# M480暫停與回復MP3播放器

NuMicro® 32位系列微控制器範例代碼介紹

## 文件資訊

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| 應用簡述 | 本範例代碼使用 M480 外部音訊編解碼器 NAU88L25 播放在 SD 卡裡 MP3 格式的檔案，此 MP3 播放器提供播放、停止、暫停、回復功能。 |
| BSP 版本 | M480 Series BSP CMSIS V3.05.001 |
| 開發平台 | NuMaker-PFM-M487 v3.0 |

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# 1. 概述

本範例代碼使用 M480 外部音訊編解碼器 NAU88L25 播放在 SD 卡裡 MP3 格式的檔案，此 MP3 播放器提供播放、停止、暫停、回復功能。

首先使用者需將 MP3 格式的檔案放進 SD 卡裡，並將修改檔名為 test.mp3 或是修改 *mp3.c* 中的 *#define MP3_FILE* 至正確的名稱。此範例程式將會自動讀取 SD 卡裡的 MP3 檔案、使用 NAU88L25 音訊編解碼器、並且自動透過 I²S 介面播放音樂。

## 1.1 執行結果

本範例代碼執行暫停與回復音樂的功能如下圖 1-1 所示，使用者可以按壓 SW3 按鈕暫停音樂，再次按壓 SW3 按鈕則可以回復音樂到暫停前。

圖 1-1 暫停與回復音樂展示結果

第二個展示停止與重新播放音樂結果如下圖 1-2 所示，使用者可以按壓 SW2 按鈕停止播放音樂，再次按壓 SW2 按鈕則可以重新播放音樂。

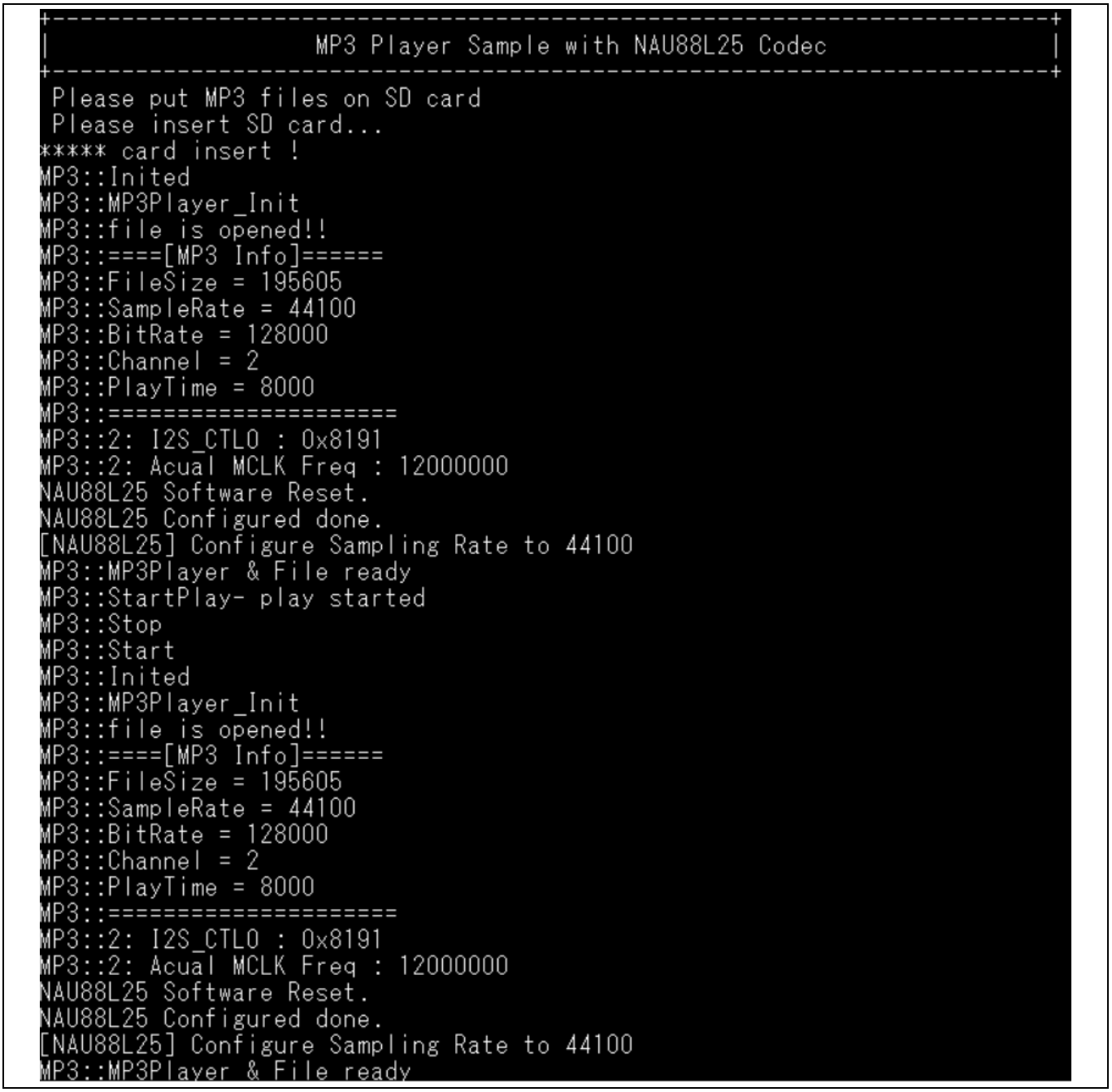



圖 1-2 停止與重新播放音樂展示結果

## 2. 代碼介紹

*main.c* 會初始化 I²C、SD、GPIO 介面與 NAU88L25，後續將會呼叫 *mp3.c* 來播放音樂，直到音樂停止。

```
int32_t main (void)
{
    TCHAR    sd_path[] = { '0', ':', 0 };    /* SD drive started from 0 */

    MP3RESULT u8MainMP3Result = MP3_OK;

    /* Init System, IP clock and multi-function I/O */
    SYS_Init();

    /* Configure PG.15 as Quasi-bidirection mode and enable interrupt by falling edge
trigger */
    GPIO_SetMode(PG, BIT15, GPIO_MODE_QUASI);
    GPIO_EnableInt(PG, 15, GPIO_INT_FALLING);
    NVIC_EnableIRQ(GPG_IRQn);

    /* Enable interrupt de-bounce function and select de-bounce sampling cycle time is
1024 clocks of LIRC clock */
    GPIO_SET_DEBOUNCE_TIME(GPIO_DBCTL_DBCLKSRC_LIRC, GPIO_DBCTL_DBCLKSEL_1024);
    GPIO_ENABLE_DEBOUNCE(PG, BIT15);

    /* Configure PF.11 as Quasi-bidirection mode and enable interrupt by falling edge
trigger */
    GPIO_SetMode(PF, BIT11, GPIO_MODE_QUASI);
    GPIO_EnableInt(PF, 11, GPIO_INT_FALLING);
    NVIC_EnableIRQ(GPF_IRQn);

    /* Enable interrupt de-bounce function and select de-bounce sampling cycle time is
