使用GPIO和TIMER模擬UART傳送

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	使用 GPIO 及 TIMER 模擬 UART 波形
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

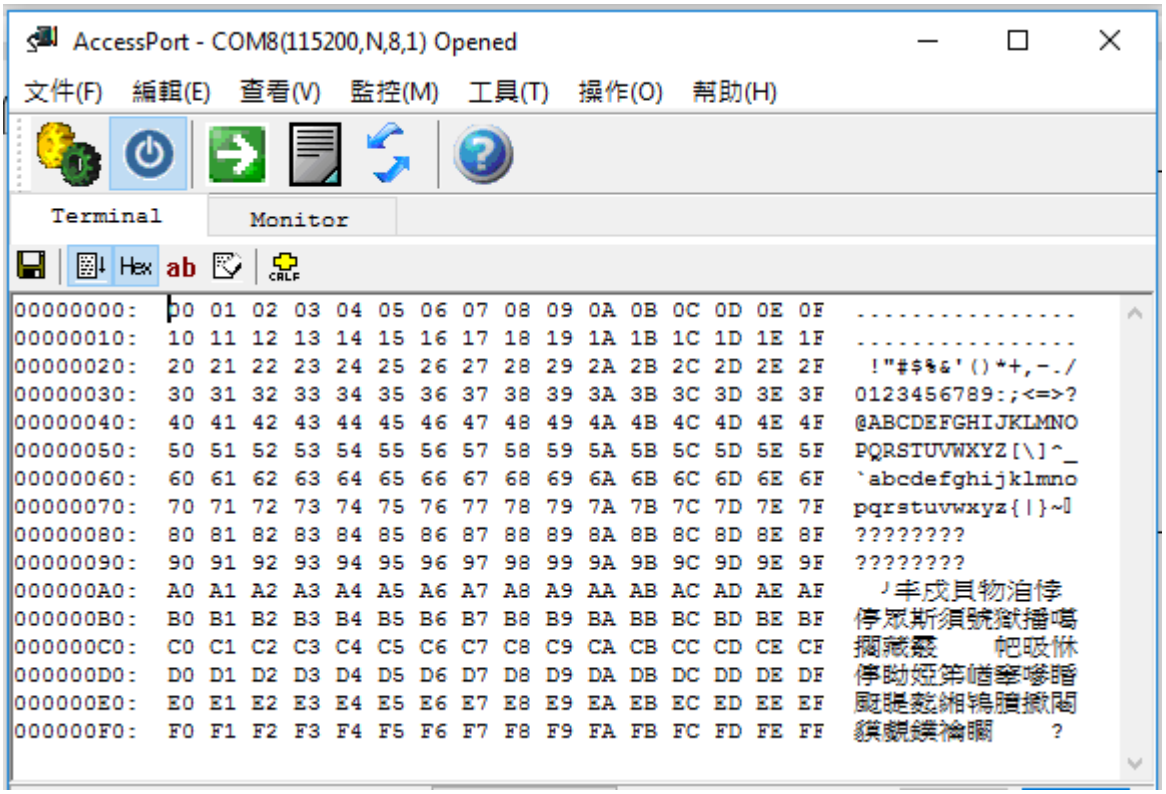
1.1 簡介

當在應用時，有時難免會到硬件UART組數不夠用，此時便可以用TIMER中斷配合GPIO產生UART的波形，因為是軟體處理，使用者需要小心，在UART丟出去前，把其它中斷關閉以免被打斷傳輸。本範例提供了2個API，讓使用者呼叫：

API	功能
void SW_UART_INIT(void)	Software UART的初始化
void UART_GPIO(uint32_t u8UartData)	送出字元

1.2 執行結果

NUC240開發板的PA.0 連接至NuBridge UART RX。開啟電腦終端機軟體，設置UART傳輸速度為115200bps，無校驗位元 ，數據長度為8位元，停止位元長度為1位元。執行程式後，終端機打印出0x00-0xFF。



