MS51 SPI 實現 ARGB LED 呼吸燈燈效

NuMicro® 8 位系列微控制器范例代码介绍

文件信息

应用简述	本范例代码使用MS51 SPI 来模拟ARGB LED 的时序并实现呼吸灯灯效
BSP 版本	MS51 Series BSP V1.00.003
开发平台	NuMaker-MS51PC Ver1.0

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1 概述

此范例代码使用MS51 系列的SPI 来仿真ARGB LED 的时序，演示ARGB LED 呼吸灯效果。此范例代码使用一组timer 来定时更新ARGB LED 呼吸灯的亮度及一组SPI 来模拟ARGB LED 的时序。

1.1 原理

1.1.1 ARGB LED 数据传输时间(TH+TL=1.25 us ± 600 ns)

ARGB LED 时序图如图 1-1至图 1-3所示。逻辑'0'定义为高准位0.4 us ± 150 ns 与低准位0.85 us ± 150 ns; 逻辑'1'定义为高准位0.8 us ± 150 ns 与低准位0.45 us ± 150 ns; 逻辑重置定义为大于50 us的低准位。

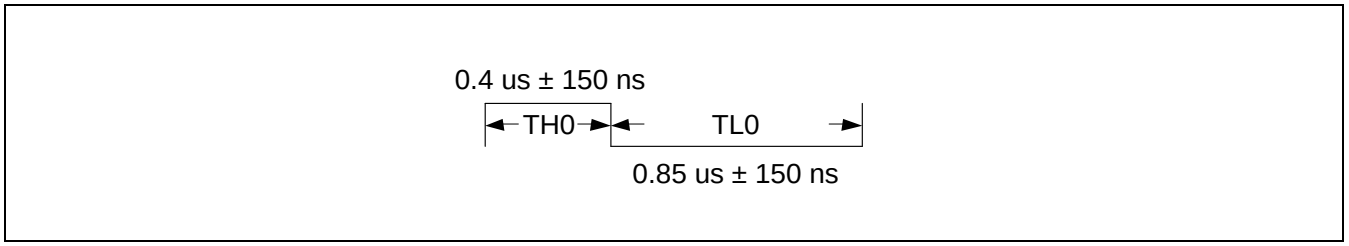

图 1-1 逻辑'0'

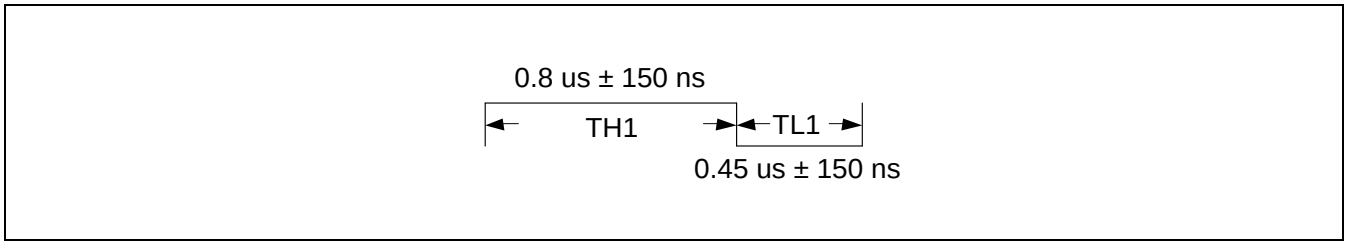

图 1-2 逻辑'1'

图 1-3 重置

1.1.2 SPI 时钟频率

程序中设定系统时钟HIRC 为24 MHz 以及SPI 时钟除频值为8，由此可计算出SPI 时钟速率为3 MHz，这代表一个SPI 时钟为 0.333 us。换句话说，逻辑'0' 映像为SPI 位样式为'1000'，如图 1-4所示; 逻辑'1' 映像为SPI 位样式为'1110'，亦即3 个字节的RGB 数据格式可转化成12 个字节的SPI 数据格式。