1024 clocks of LIRC clock */
    GPIO_SET_DEBOUNCE_TIME(GPIO_DBCTL_DBCLKSRC_LIRC, GPIO_DBCTL_DBCLKSEL_1024);
    GPIO_ENABLE_DEBOUNCE(PF, BIT11);

    /* BOD Level Set */
    /* Unlock protected registers before setting Brown-out detector function and Power-
down mode */
    SYS_UnlockReg();

    /* Enable Brown-out detector function */
    SYS_ENABLE_BOD();

    /* Set Brown-out detector voltage level as 2.4V */
    SYS_SET_BOD_LEVEL(SYS_BODCTL_BODVL_2_4V);

    /* Enable Brown-out detector interrupt function */
    SYS_DISABLE_BOD_RST();

    /* Enable Brown-out detector and Power-down wake-up interrupt */
    NVIC_EnableIRQ(BOD_IRQn);
```

```
    /* Init SD */
    SD_Inits();

    /* Init UART to 115200-8n1 for print message */
    UART_Open(UART0, 115200);

    printf("+-----------------------------------------------------------------------
+\n");
    printf("|                    MP3 Player Sample with NAU88L25 Codec
|\n");
    printf("+-----------------------------------------------------------------------
+\n");
    printf(" Please put MP3 files on SD card \n");

    printf(" Please insert SD card... \n");
    while(1)
    {
        if (SDH_Open_Disk(SDH0, CardDetect_From_GPIO) == Successful)
            break;
    }
/* set default path */
f_chdrive(sd_path);

    /* Init I2C2 to access WAU88L25 */
    I2C2_Init();

    /* select source from HXT(12MHz) */
    CLK_SetModuleClock(I2S0_MODULE, CLK_CLKSEL3_I2S0SEL_HXT, 0);

    SetMP3PlayerStatus(eMP3PLAYER_STATUS_START);

    while(1)
    {
        /* play mp3 */
        if (SD0.IsCardInsert == TRUE)
        {
            u8MainMP3Result = TASK_MP3Player();
            if(u8MainMP3Result > MP3_MAD_BUFLEN_ERR)
            {
                printf("MP3 Play Error code : %d\n\r", u8MainMP3Result);
                printf("Exit MP3 Player\n\r");
                break;
            }
        }
    }
}
```

