Playing Sound through M487 DAC

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This example code uses the M487 microcontroller (MCU) to play WAV file sound on a SD card via DAC.
BSP Version	M480_BSP_CMSIS_V3.05.003
Hardware	NuMaker-PFM-M487 V3.0

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1 Overview

This example code uses the M487 MCU to play WAV file sound on a SD card via DAC.

1.1 Principle

This example code uses the M487 MCU to open the WAV file in PCM format on a SD card, read the data, convert 16-bit singed data to 12-bit unsigned data, and then use a timer to trigger PDMA to transfer the data to DAC. When connecting earphones, there is no need to connect other circuits, and the earphones can be driven directly through DAC. To receive speaker sound, an external power amplifier module is needed. This example code is tested using the HT8693 mono audio amplifier module of HEROIC. The HT8693 is a class D and AB audio power amplifier, up to 9V in D mode and up to 8.4V in AB mode.

The audio source needs to be a WAV file in mono 16-bit PCM format.

1.2 Demo Result

The printed information of program running is as follows:

```
+------------------------------------------------------------------------+
|          Example of playing WAV file on SD card through DAC            |
+------------------------------------------------------------------------+
***** card insert !
Done..
```

Figure 1-1 SD Card Is Inserted and WAV File Is Played Successfully

```
+------------------------------------------------------------------------+
|          Example of playing WAV file on SD card through DAC            |
+------------------------------------------------------------------------+
SD initial fail!!
Open file error!
```

Figure 1-2 SD Card Is Not Inserted

2 Code Description

Open the WAV file. The WAV file name of SD card is defined as test.WAV.

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

Read the sampling rate and set the timer trigger time.

```
    // 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);
```

