Power-down Wake-up Interrupt

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This code wakes up the MCU by GPIO and then enters to power-down wake-up interrupt.
BSP Version	NUC230_240 Series BSP CMSIS V3.01.001
Hardware	NuTiny-EVB-NUC240 V1.2

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of NuMicro microcontroller based system design. Nuvoton assumes no responsibility for errors or omissions.

All data and specifications are subject to change without notice.

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

1 Function Description

1.1 Introduction

Power-down wake-up interrupt source comes from peripheral. If interrupt priority is at the same layer (default state), the peripheral hardware interrupt will be executed first before the Power-down wake-up interrupt.
If user wants the Power-down wake-up interrupt to occur first, you can configure the Power-down wake-up interrupt priority.

1.2 Principle

NUC240 supports interrupt generated form system processor and 32 interrupt requests from external peripherals. The interrupt priority can be configured in Nest Vector Interrupt Controller (NVIC) controller register, NVIC_IPR0~7. The Reset, NMI and HardFault priority are fixed to the highest. Others interrupt priority are configurable.

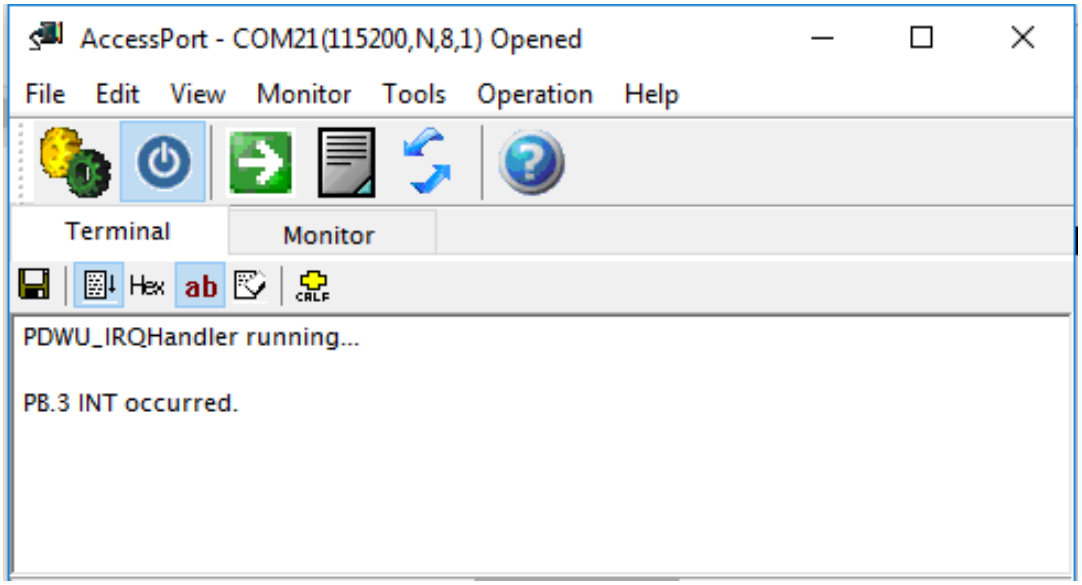
Name	Vector Number	Priority
Reset	1	-3
NMI	2	-2
HardFault	3	-1
Reserved	4~10	Reserved
SVCall	11	Configurable
Reserved	12~13	Reserved
PendSV	14	Configurable
SysTick	15	Configurable
Interrupt (IRQ0~IRQ31)	16~47	Configurable

An interrupt priority control register is 8 bits. The two MSB bits are for priority configuration. Other bits are reserved. So the priority can be set as 0 to 3. The smaller configuration has the higher priority. Setting the priority to 0 indicates the highest priority. Setting the priority to 3 indicates the lowest priority.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Implemented		Not implemented, read as 0.					

1.3 Demo Result

This code uses NUC240 board. Connect PB.0(UART RX) and PB.1(UART TX) to NuBridge. The print message is from UART0.
When PB.3 pin status is from high to low, MCU will wake-up and enter to Power-down wake-up interrupt at first, then enter to GPIO interrupt.



2 Code Description

2.1 GPIO Interrupt Configuration

Configure PB.3 as GPIO input mode. Enable interrupt by falling edge trigger. Enable NVIC interrupt.

```
    /* 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);
```

Clear PB.3 interrupt flag and print message in GPIO interrupt.

```
oid 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");
    }
}
```

To let Power-down wake-up interrupt occur before GPIO interrupt, setting GPIO interrupt priority as 3 (lowest).

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

2.2 Wake-up Interrupt Configuration

Enable Power-down wake-up interrupt and NVIC.

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

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

Clear interrupt flag and print message in Power-down wake-up interrupt.

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

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

To let Power-down wake-up interrupt occur first, setting Power-down wake-up interrupt priority as 0 (highest).

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

2.3 Entering to Power-down Mode

Call CLK_PowerDown API and then enter to Power-down mode

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

3 Software and Hardware Environment

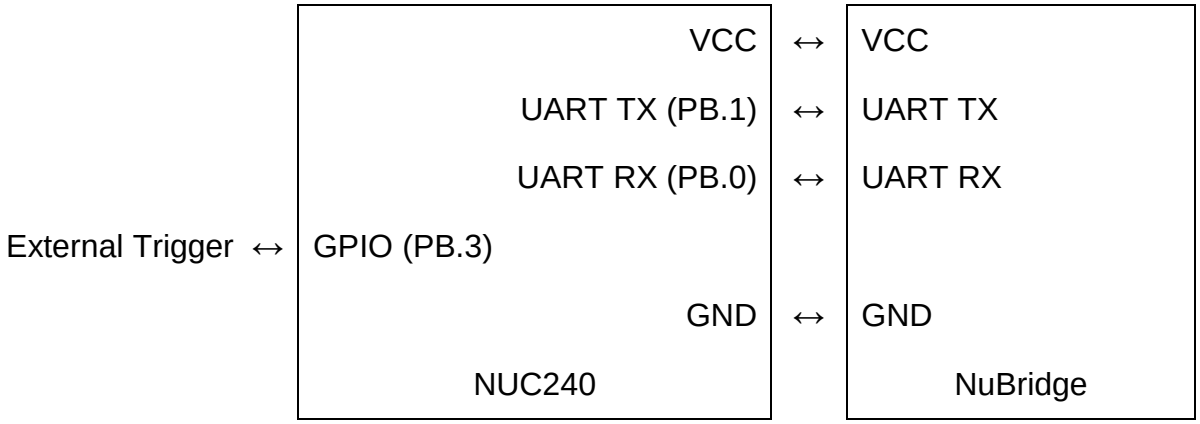
Software Environment

- BSP version
  - NUC240 Series BSP CMSIS V3.01.001
- IDE version
  - Keil uVersion 5.28

Hardware Environment

- Circuit components
  - NuTiny-EVB-NUC240 V1.2
  - NuBridge
- Diagram

NUC240 uses GPIO(PB.3) pin as wake-up source.



4 Directory Information

- 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 How to Execute Example Code

1. Browsing into sample code folder by Directory Information (section 4) and double click NUC230_240_PDWK_INT.uvproj.
2. Enter Keil compile mode
   a. Build
   b. Download
3. Press Reset button on development board and code stat to execute.

6 Revision History

Date	Revision	Description
Jul. 31, 2019	1.00	1. Initially issued.

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

Please note that all data and specifications are subject to change without notice.
All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.