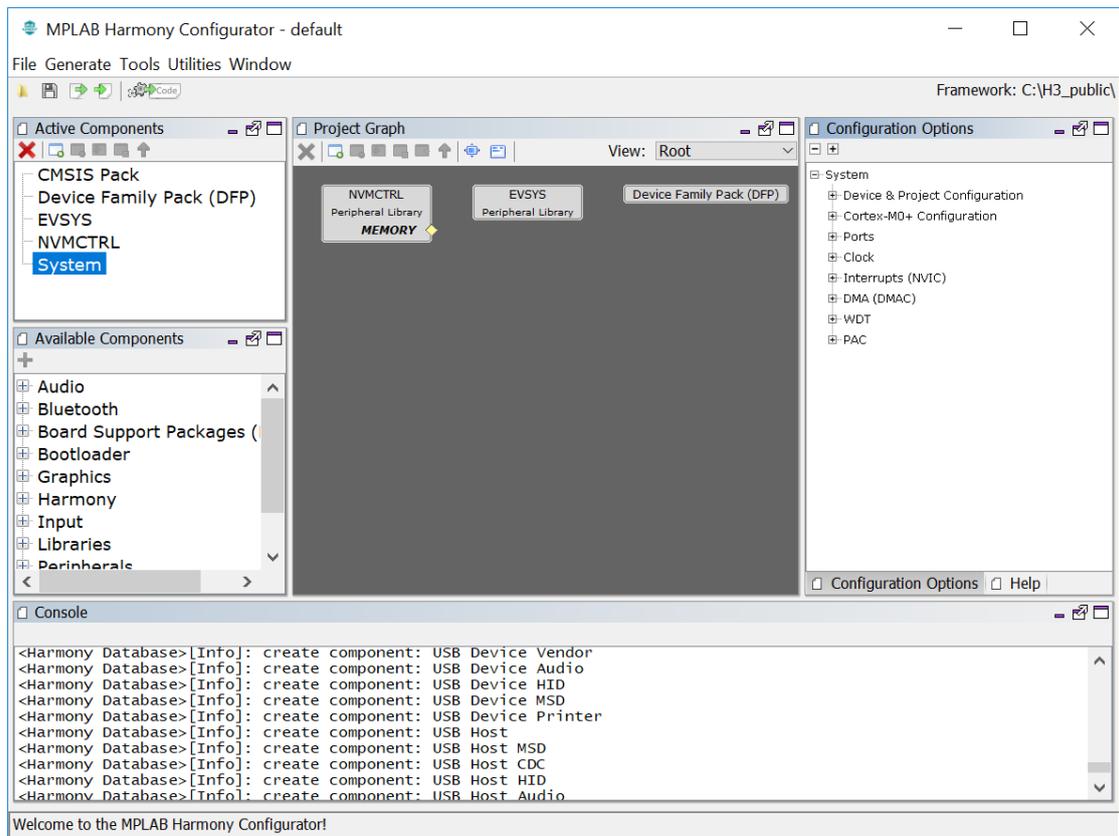
选择芯片类型“ATSAMD21J18A”，最后点击“Finish”按钮启动 MHC 配置界面。

(二) 启动 MHC

第一次创建项目时，MHC 配置界面会自动启动。或者手动在 MPLAB X 里点击 Tools > Embedded > MPLAB Harmony 3 Configurator 启动 MHC:

