省电模式唤醒中断

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	本范例代码在POWER DOWN模式之下，使用GPIO唤醒MCU，进入POWER DOWN WAKEUP 中断。
BSP 版本	NUC230_240 Series BSP CMSIS V3.01.001
开发平台	NuTiny-EVB-NUC240 V1.2

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1 功能介绍

1.1 简介

在Power Down Wakeup中断来源是从周边过来的，如果中断优先权是同一层，周边硬件中断会先执行。若希望Power Down Wakeup中断先发生，可以将Power Down Wakeup中断优先权提高。

1.2 原理

NUC240支持系统核心产生的中断和32个可由周边产生的中断。中断的优先权可由向量中断控制器(NVIC)的中断优先控制缓存器(NVIC_IPR0~7) 设定。除了Reset，NMI，HardFault的优先权固定为最高，其他的都可以做配置。

名称	向量号码	优先权
Reset	1	-3
NMI	2	-2
HardFault	3	-1
保留	4~10	保留
SVCall	11	可配置
保留	12~13	保留
PendSV	14	可配置
SysTick	15	可配置
Interrupt (IRQ0~IRQ31)	16~47	可配置

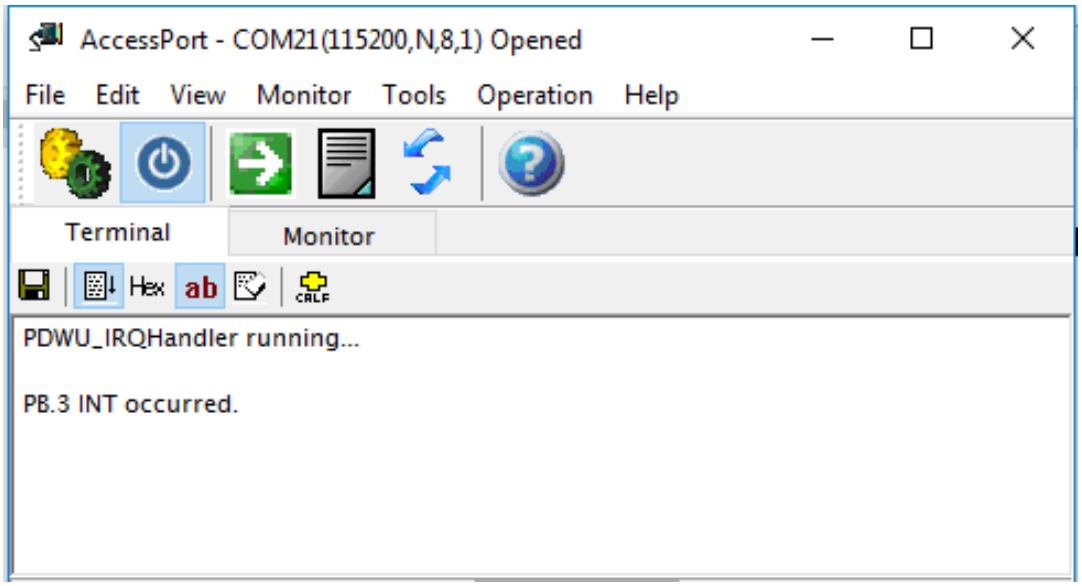
一个中断的优先权设定有8个位，只有最高两个位的设定有效，因此优先权可以设定为0~3，数字越小的优先权越高，设定为0的优先权最高，设定为3的优先权最低。

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
用于优先权设定		没有实现功能，读回零					

1.3 执行结果

使用NUC240开发板，PB.0(UART RX)及PB.1(UART TX)连接到连接至NuBridge，从UART0打印讯息。

当PB.3接地时，MCU会被唤醒，之后进PDWU 中断，再进GPIO中断。



2 代码介绍

2.1 GPIO 中断设定

设定 GPIO (PB.3) 为输入模式，下降边缘触发中断，开启NVIC中断功能。

```
    /* Configure PB.3 as Input mode and enable interrupt by falling edge trigger */
    GPIO_SetMode(PB, BIT3, GPIO_PMD_INPUT);
    GPIO_EnableInt(PB, 3, GPIO_INT_FALLING);
    NVIC_EnableIRQ(GPAB_IRQn);
```

