M487通過DAC播放音效

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

應用簡述	本範例使用 M487 MCU 通過 DAC 播放 SD 卡裡 WAV 檔音效
BSP 版本	M480_BSP_CMSIS_V3.05.003
開發平台	NuMaker-PFM-M487 V3.0

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1 概述

本範例使用M487 MCU通過DAC播放SD卡裡WAV檔音效。

1.1 原理

使用M487 MCU打開SD卡上的WAV（PCM格式）檔，讀出資料將16-bit singed資料轉成12-bit unsigned資料再用timer觸發PDMA將資料搬運到DAC，接耳機時，不需要外接其它電路，通過DAC可直接驅動。而接喇叭時，需要外接功放模組，本範例代碼測試時使用的是HEROIC的HT8693單聲道音訊功放模組，HT8693是一款具有D類和AB類兩種工作模式的音訊功率放大器，D類模式下最大供電電壓可達9V，AB類模式下最大供電電壓可達到8.4V。

音訊源需要是單聲道的16-bit PCM格式，WAV檔。

1.2 執行結果

程式運行列印資訊如下圖所示：

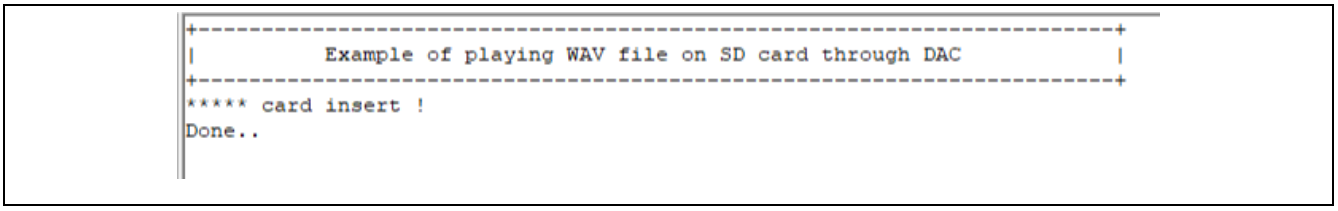

圖 1-1 SD 卡插入並成功播放 WAV 檔程式運行列印結果

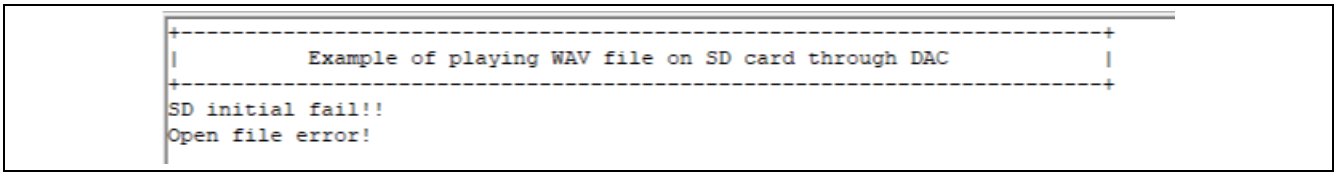

圖 1-2 SD 卡未插入程式運行列印結果

2 代碼介紹

SD 卡裡 WAV 檔案名定義為 test.wav,並打開該文件。

```
res = f_open(&wavFileObject, "0:\\test.wav", FA_OPEN_EXISTING | FA_READ);
```

讀取採樣速率，設置 timer 觸發時間。

```
// read sampling rate from WAV header
memset(aWavHeader, 0, sizeof(aWavHeader));
f_read(&wavFileObject, aWavHeader, 44, &ReturnSize);
u32WavSamplingRate = aWavHeader[6];

u8PCMBufferPlayIdx = 0;
PDMA_Init(u32WavSamplingRate);
```