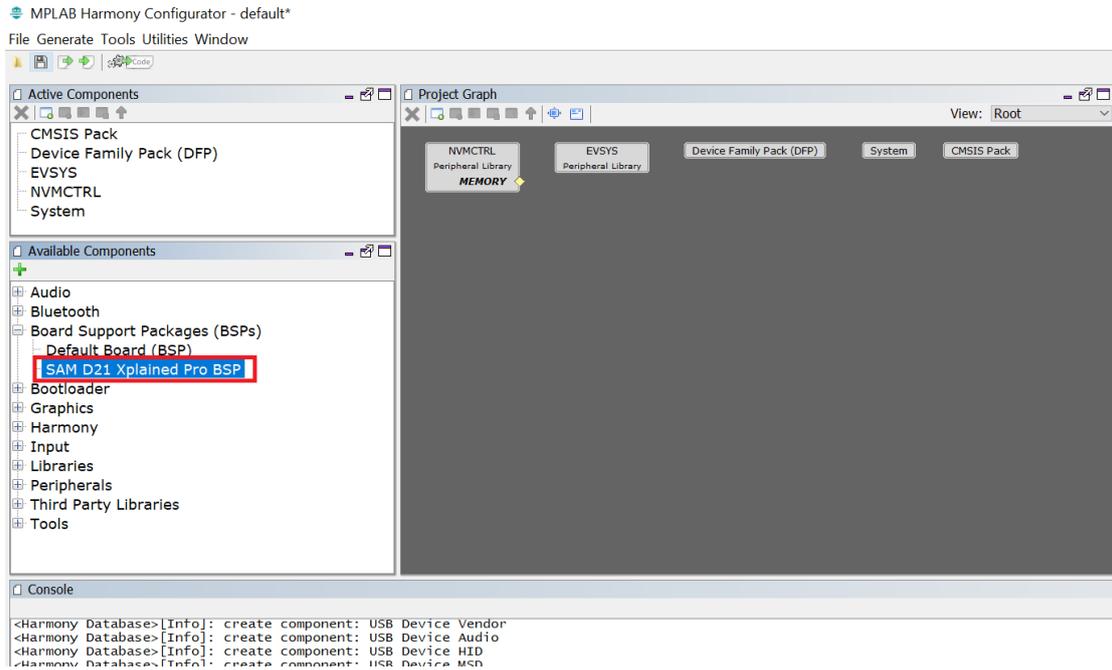


启动完成后的，主界面如下图：

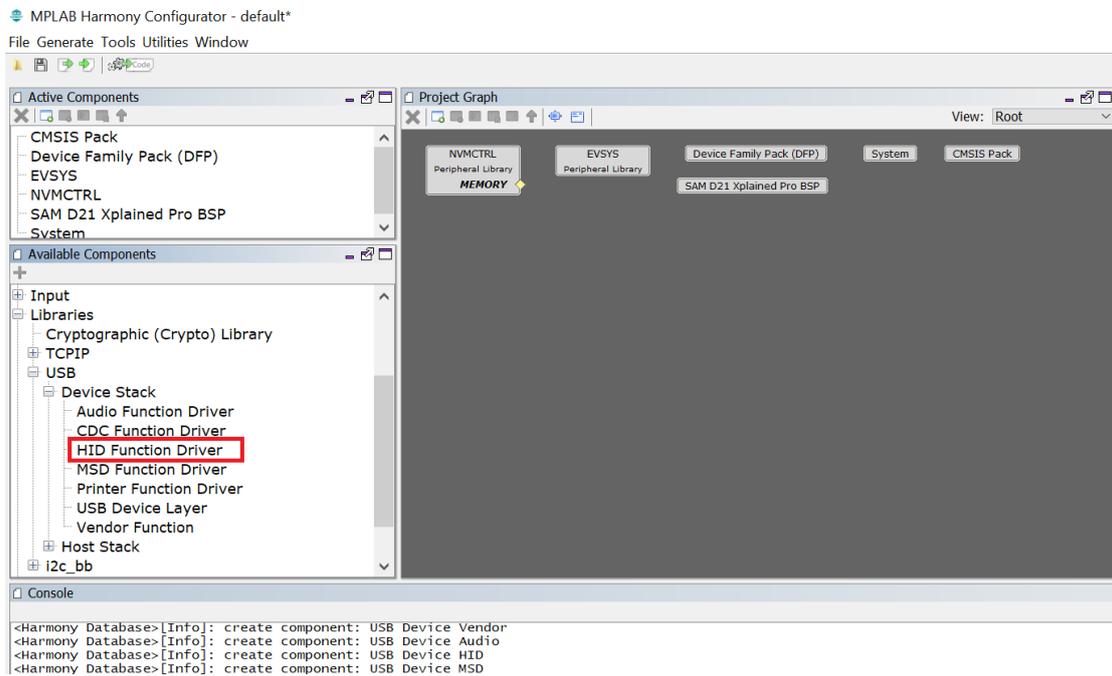


(三) 添加 D21 Xplained Board (BSP)和 HID USB Function Driver 的支持

从 Board Support Packages (BSPs)选择 SAM D21 Xplained Pro BSP，双击，添加到 Project Graph。



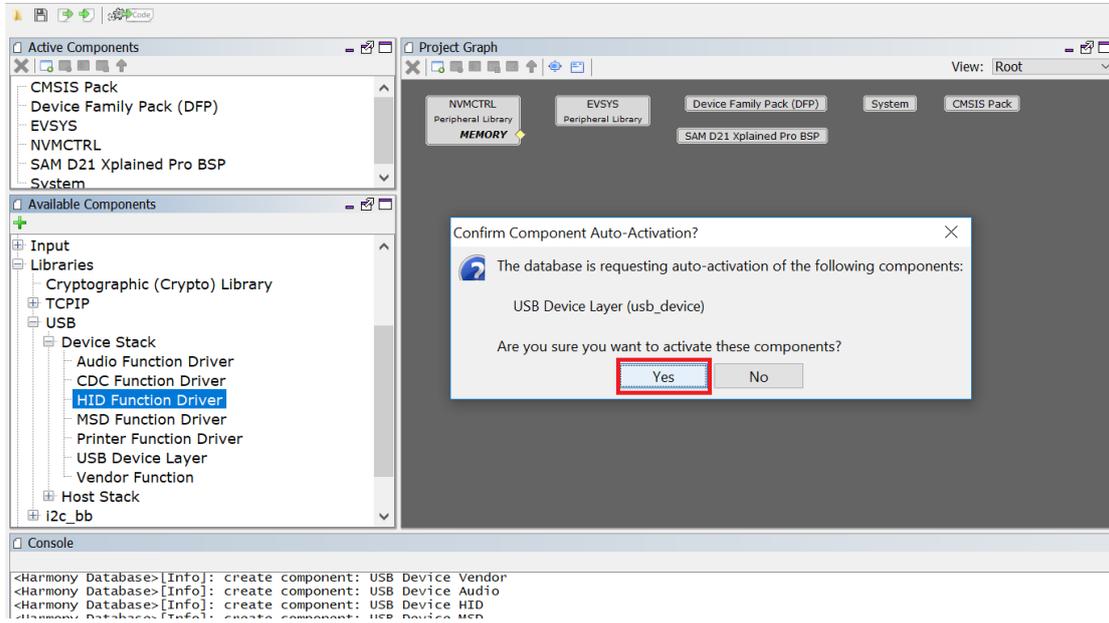
从 Libraries 的 USB device stack 下选择 HID Function Driver, 双击添加到 Project Graph.