*mp3.c* 將會初始化 I²S 與顯示讀取到的 MP3 檔案資訊，*TASK_MP3Player* 函式將會讀取並且設定 MP3 播放器的狀態旗標，並且執行相對應的函式。

```
MP3RESULT TASK_MP3Player()
{
    MP3RESULT mp3Result = MP3_OK;
    /* Set MP3 Player Status by Button and Reset Flag */
    switch (Status_Flag)
```

```
    {
    case eMP3PLAYER_STATUS_RESUME:
        SetMP3PlayerStatus(eMP3PLAYER_STATUS_RESUME);
        Status_Flag = eMP3PLAYER_STATUS_NONE;
        break;
    case eMP3PLAYER_STATUS_PAUSE:
        SetMP3PlayerStatus(eMP3PLAYER_STATUS_PAUSE);
        Status_Flag = eMP3PLAYER_STATUS_NONE;
        break;
    case eMP3PLAYER_STATUS_STOP:
        SetMP3PlayerStatus(eMP3PLAYER_STATUS_STOP);
        Status_Flag = eMP3PLAYER_STATUS_NONE;
        break;
    case eMP3PLAYER_STATUS_START:
        SetMP3PlayerStatus(eMP3PLAYER_STATUS_START);
        Status_Flag = eMP3PLAYER_STATUS_NONE;
        break;
    default:
        break;
    }
    newplayerstatus = u8MP3PlayerStatus;
    if(currentplayerstatus != newplayerstatus)
    {
        currentplayerstatus = newplayerstatus;
        switch(newplayerstatus)
        {
        case eMP3PLAYER_STATUS_START :
            NAU88L25_Unmute();
            MP3Player_DeviceInit();
            mp3Result = MP3Player_DataInit();
            printf("MP3::MP3Player & File ready\n\r");
            break;
        case eMP3PLAYER_STATUS_STOP:
            NAU88L25_Mute();
            MP3Player_PlayStop();
            break;

        default:
            break;
        }
    }
    if(eMP3PLAYER_STATUS_STOP != currentplayerstatus)
        mp3Result = MP3Player_PlayStart(newplayerstatus);
}
```