在GPIO中断里清除PB.3中断旗标，以及打印讯息。

```
void GPAB_IRQHandler(void)
{
    /* To check if PB.3 interrupt occurred */
    if(GPIO_GET_INT_FLAG(PB, BIT3)) {
        GPIO_CLR_INT_FLAG(PB, BIT3);
        printf("PB.3 INT occurred.\n");
    } else {
        /* Un-expected interrupt. Just clear all PA, PB interrupts */
        PA->ISRC = PA->ISRC;
        PB->ISRC = PB->ISRC;
        printf("Un-expected interrupts.\n");
    }
}
```

为了让唤醒中断比GPIO中断早产生，设定GPIO中断的优先权为3(最低)。

```
    /* Set PA and PB interrupt priority as 3(lowest) */
    NVIC_SetPriority(GPAB_IRQn,3);
```

2.2 唤醒中断设定

开启唤醒中断功能。

```
    /* Enable wake-up interrupt source */
    CLK->PWRCON |= CLK_PWRCON_PD_WU_INT_EN_Msk;

    /* Enable IRQ request for PDWU interrupt */
    NVIC_EnableIRQ(PWRWU_IRQn);
```

在唤醒中断里清除唤醒中断旗标，以及打印讯息。

```
void PWRWU_IRQHandler(void)
{
    printf("PDWU_IRQHandler running...\n");

    /* Clear interrupt */
    CLK->PWRCON  |= CLK_PWRCON_PD_WU_STS_Msk;
}
```

为了让唤醒中断先产生，设定唤醒中断的优先权为0(最高)。

```
    /* Set Power-down wake-up interrupt priority as 0(highest) */
    NVIC_SetPriority(PWRWU_IRQn,0);
```

2.3 进入省电模式

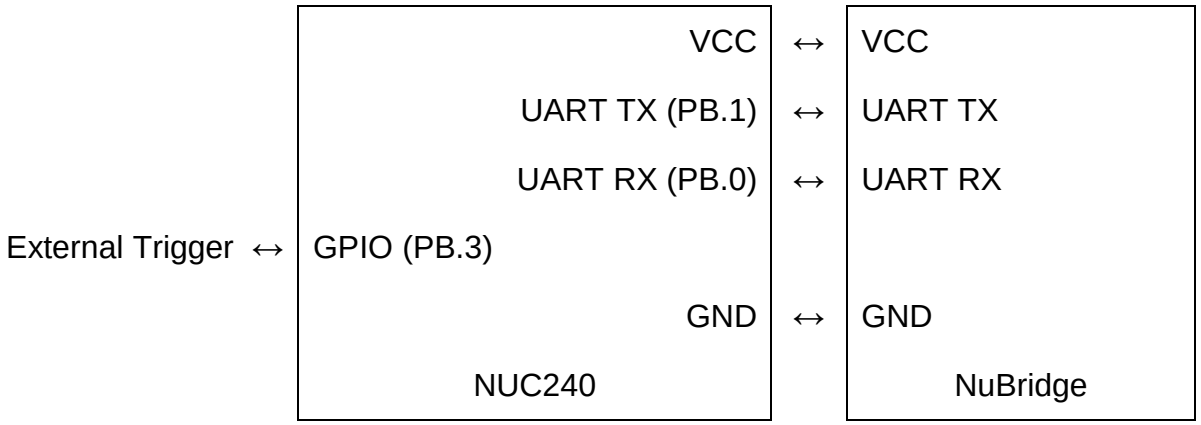
呼叫CLK_PowerDown API后进入省电模式。

```
    /* Enter to Power-down mode and wait for PB.3 falling edge interrupt event */
    UART_WAIT_TX_EMPTY(UART0);
    CLK_PowerDown();
```

3 软件与硬件环境

- 软件环境
  - BSP 版本
    - NUC230_240 Series BSP CMSIS V3.01.001
  - IDE 版本
    - Keil uVersion 5.28
- 硬件环境
  - 电路组件
    - NuTiny-EVB-NUC240 V1.2
    - NuBridge
  - 示意图

NUC240 使用 GPIO(PB.3) 脚位为唤醒来源。



4 目录信息

- EC_NUC240_PDWK_INT_V1.00
  - Library — Sample code header and source files
    - CMSIS — Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
    - Device — CMSIS compliant device header file
    - StdDriver — All peripheral driver header and source files
  - SampleCode
    - ExampleCode — Source file of example code

5 如何执行范例程序

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 NUC240_PDWK_INT.uvproj。
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
3. 按开发版上的重置按钮让程序开始执行

6 修订纪录

Date	Revision	Description
Jul. 31, 2019	1.00	1. 初始发布.

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