添加过程, 按以下设置选择相应的关联组件到工程

MPLAB Harmony Configurator - default*

File Generate Tools Utilities Window



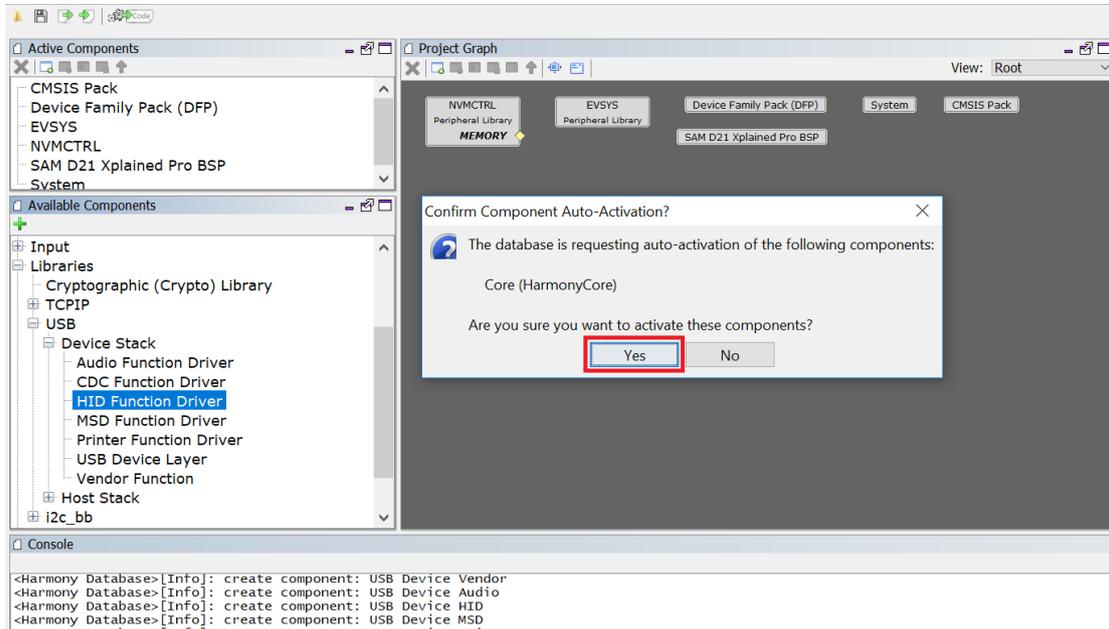
The screenshot shows the MPLAB Harmony Configurator interface. On the left, the 'Available Components' tree is expanded to 'USB > Device Stack > USB Device Layer'. A dialog box titled 'Confirm Component Auto-Activation?' is displayed in the center, asking for confirmation to activate the 'USB Device Layer (usb_device)'. The 'Yes' button is highlighted with a red box. The Project Graph on the right shows various components like NVMCTRL, EVSYS, and Device Family Pack (DFP).

```

<Harmony Database>[Info]: create component: USB Device Vendor
<Harmony Database>[Info]: create component: USB Device Audio
<Harmony Database>[Info]: create component: USB Device HID
<Harmony Database>[Info]: create component: USB Device MSC
  
```

MPLAB Harmony Configurator - default*

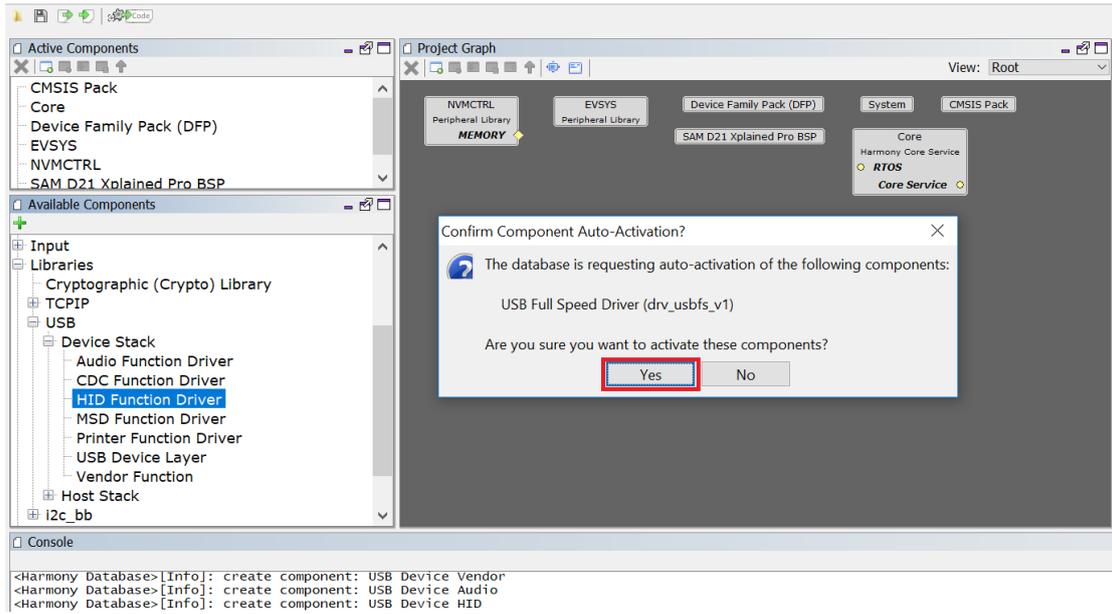
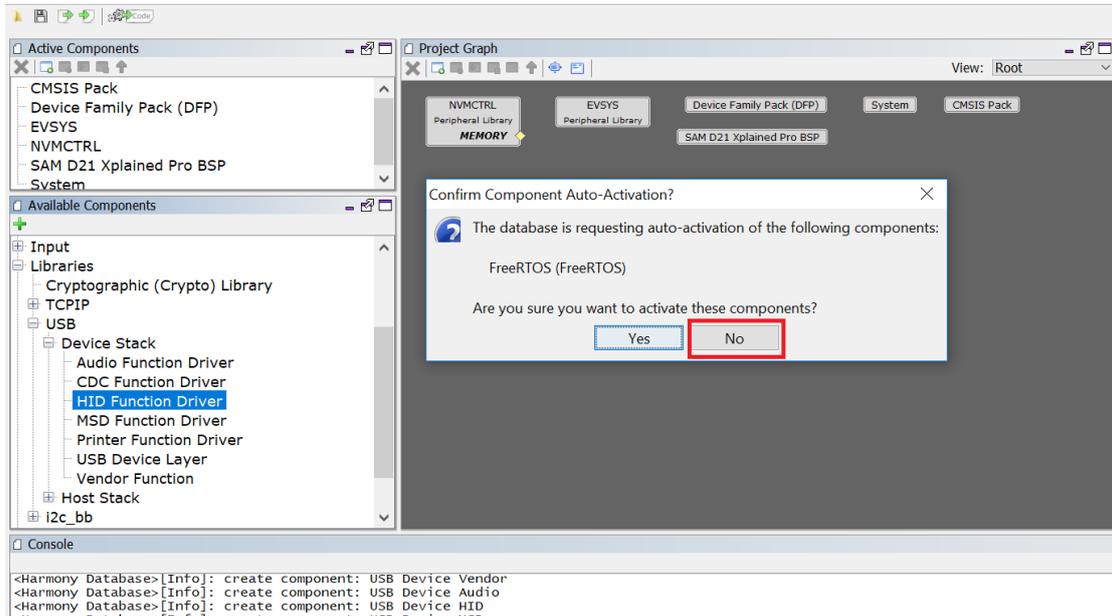
File Generate Tools Utilities Window