Convert 16-bit singed data to 12-bit unsigned data.

```
    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 Software and Hardware Requirements

3.1 Software Requirements

- BSP version
  - M480_BSP_CMSIS_V3.05.003
- IDE version
  - Keil uVersion 5.35

3.2 Hardware Requirements

- Circuit components
  - NuMaker-PFM-M487 V3.0
  - Mono audio amplifier module (HT8693)
  - 15W, 8Ω speaker
- Pin Connect

There are two ways to output sound through DAC. The following diagram is the earphone output scheme:

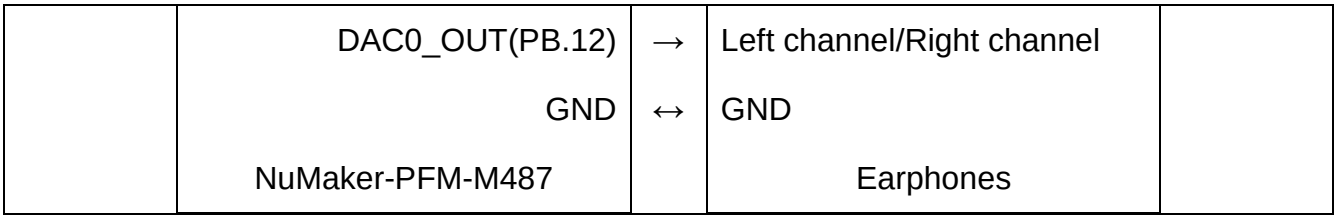

Figure 3-1 M487 and Earphone Connection Diagram

The following diagram is the DAC output plus HT8693 power amplifier module and speaker scheme:

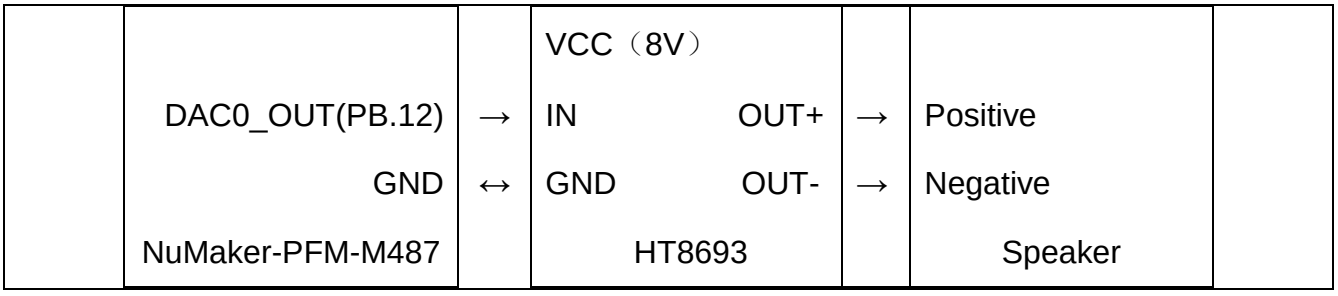

Figure 3-2 M487, HT8693 and Speaker Connection Diagram

4 Directory Information

The directory structure is shown below.

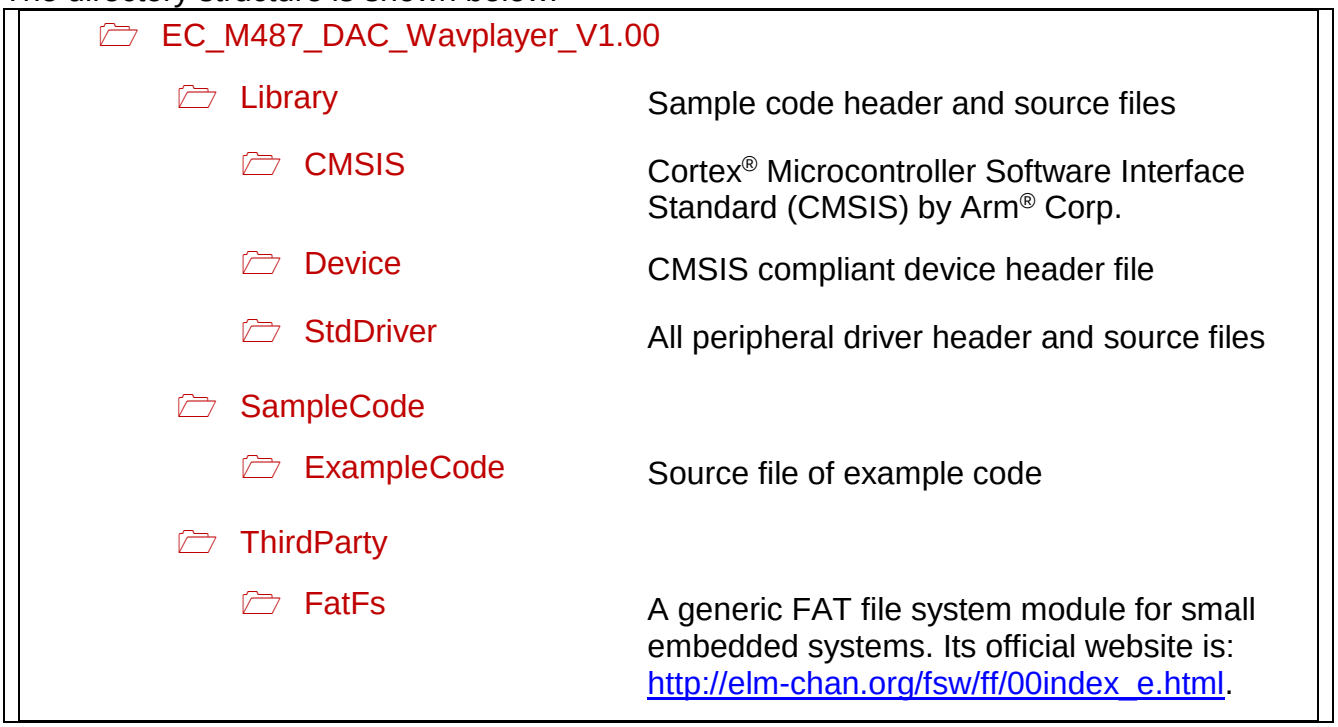

Figure 4-1 Directory Information

5 Example Code Execution

1. Browse the sample code folder as described in the Directory Information section and double-click DAC_Wavplayer.*uvproj*.
2. Enter Keil compile mode.
   - Build
   - Download
   - Start/Stop debug session
3. Open the serial port tool and select the corresponding serial port.
   - Press the reset key and view the serial port debug information

6 Revision History

Date	Revision	Description
2022.03.22	1.00	1. Initially issued.

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