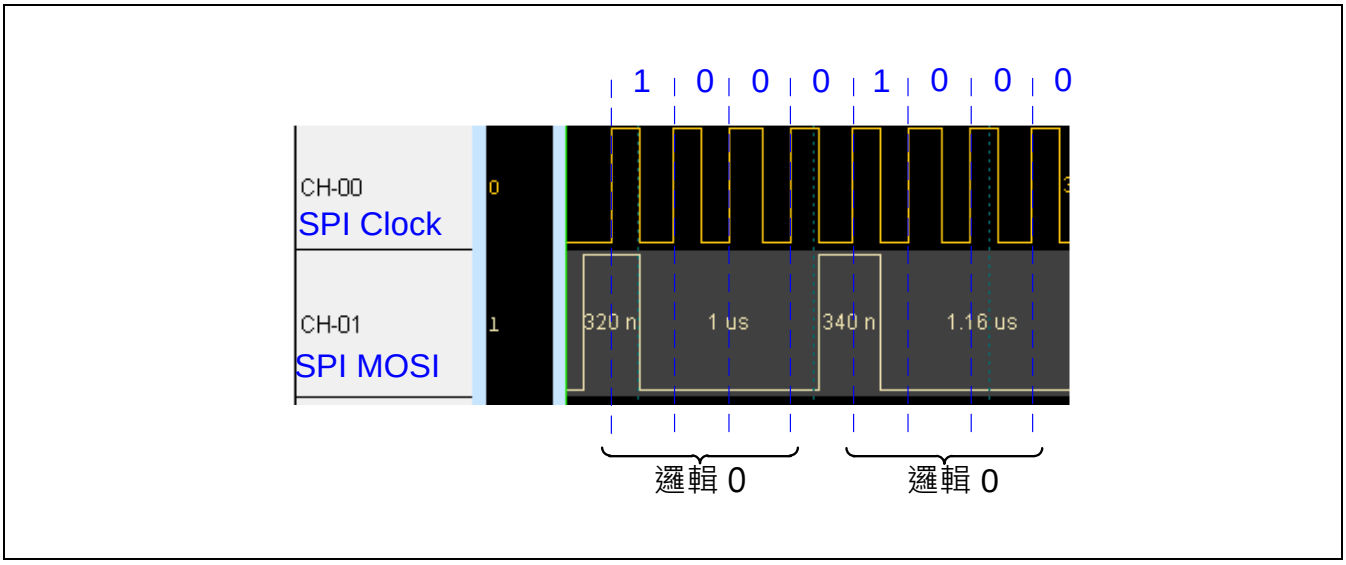

图 1-4 逻辑'0' 映像为 SPI 位样式

1.2 执行结果

执行结果如图 1-5所示。

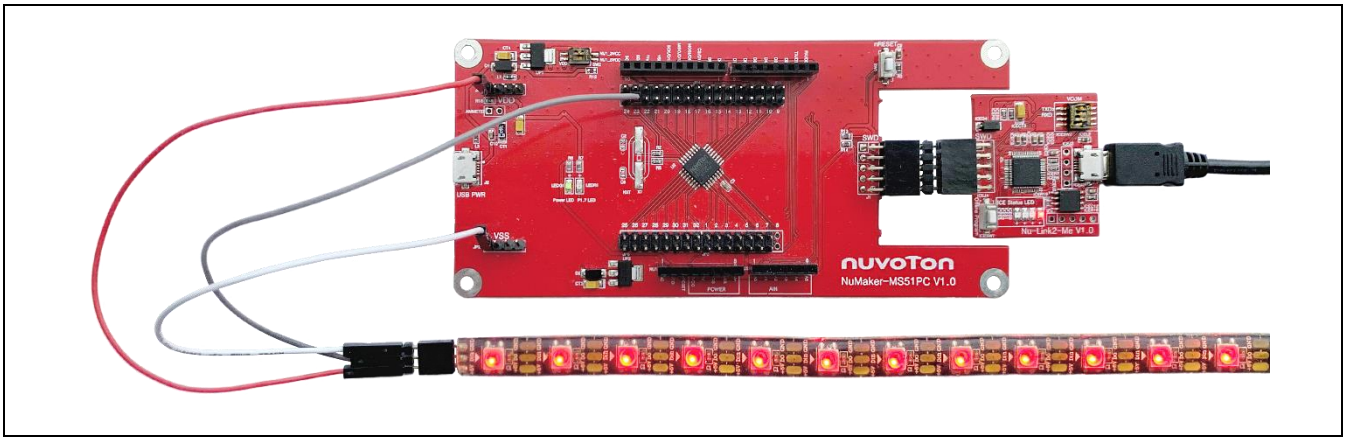

图 1-5 执行结果

2 代码介绍

代码工作流程如下：

1. main.c 中初始化 MS51 相关外设，包含 HIRC、SPI、与 Timer 3
2. 在 while 循环中呼叫 Breathing_TOPDOWN()来计算出相对应的 ARGB LED 亮度
3. 使用 SPI_Send() 来模拟 ARGB LED 时序

```
void main (void)
{
    /* Set HIRC = 24 MHz */
    MODIFY_HIRC(HIRC_24);

    P00 = 1;
    P00_INPUT_MODE;
    ENABLE_P00_PULLDOWN;

    /* Set SPI configure */
    SPI_Init();

    /* Enable Timer3 to add time counter */
    Timer3_1ms_initial();

    /* Init LED to all disable */
    Disable_TOPDOWN();
    SPI_Send();

    while(1)
    {

        /* Control LED */
        if (!spi_finish_flag)
        {
            Breathing_TOPDOWN();
            SPI_Send();
        }
    }
}
```