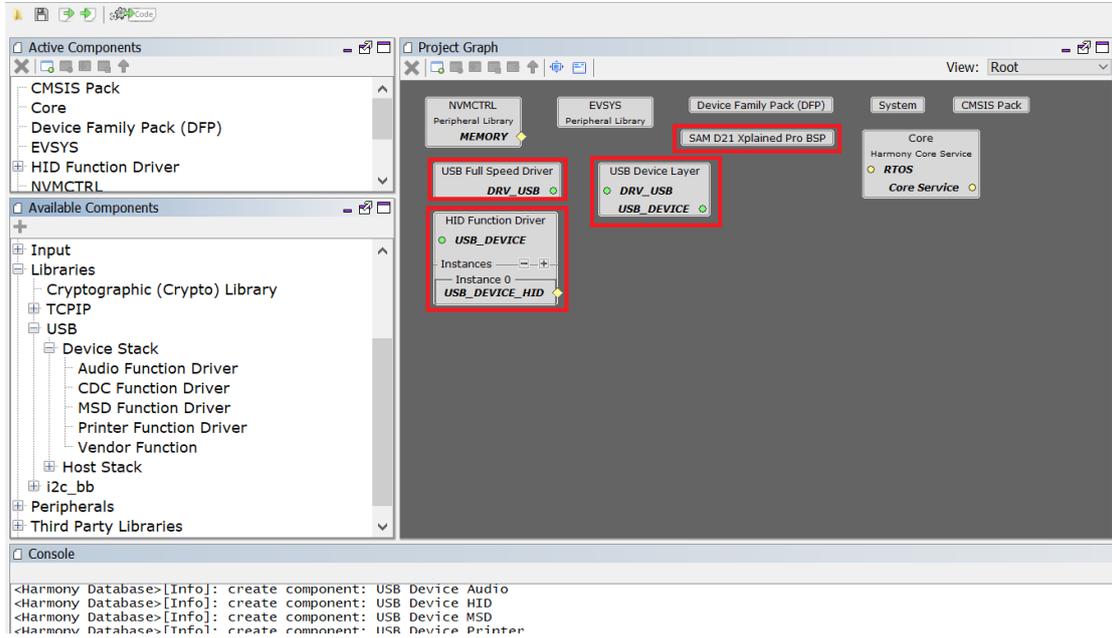
This screenshot is similar to the one above, but the confirmation dialog is for the 'Core (HarmonyCore)' component. The 'Yes' button is again highlighted with a red box. The Project Graph and 'Available Components' tree are in the same state as in the previous screenshot.

```

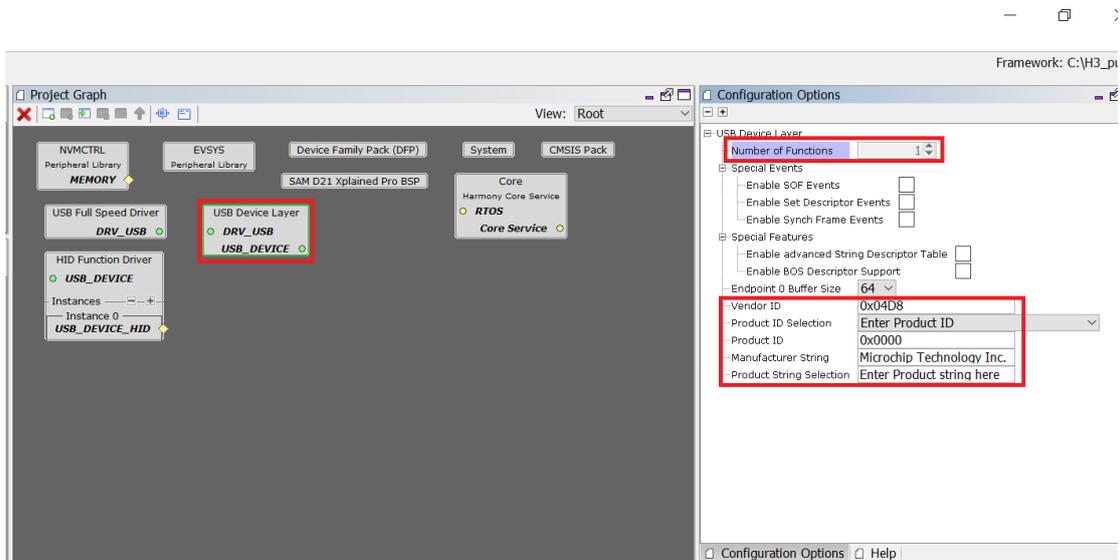
<Harmony Database>[Info]: create component: USB Device Vendor
<Harmony Database>[Info]: create component: USB Device Audio
<Harmony Database>[Info]: create component: USB Device HID
<Harmony Database>[Info]: create component: USB Device MSD
  
