透過SVC取得目前程式執行的PC值

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	本範例代碼透過 SVC 讀取，並打印 MCU 目前程式執行的 pc，stack， r0， r1， r12 等暫存器值。
BSP 版本	NUC230_240 Series BSP CMSIS V3.01.001
開發平台	NuTiny-EVB-NUC240 V1.2

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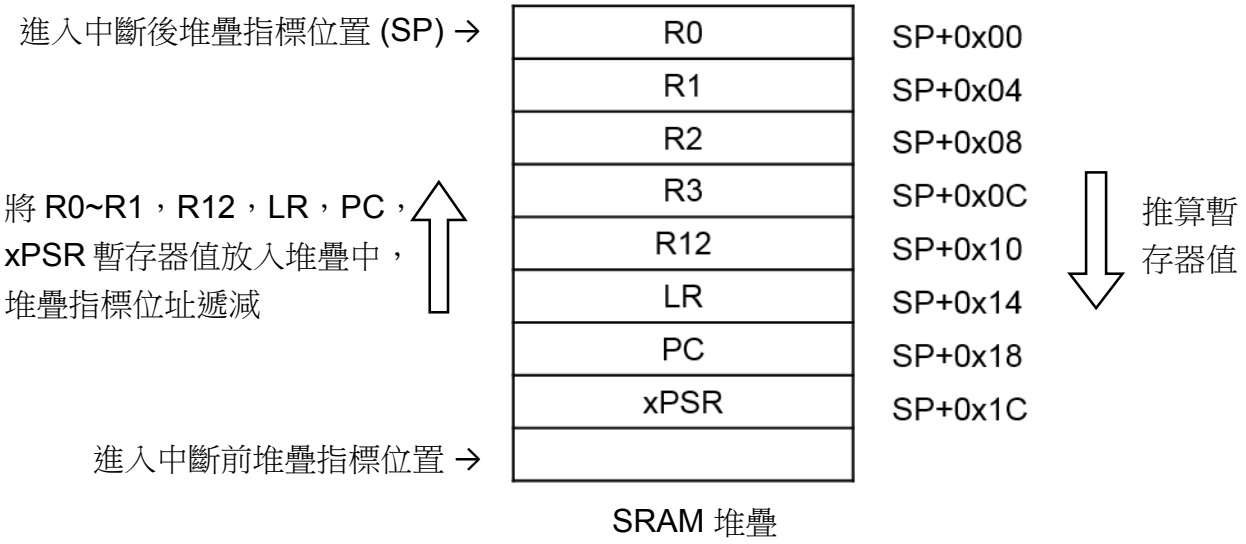
1 功能介紹

1.1 簡介

透過SVC讀取程式執行當下的PC值，執行SVC指令時，系統會產生SVC中斷，可用於OS系統服務程式的操作。產生SVC中斷時，系統會將目前暫存器的狀態放入堆疊中，本範例代碼利用這些資訊來獲取呼叫產生SVC中斷時的程式位址(PC)，並將該PC值打印出來，其他可獲取的資訊包括堆疊(stack)，R0~R3，R12，xPSR。

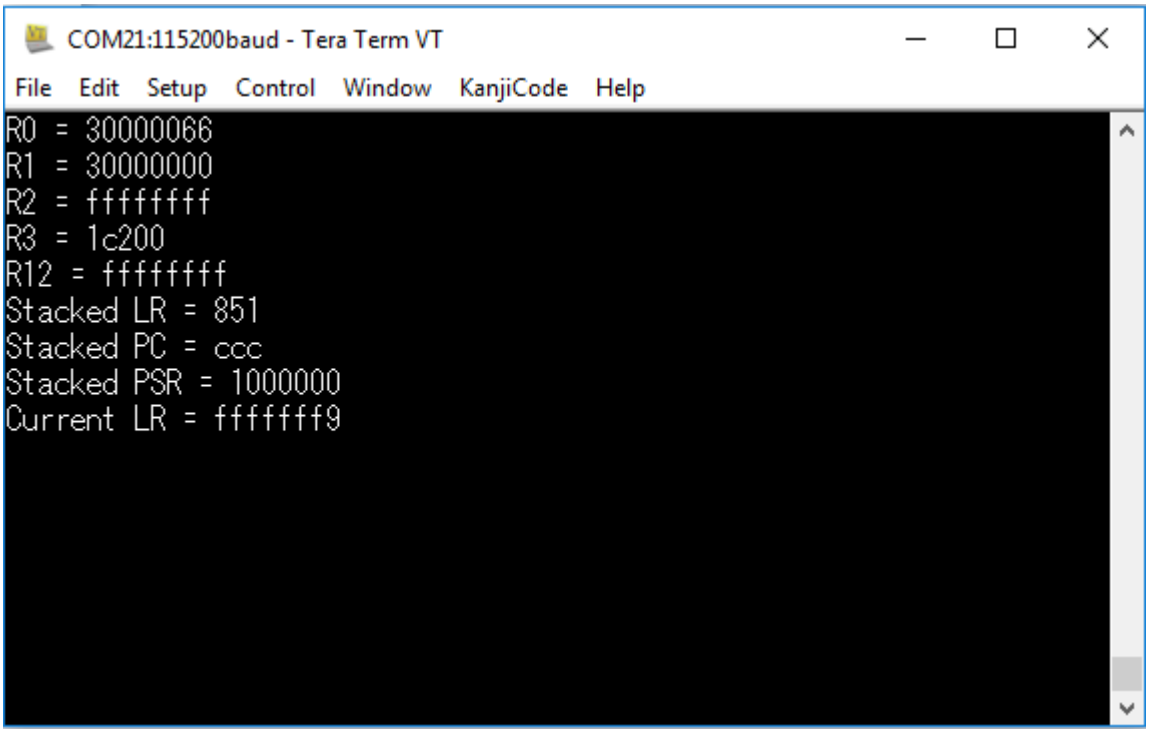
1.2 原理

中斷發生時，系統會自動將下列8個暫存器數值放入堆疊中：R0，R1，R2，R3，R12，LR，PC，xPSR。在SCV中斷裡，讀取目前堆疊指標的位置，即可推算得知這8個數值，包括執行SVC指令時的程式位址(PC)。