当 Breathing_TOPDOWN()被呼叫时，会定时更新 ARGB LED 亮度。计数器与亮度变化的关系如表 2-1 所示。

```
void Breathing_TOPDOWN(void)
{
    unsigned char TempR, TempG, TempB;
    unsigned long TempCal;

    /* Calculate brightness */
    TempCal = *(BreathingBright + (HDIV_Mod(HDIV_Div(TOPDOWNTimeCounter,
(BreathingRate[TOPDOWNSpeed]) * 8), BreathingArraySize)));
    TempCal = HDIV_Div((TempCal * TOPDOWNBrightness), 100);

    /* Calculate color and set transfer data */
    TempR = HDIV_Div((TOPDOWNRGBColor[0] * TempCal), 100);
    TempG = HDIV_Div((TOPDOWNRGBColor[1] * TempCal), 100);
    TempB = HDIV_Div((TOPDOWNRGBColor[2] * TempCal), 100);
    Set_TOPDOWN_RGB(TempR, TempG, TempB);
```

```
    /* Reset TOPDOWNTimeCounter */
    if(HDIV_Div(TOPDOWNTimeCounter, BreathingRate[TOPDOWNSpeed] * 8 * BreathingArraySize))
    {
        TOPDOWNTimeCounter -= BreathingRate[TOPDOWNSpeed] * 8 * BreathingArraySize;
    }
}
```

TOPDOWNTimeCounter	TempCal	TempR	TempG	TempB
0	0	0	0	0
…	…	…	…	…
48	0	0	0	0
…	…	…	…	…
96	1	2	0	0
…	…	…	…	…
144	2	5	0	0
…	…	…	…	…

表 2-1 计数器与亮度变化的关系表

3 软件与硬件需求

- 软件需求
  - BSP 版本
    - MS51 Series BSP V1.00.003
  - IDE 版本
    - Keil uVersion 5.26
- 硬件需求
  - 电路组件
    - NuMaker-MS51PC Ver1.0
    - ARGB LED
  - 示意图

使用 SPI MOSI 脚位来模拟 ARGB LED 时序图。

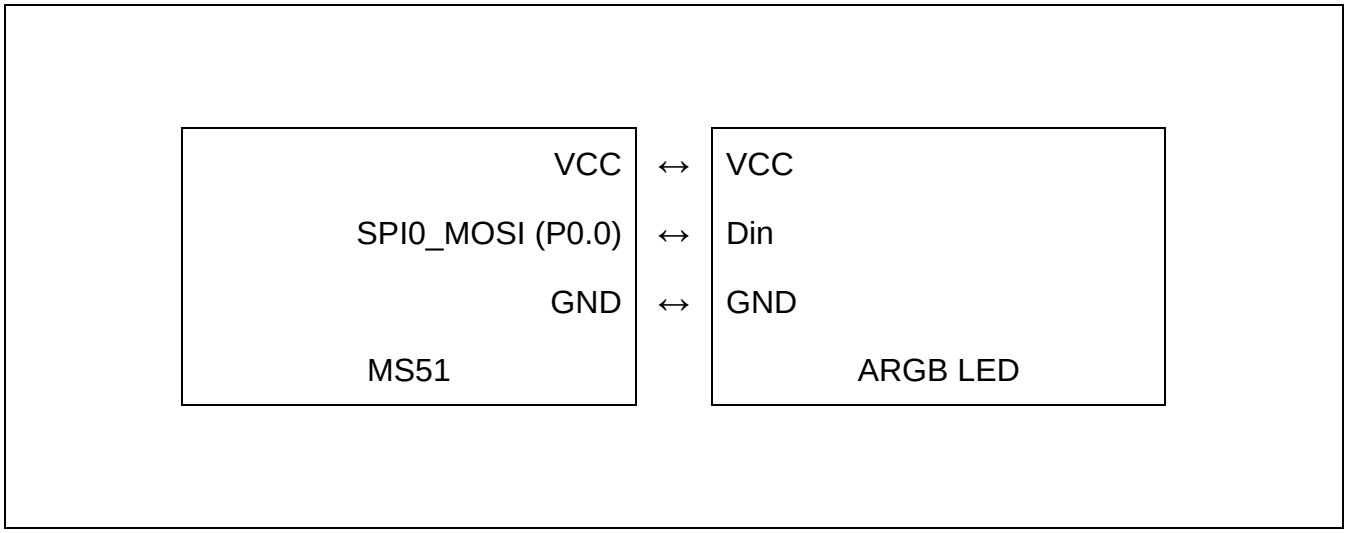

图 3-1 示意图

注：ARGB LED 工作电压为 5V，故 NuMaker-MS51PC 开发板为 ARGB LED 供电电压必须更换为 5V。可以改变 Nu-Link2-Me 上的 ICEJPR1(MCUVCC)电阻使其输出 5V 电压，如图 3-2 所示。