```



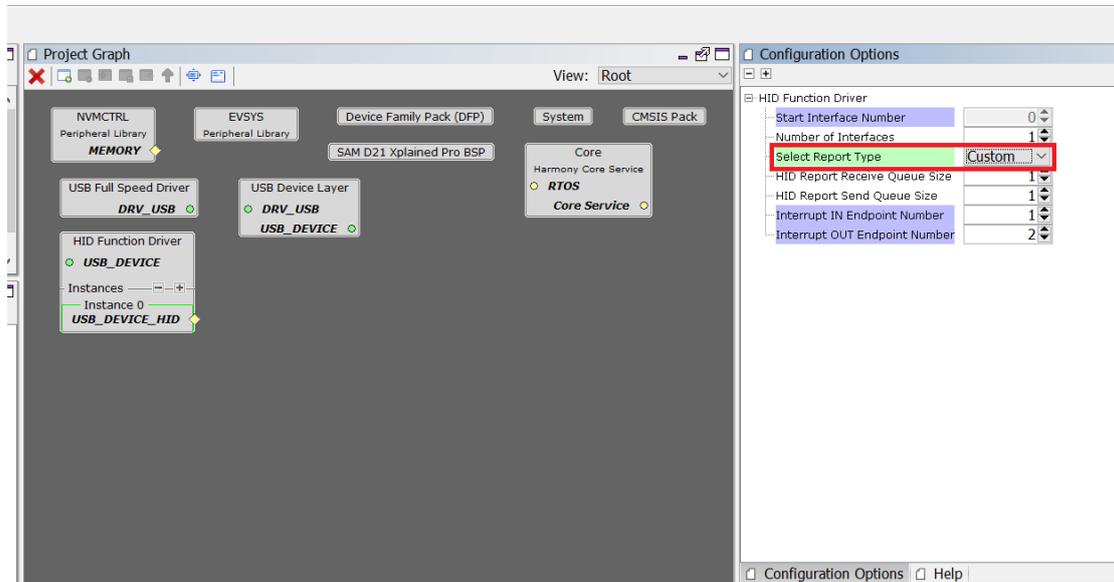
BSP 和 HID Function Driver 添加完毕后的配置界面如下：



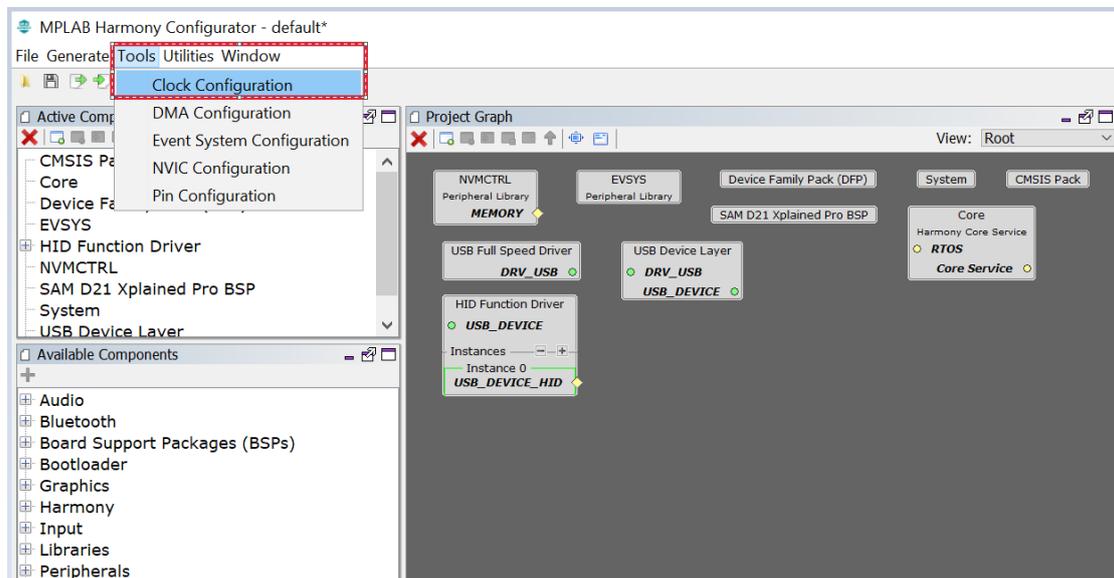
我们选择 USB Device Layer 可以配置 PID&VID 等。



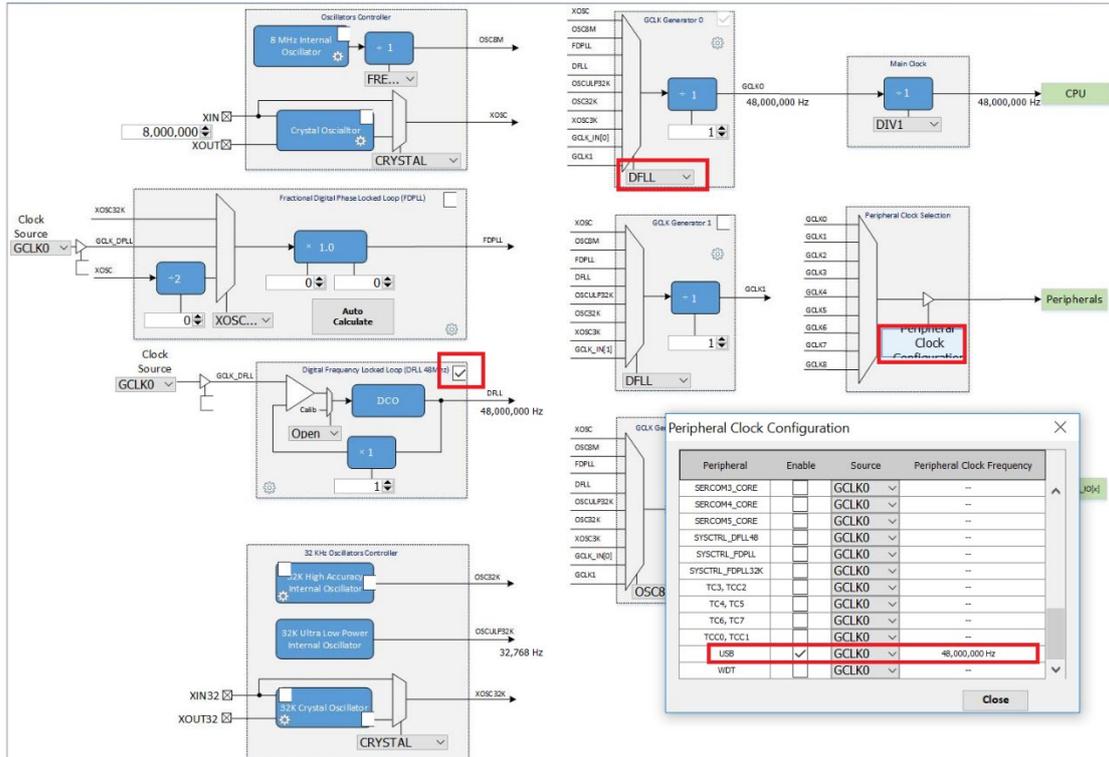
其他 USB Full Speed Driver 就用默认的设置，不需要修改。HID Function Driver 我们这里选择 custom。