2 代碼介紹

2.1 軟體 UART 初始化

SW_UART_INIT負責Software UART的初始化：將GPIO(PA.0)腳位設定成輸出模式，配置Timer 0頻率為115200Hz，以及開啟Timer 0中斷。

```
void SW_UART_INIT(void)
{
    /* Configure PA.0 as output mode */
    GPIO_SetMode(PA, BIT0, GPIO_PMD_OUTPUT);

    /* Enable peripheral clock */
    CLK->APBCLK |= CLK_APBCLK_TMR0_EN_Msk;

    /* Select peripheral clock source */
    CLK->CLKSEL1 |= CLK_CLKSEL1_TMR0_S_HIRC;

    /* Open Timer0 frequency 115200 in periodic mode, and enable interrupt */
    TIMER0->TCMPR = (22118400/115200);
    TIMER0->TCSR = TIMER_TCSR_IE_Msk | TIMER_PERIODIC_MODE;
    TIMER_SET_PRESCALE_VALUE(TIMER0, 0);

    /* Enable Timer0 NVIC */
    NVIC_EnableIRQ(TMR0_IRQn);
}
```

2.2 UART 字元傳送

UART_GPIO負責傳送UART字元：準備好要傳送的字元，加上起始位元和停止位元，總共10個位元的資料。開始Timer 0計數，直到所有位元資料都處理完畢，再停止Timer 0計數。

```
void UART_GPIO(uint32_t u32UartData)
{
    /* Prepare transmit data */
    g_u32Data = (u32UartData<<1)|(1<<9);  //STOP BIT + 8 DATA BIT + START BIT
    g_u32Count = 10;

    /* Start Timer0 counting */
```

```
    TIMER_Start(TIMER0);
    while(g_u32Count!=0);

    /* Stop Timer0 counting */
    TIMER_Stop(TIMER0);
}
```

2.3 TIMER 中斷處理

Timer 0中斷裡根據要傳輸的資料控制GPIO，如果資料為1就輸出高電壓準位，如果資料為0就輸出低電壓準位。

```
void TMR0_IRQHandler(void)
{
    /* Clear Timer0 time-out interrupt flag */
    TIMER_ClearIntFlag(TIMER0);

    /* Control PA.0 output status */
    if(g_u32Count!=0) {
        if((g_u32Data&0x01)==0x01)
            PA0=1;
        else
            PA0=0;
        g_u32Data=g_u32Data>>1;
        g_u32Count--;
    }
}
```

3 軟體與硬體環境

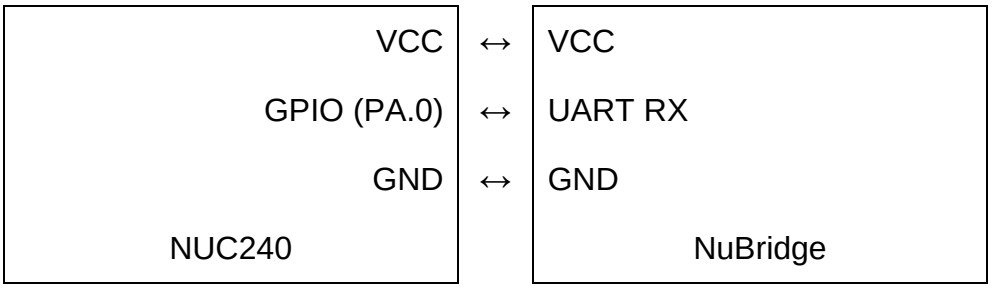
● 軟體環境

- ■ 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 使用 GPIO(PA.0) 腳位模擬 UART 輸出波形。



4 目錄資訊

- EC_NUC240_GPIO_UART_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
    - NuEdu — Library for NuEdu-SDK-xxxx board
    - 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_GPIO_UART.uvproj。
2. 進入編譯模式介面
   a. 編譯
   b. 下載代碼至記憶體
   c. 進入 / 離開除錯模式
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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