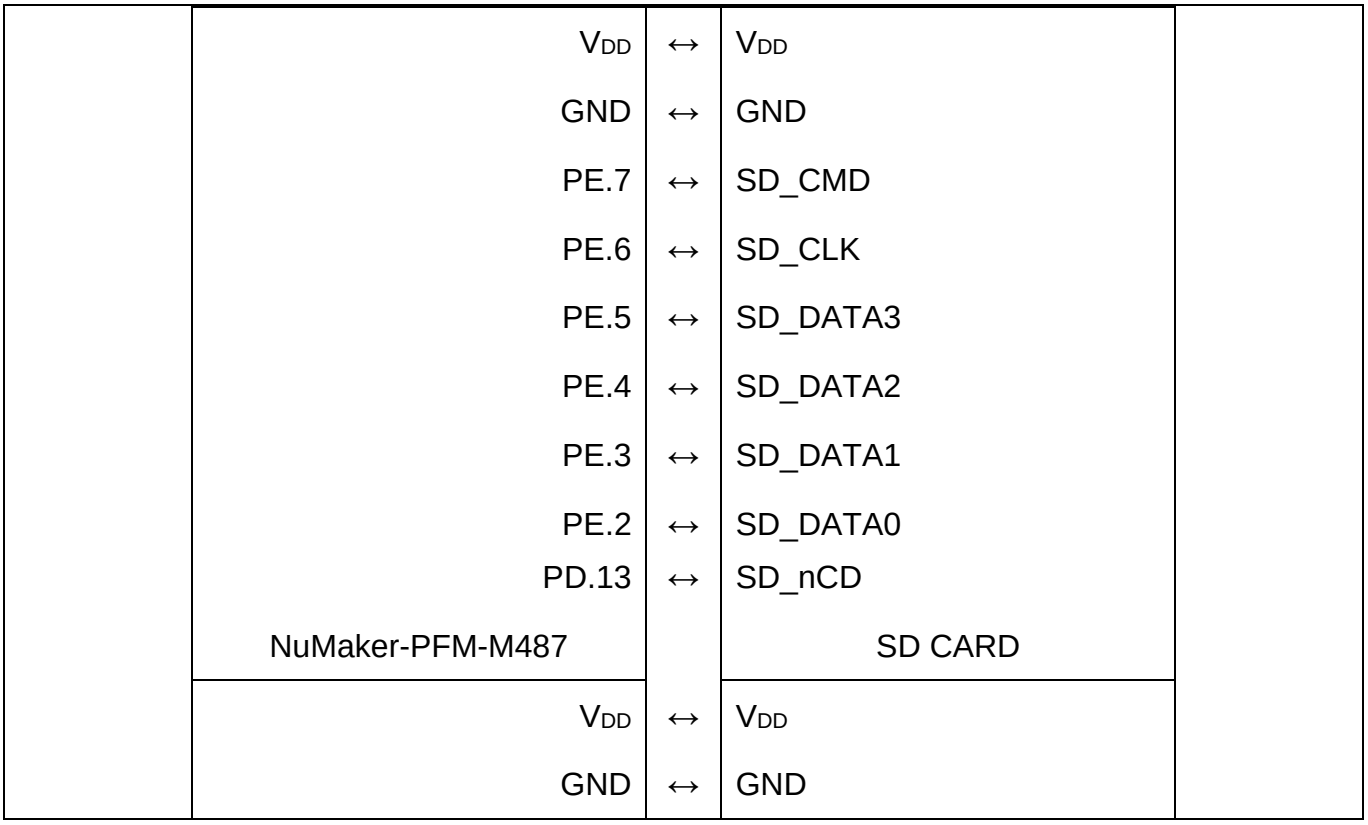
# 3. 軟體與硬體需求

## 3.1 軟體需求

- BSP 版本
  - M480 Series BSP CMSIS V3.05.001
- IDE 版本
  - Keil uVersion 5.26

## 3.2 硬體需求

- 電路元件
  - NuMaker-PFM-M487 v3.0
  - SD 卡
- 示意圖
  - NuMaker-PFM-M487 與 SD 卡、NAU88L25 連接示意圖



| | | | | |
|---|---|---|---|---|
| | PD.0 | ↔ | I2C_SCL | |
| | PD.1 | ↔ | I2C_SSA | |
| | PF.10 | ↔ | I2S_BCLK | |
| | PF.9 | ↔ | I2S_MCLK | |
| | PF8 | ↔ | I2S_DI | |
| | PF7 | ↔ | I2S_DO | |
| | PF6 | ↔ | I2S_LRCK | |
| | NuMaker-PFM-M487 | | NAU88L25 | |

圖 3-1 腳位連接示意圖

# 4. 目錄資訊

| | |
|---|---|
| EC_M480_Pause_and Resume_MP3_Player_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 |
| ThirdParty | |
| FatFs | A generic FAT file system module for small embedded systems. Its official website is: http://elm-chan.org/fsw/ff/00index_e.html. |
| LibMAD | A MPEG audio decoder library which currently supports MPEG-1 and the MPEG-2 extension to lower sampling frequencies, as well as the de facto MPEG 2.5 format. All three audio layers — Layer I, Layer II, and Layer III (i.e. MP3) are fully implemented. This library is distributed under GPL license. Please contact Underbit Technologies (http://www.underbit.com/) for the commercial license |

圖 4-1 目錄資訊

# 5. 範例程式執行

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 *Pause_and_Resume_MP3_Player.uvproj*。
2. 進入編譯模式介面
   - 編譯
   - 下載代碼至記憶體
   - 進入 / 離開除錯模式
3. 進入除錯模式介面
   - 執行代碼

# 6. 修訂紀錄

| Date | Revision | Description |
|---|---|---|
| 2022.06.21 | 1.00 | 初始發布。 |

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