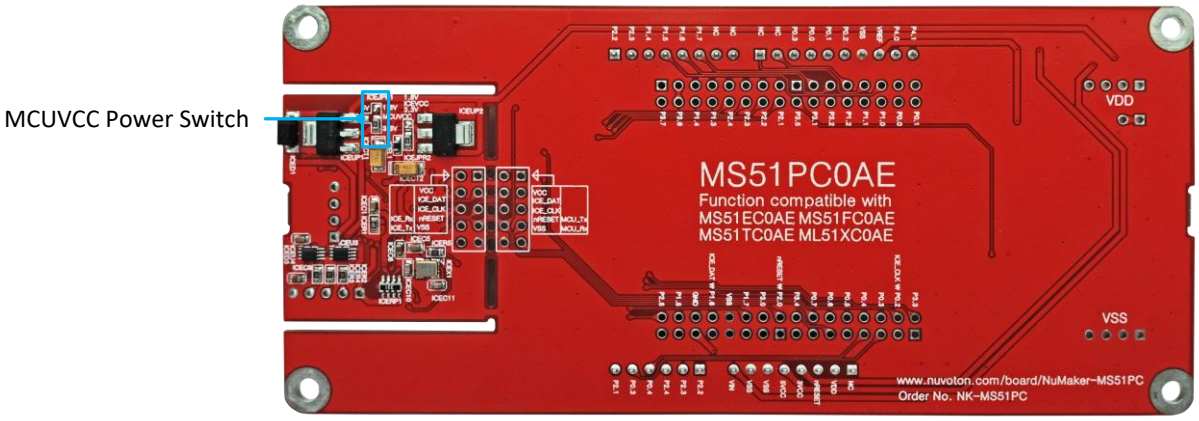

图 3-2 Nu-Link2-Me 5V 电源供应

4 目录信息

目录信息如图 4-1所示。

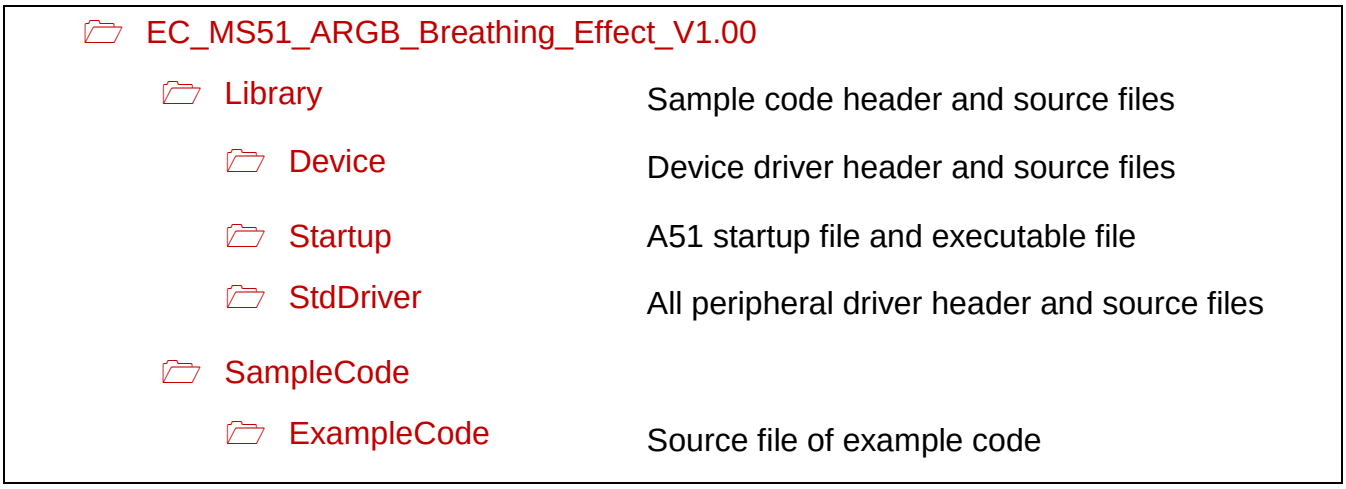

图 4-1 目录信息

5 范例程序执行

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 *MS51_ARGB_Breathing_Effect.uvproj*。
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开除错模式
3. 进入除错模式接口
   a. 执行代码

6 修订纪录

Date	Revision	Description
2021.07.29	1.00	1. 初始发布.

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