讀出資料將 16-bit singed 資料轉成 12-bit unsigned 資料。

```
while (1)
{
    if (u8PCMBuffer_Alt)
    {
        u8PCMBuffer_Alt = 0;

        res = f_read(&wavFileObject, (uint8_t *)&aPCMBuffer[2][0], PCM_BUFFER_SIZE
                          * 4, &ReturnSize);
        pPCMSrcBuffer = (uint16_t *)&aPCMBuffer[2][0];

        for (i = 0; i < PCM_BUFFER_SIZE * 2; i++)
        {
            if (pPCMSrcBuffer[i] & 0x8000)
            //signed 16-bit data convert to unsigned 12-bit data
            {
                pPCMSrcBuffer[i] = ~(pPCMSrcBuffer[i] - 1);
                pPCMSrcBuffer[i] =   0x800 - (pPCMSrcBuffer[i] >> 4);
            }
            else
            {
                pPCMSrcBuffer[i] = (pPCMSrcBuffer[i] >> 4) + 0x800;
            }
        }
        if (u8PCMBufferPlayIdx == 1)
```

```
            {
                pPCMDesBuffer = (uint16_t *)&aPCMBuffer[0][0];

                for (i = 0; i < PCM_BUFFER_SIZE * 2; i++)
                pPCMDesBuffer[i] = pPCMSrcBuffer[i];

            }
            else
            {
                pPCMDesBuffer = (uint16_t *)&aPCMBuffer[1][0];

                for (i = 0; i < PCM_BUFFER_SIZE * 2; i++)
                    pPCMDesBuffer[i] = pPCMSrcBuffer[i];
            }

            if (f_eof(&wavFileObject))
                break;

        }
    }
```

3 軟體與硬體需求

3.1 軟體需求

- BSP 版本
  - M480 Series BSP CMSIS V3.05.003
- IDE 版本
  - Keil uVersion 5.35

3.2 硬體需求

- 電路元件
  - NuMaker-PFM-M487 V3.0
  - 單聲道音訊功放模組 (HT8693)
  - 15W、8 歐姆喇叭
- 示意圖

通過 DAC 輸出音效有兩種方案，如下連線圖是耳機輸出方案：

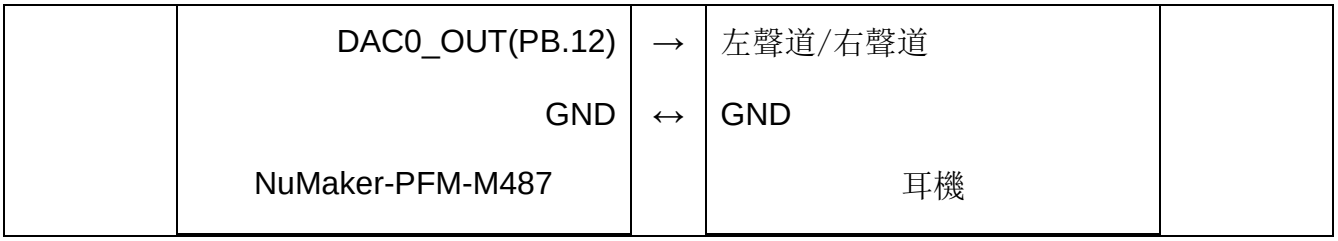

圖 3-1 M487 與耳機連接圖

以下連線圖是 DAC 輸出外加 HT8693 功放模組和喇叭方案：

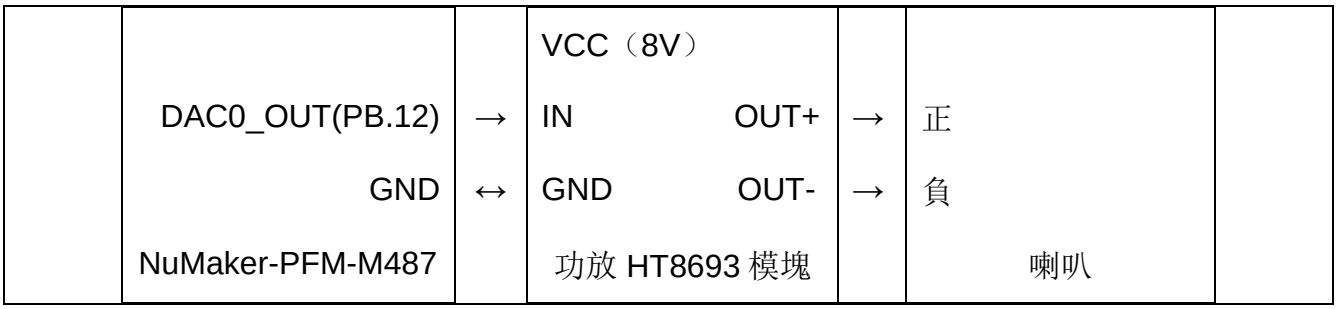

圖 3-2 M487 與 HT8693 和喇叭連接圖

4 目錄資訊

EC_M487_DAC_Wavplayer_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.

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 DAC_Wavplayer.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
2022.03.22	1.00	1. 初始發布.

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