1.3 執行結果

使用NUC240開發板，PB.0(UART RX)及PB.1(UART TX)連接到連接至NuBridge，從UART0打印訊息。訊息顯示呼叫SVC當下的PC值和其他資訊。



2 代碼介紹

產生SVC中斷

執行SVC指令產生SVC中斷，利用Keil MDK提供的 __svc 關鍵字定義SVC函式，定義數字0的SVC函式，沒有傳入參數及傳回值。

```
    /* Define SVC function */
    void __svc(0x00) svc_PC(void);
```

使用時直接呼叫定義的SVC函式即可。

```
    /* Supervisor Call */
    svc_PC();
```

SVC中斷處理

讀取LR的第二個位元，檢查使用的堆疊是哪一個，PSP或MSP。呼叫打印函式，傳入參數：堆疊指標和返回地址。

```
__asm void SVC_Handler(void)
{
    MOVS    r0, #4
    MOV     r1, LR
    TST     r0, r1
    BEQ     stacking_used_MSP
    MRS     R0, PSP         ; first parameter - stacking was using PSP
    B       get_LR_and_branch
stacking_used_MSP
    MRS     R0, MSP         ; first parameter - stacking was using MSP
get_LR_and_branch
    MOV     R1, LR          ; second parameter is LR current value
    LDR     R2,=__cpp(dump_handler_c)
    BX      R2
    NOP
    BX      LR
}
```

打印PC值

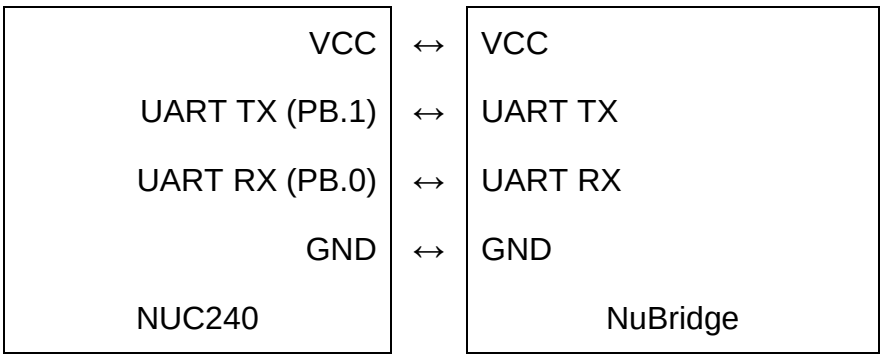
從堆疊裡讀取R0~R3，R12，LR，PC和xPSR數值，並打印出來。

```
void dump_handler_c(unsigned int * hardfault_args, unsigned lr_value)
{
    static volatile unsigned int stacked_r0;
    static volatile unsigned int stacked_r1;
    static volatile unsigned int stacked_r2;
    static volatile unsigned int stacked_r3;
    static volatile unsigned int stacked_r12;
    static volatile unsigned int stacked_lr;
    static volatile unsigned int stacked_pc;
    static volatile unsigned int stacked_psr;

    stacked_r0 = ((unsigned long) hardfault_args[0]);
    stacked_r1 = ((unsigned long) hardfault_args[1]);
    stacked_r2 = ((unsigned long) hardfault_args[2]);
    stacked_r3 = ((unsigned long) hardfault_args[3]);
    stacked_r12 = ((unsigned long) hardfault_args[4]);
    stacked_lr = ((unsigned long) hardfault_args[5]);
    stacked_pc = ((unsigned long) hardfault_args[6]);
    stacked_psr = ((unsigned long) hardfault_args[7]);

    printf ("R0 = %x\n", stacked_r0);
    printf ("R1 = %x\n", stacked_r1);
    printf ("R2 = %x\n", stacked_r2);
    printf ("R3 = %x\n", stacked_r3);
    printf ("R12 = %x\n", stacked_r12);
    printf ("Stacked LR = %x\n", stacked_lr);
    printf ("Stacked PC = %x\n", stacked_pc);
    printf ("Stacked PSR = %x\n", stacked_psr);
    printf ("Current LR = %x\n", lr_value);
}
```

3 軟體與硬體環境

- **軟體環境**
  - BSP 版本
    - NUC230_240 Series BSP CMSIS V3.01.001
  - IDE 版本
    - Keil uVersion 5.28
- **硬體環境**
  - 電路元件
    - NuTiny-EVB-NUC240 V1.2
    - NuBridge
  - 示意圖

NUC240 開發版連接 Nubridge，用來打印訊息。



4 目錄資訊

- EC_NUC240_READ_PC_BY_SVC_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 如何執行範例程式

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 NUC240_READ_PC_BY_SVC.uvproj。
2. 進入編譯模式介面
   a. 編譯
   b. 下載代碼至記憶體
3. 進入除錯模式介面
   a. 執行代碼

6 修訂紀錄

Date	Revision	Description
Jul. 31, 2019	1.00	1. 初始發布.

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