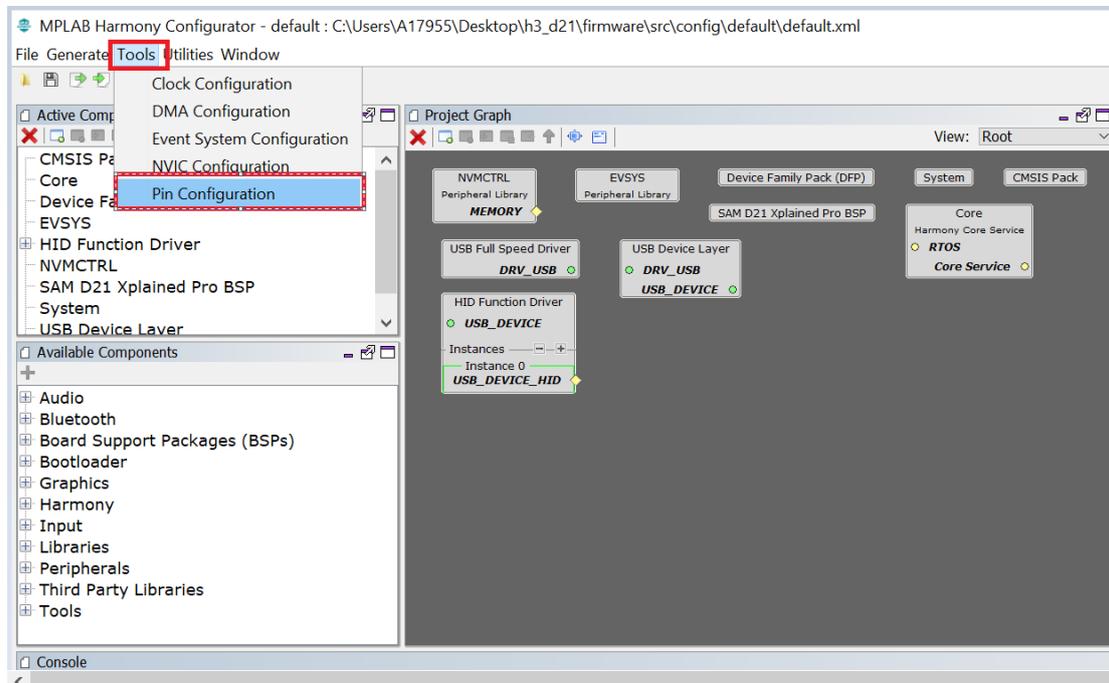
(四) 选择 Tools>Clock Configuration 菜单，启动时钟配置



在 D21 的时钟配置界面，确认时钟源采用 DFLL，确保 USB 外设的时钟是 enable 的。



(五) 使用 Tools>Pin Configuration, 配置 USB 引脚分配



USB 的管脚分配可以参考以下 D21 Xplained Board User guide 文档 (Atmel-42220-SAMD21-Xplained-Pro_User-Guide.pdf)

