Simulate UART Transmission by Software

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This code uses GPIO and TIMER to simulate UART waveform.
BSP Version	NUC230_240 Series BSP CMSIS V3.01.001
Hardware	NuTiny-EVB-NUC240 V1.2

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1 Function Description

1.1 Introduction

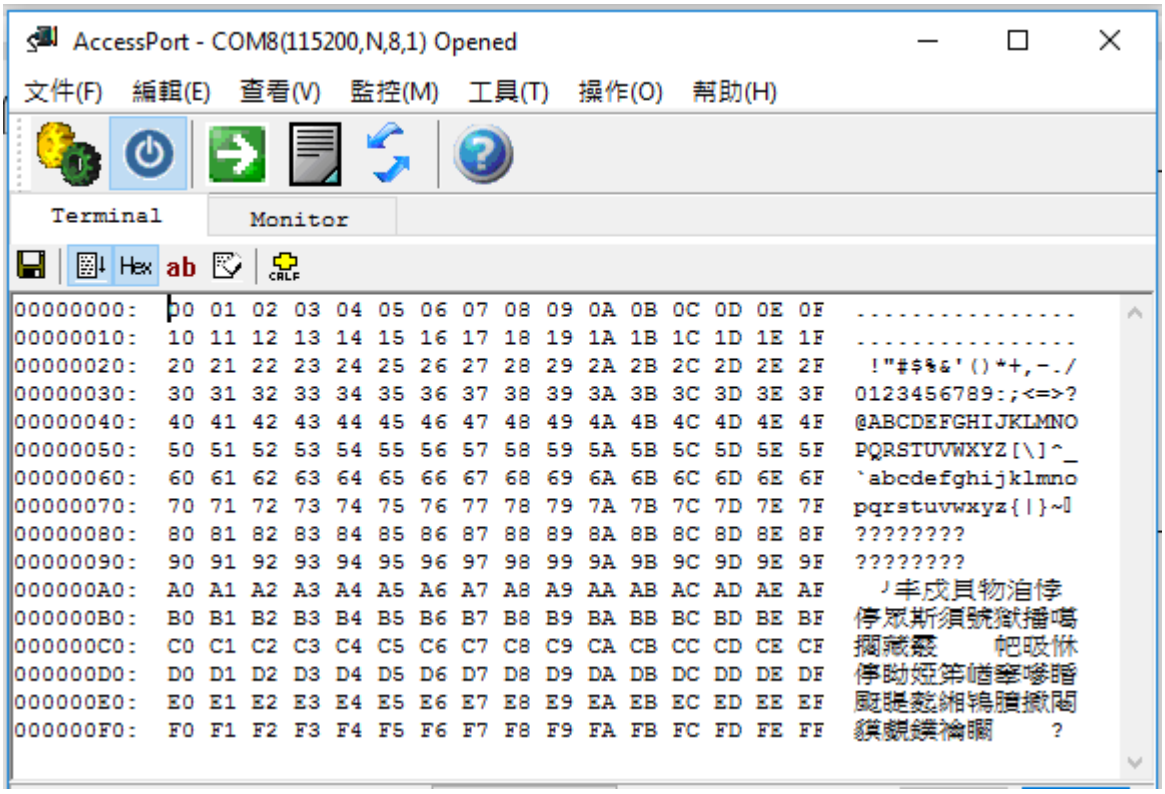
If we do not have enough UART channel to use in the application, we can use TIMER interrupt with GPIO to generate UART waveform. Since the waveform is processed by software, other interrupts have to be disabled to avoid interruption while waveform transmitting.

This code provides two API for user:

API	Function
void SW_UART_INIT(void)	Initial Software UART
void UART_GPIO(uint32_t u8UartData)	Send Character

1.2 Demo Result

The PA.0 of NUC240 board is connected to NuBridge UART RX. Open the computer terminal software, set UART baud rate to 115200 bps, no parity bit, data length is 8 bits, and the stop bit is 1 bit. After executing the program, the terminal shows 0x00 – 0xFF.



2 Code Description

2.1 Initial Software UART

SW_UART_INIT is used for software UART initialization: setting the GPIO(PA.0) to output mode, configure Timer 0 frequency as115200Hz, and enable Timer 0 interrupt.

```
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 Send UART Character

UART_GPIO is used for sending UART character: prepare the character to send, including start bit and stop bit. The data for transmission is total 10 bits. Start Timer 0 counting until the transmission is finished, then stop Timer 0 counting.

```
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 Interrupt Handling

Controlling GPIO in Timer 0 interrupt according to the transmitted data. If the data is 1 then set GPIO output high. If the data is 0 then set GPIO output low.

```
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 Software and Hardware Environment

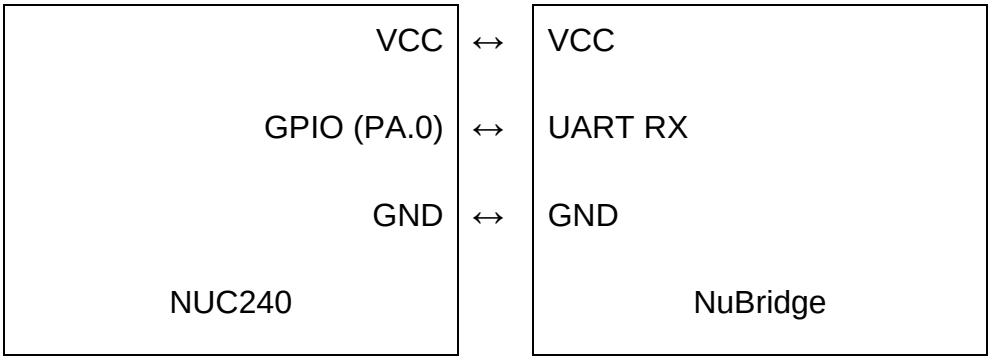
Software Environment

- BSP version
  - NUC230_240 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(PA.0) pin to simulate UART output waveform.



4 Directory Information

- 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 How to Execute Example Code

1. Browsing into sample code folder by Directory Information (section 4) and double click NUC240_GPIO_UART.uvproj.
2. Enter Keil compile mode
   a. Build
   b. Download
   c. Start/Stop debug session
3. Enter debug mode
   a. Run

6 Revision History

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

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