Table 4-7. USB Connections

Pin on SAM D21	USB
PA14	VBUS Detection
PA03	USB ID

Pin on SAM D21	USB
PA24	USB D-
PA25	USB D+

Pin Number	Pin ID	Custom Name	Function	Mode	Direction	Latch	Pull Up	Pull Down
25	PB12		Available	Digital	High Impedance	Low		
26	PB13		Available	Digital	High Impedance	Low		
27	PB14		Available	Digital	High Impedance	Low		
28	PB15		Available	Digital	High Impedance	Low		
29	PA12		Available	Digital	High Impedance	Low		
30	PA13		Available	Digital	High Impedance	Low		
31	PA14	USB_VBUS_SENSE	GPIO	Digital	In	Low		
32	PA15	SWITCH	SWITCH_AL	Digital	Out	High		
33	GPIO0		Available	Digital	High Impedance	Low		
34	VEE00		Available	Digital	High Impedance	Low		
35	PA16		Available	Digital	High Impedance	Low		
36	PA17		Available	Digital	High Impedance	Low		
37	PA18		Available	Digital	High Impedance	Low		
38	PA19		Available	Digital	High Impedance	Low		
39	PB16		Available	Digital	High Impedance	Low		
40	PB17		Available	Digital	High Impedance	Low		
41	PA20		Available	Digital	High Impedance	Low		
42	PA21		Available	Digital	High Impedance	Low		
43	PA22		Available	Digital	High Impedance	Low		
44	PA23		Available	Digital	High Impedance	Low		
45	PA24	USB_DM	USB_DM	Digital	High Impedance	N/A		
46	PA25	USB_DP	USB_DP	Digital	High Impedance	N/A		

Pin on SAM D21	LED
PB30	Yellow LED0

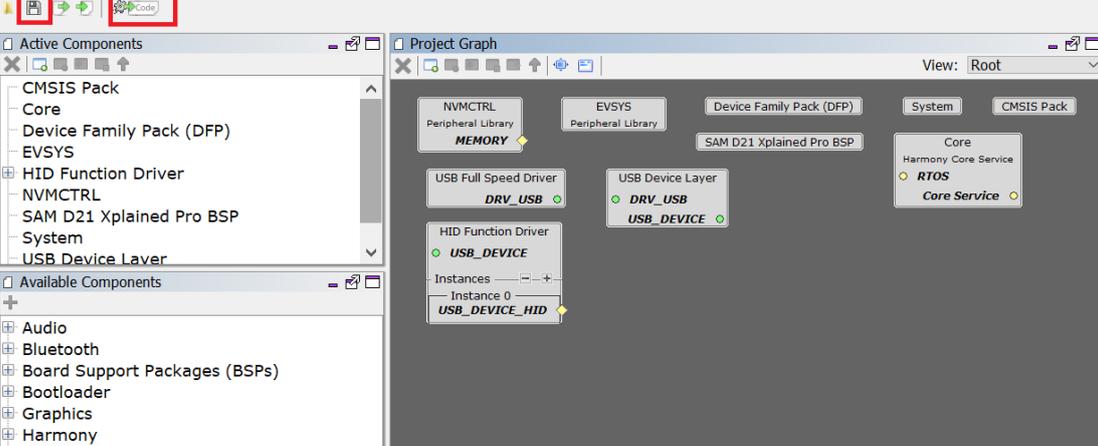
59	PB30	LED	LED_AL	Digital	Out	High		
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(六) “保存”项目配置和“代码生成”

在任务栏点击“保存”和“代码生成”按钮

MPLAB Harmony Configurator - default: C:\Users\A17955\Desktop\h3_d21\firmware\src\config\default\default.xml

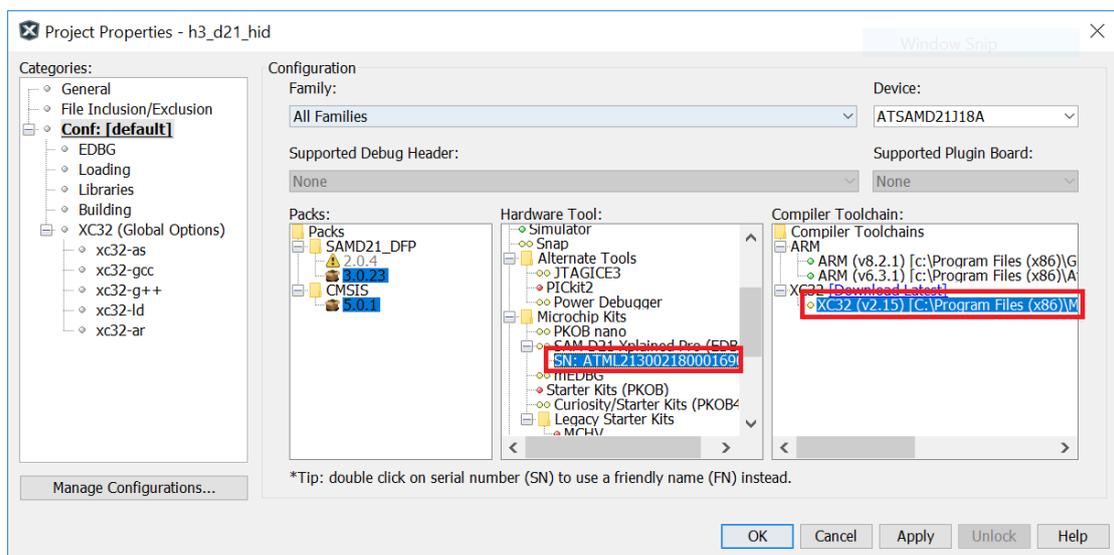
File Generate Tools Utilities Window



The screenshot shows the MPLAB Harmony Configurator interface. The 'File' menu is open, and the 'Save' and 'Generate Code' buttons are highlighted with red boxes. The Project Graph displays the following components:

- NVMCTRL (Peripheral Library)
- EVSYS (Peripheral Library)
- Device Family Pack (DFP)
- SAM D21 Xplained Pro BSP
- System
- CMSIS Pack
- Core (Harmony Core Service)
- RTOS (Core Service)
- Core Service
- USB Full Speed Driver (DRV_USB)
- USB Device Layer (DRV_USB, USB_DEVICE)
- HID Function Driver (USB_DEVICE)
- Instances: Instance 0 (USB_DEVICE_HID)

关闭 MHC 配置应用程序，回到工程项目管理目录树，可以看到相关的 USB 和 D21 BSP 相关的头文件和源代码已经生成了。



(八) app.c 里增加如下测试代码

app.h, app.c 的代码请参考 <Harmony 3 Framework path>\usb\apps\device\hid_basic 的例程。

(九) 编译下载测试

用 Micro USB 线通过 EDBG 调试口将 SAM D21 Xplained Board 开发板连接到电脑

编译并下载程序：

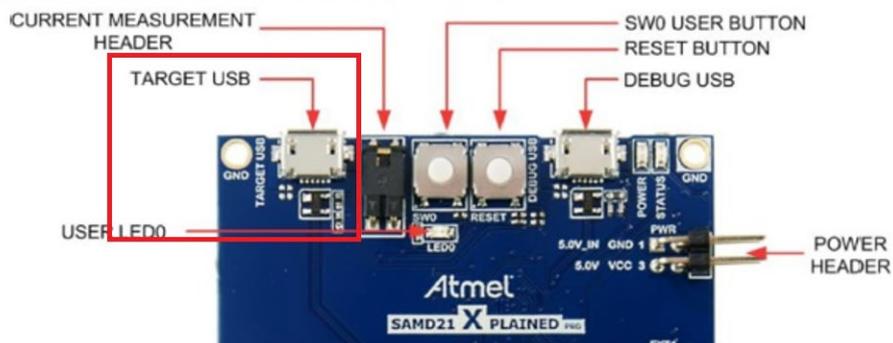


在 Windows 的设备管理器里面，确认 EDBG 的串口已经出现。

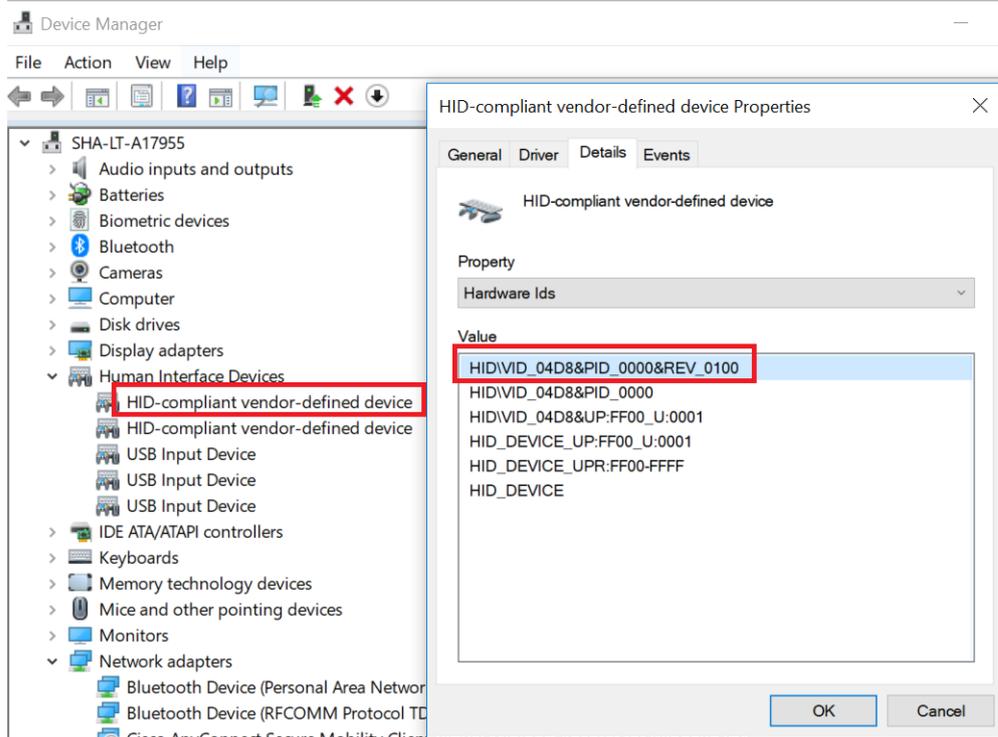


在程序烧写完毕后，确保 TARGET USB 已经连接上开发主机

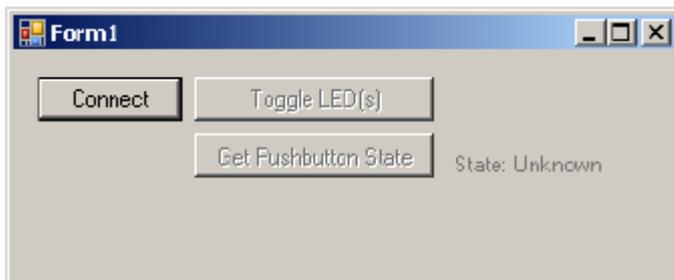
SAM D21 Xplained Pro Evaluation Kit Overview



可以通过 Windows 的设备管理器，来确保对应的 custom HID 设备已经枚举成功。



<Harmony 3 Framework path>\apps\device\hid_basic\bin\GenericHIDSimpleDemo.exe 程序可以用来测试 USB HID 的功能，开关板子上的 LED。



四、 总结

本文展示了如何通过 MPLAB X IDE 和 MHC 一步步完成了一个 Generic HID 程序，开发人员可以从这个过程了解到 Harmony 配置开发 USB HID 设备的全过程。