Freescale Semiconductor, Inc.
User's Guide

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USB Speakers User's Guide

1. Introduction

This document explains the features and usage of the USB Speakers reference design. It does not contain software or hardware descriptions. Refer to the Reference Manual or Design Guide for software and hardware descriptions.

The content of this document is oriented to any person interested in understanding the functionality of the USB Speakers reference design.

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2. Product Brief

The USB Speakers reference design demonstrates the implementation of an audio application whose audio input is via USB and its output is via a headphone amplifier. It also has the capability to control the audio volume. It features the NXP KL46Z MCU which includes an ARM® Cortex® M0+ processor and a Dialog Semiconductor DA7212 ultra low-power audio codec.

The audio is obtained via USB from a PC host. After the device is connected, the user will be able to listen to the audio with headphones and control the audio volume using the board switches.

2.1. Get to know the KL46Z

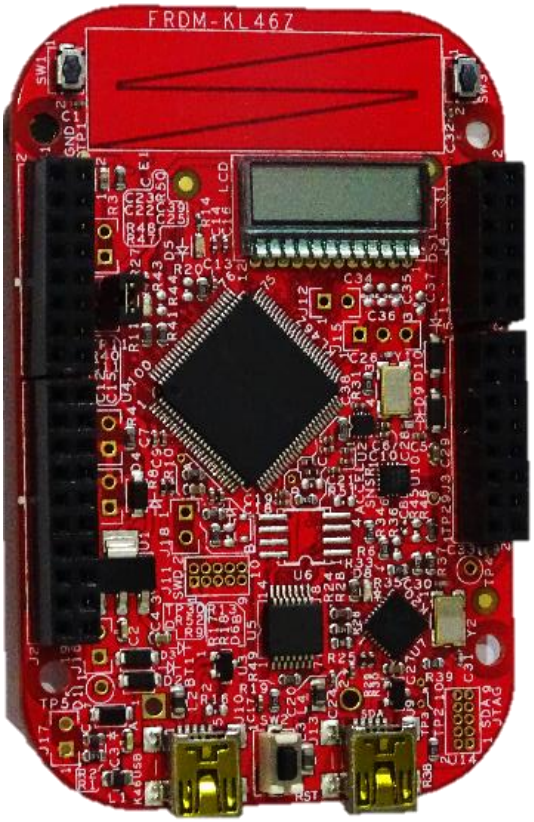

Figure 1. FRDM-KL46Z

The FRDM-KL46Z is an ultra-low-cost development platform enabled by the Kinetis L series KL4x MCU family, built on the ARM Cortex M0+ processor. This device has a maximum operation frequency of 48 MHz, 256 KB of flash, 32 KB RAM, a full-speed USB controller, segment LCD controller, and many analog and digital peripherals.

The FRDM-KL46Z features the NXP open standard embedded serial and debug adapter known as OpenSDA. This circuit offers several options for serial communications, flash programming, and run-control debugging.

2.2. Get to know the Dialog Semiconductor DA7212

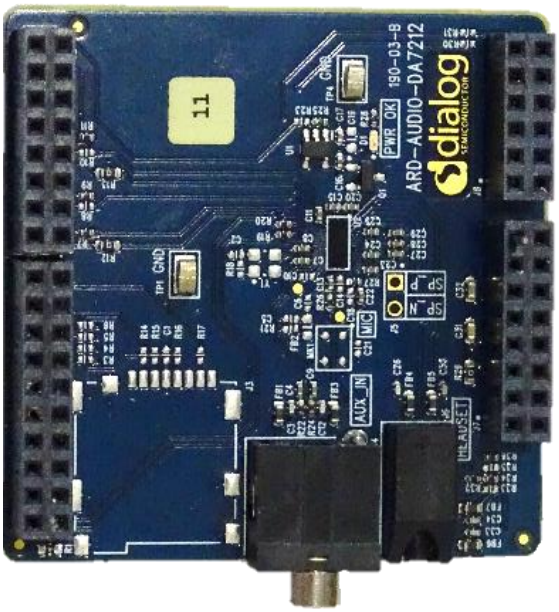

Figure 2. ARD-AUDIO-7212

The Dialog Semiconductor DA7212 ultra low-power audio codec is an audio shield that features a two-channel audio codec with capless headphone driver (DA7212), and 3.5 mm stereo AUX input jack socket. Interchangeable GND and MIC routing to the smartphone jack allows multiple headsets to be supported, compatible with the NXP *Freedom Development Platform*.

DA7212 is ideal for standalone audio/video digital processors, controlled via the MCU platform processor over the I^2C serial communication interface. Digital audio is transmitted and received over the I^2S interface.

3. Application Description

3.1. Keyboard functionality

The following table shows the switches functionality in the application.

Table 1. Keyboard functionality

Switch	Indicated Action
SW1	Volume up
SW3	Volume down

3.2. Supported frequencies, sample size and audio channels

The default configuration is: two audio channel (stereo), a sample size of two bytes, and an audio sampling rate of 48 KHz.

If required, the sampling frequency can be changed. Refer to section 5 *Using the Application* for further information.

4. Build and Load the Application

4.1. Prerequisites

Hardware and tools:

- FRDM-KL46Z
- ARD-AUDIO-DA7212
- 3.5 mm headphones
- Two USB mini cables
- PC with Windows 7 or above, Mac or Linux

Required Software:

- Kinetis Design Studio 3.0.0 IDE
- Kinetis Software Development Kit 1.3.0

The following list enumerates the required elements to get the USB Speakers reference design working:

1. Download and install J-Link software v5.02 or higher from www.segger.com.
2. J-Link or J-Link Pro debugger.
3. Download the USB Speakers software and unzip the file.
4. Connect the ARD-AUDIO-DA7212 shield into the KL46Z pins.

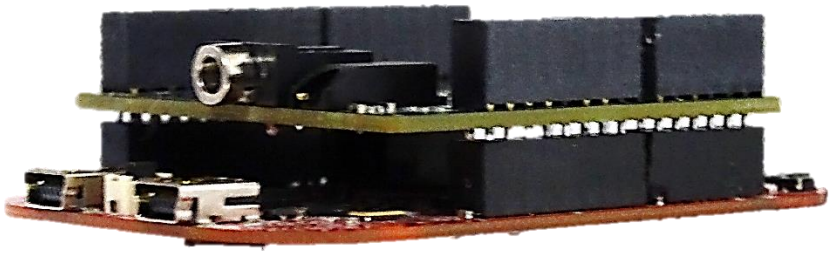

Figure 3. Dialog shield connected to the FRDM-KL46Z

4.2. Change USB device stack and Kinetis SDK files

To get the application working, it is necessary to do the following changes:

- Copy the **usb_device_config.h** from the zip file to:
  {KSDK_1.3_path}\usb\usb_core\device\include\MKL46Z4
- Copy the **usb_framework.c** from the zip file to:
  {KSDK_1.3_path}\usb\usb_core\device\sources\controller
- Copy the **usb_audio_config.h** from the zip file to:
  {KSDK_1.3_path}\usb\usb_core\device\sources\classes\include\config
- Copy the **usb_device_stack_interface.h** from the zip file to:
  {KSDK_1.3_path}\usb\usb_core\device\include
- Copy the **fsl_sai_hal.c** from the zip file to:
  {KSDK_1.3_path}\platform\hal\src\sai
- Copy the **fsl_sai_driver.c** fron the zip file to:
  {KSDK_1.3_path} \platform\drivers\src\sai

4.3. Compile the libraries

1. Open the Kinetis Design Studio 3.0.0 IDE.
2. Click on file tab and then click on import.

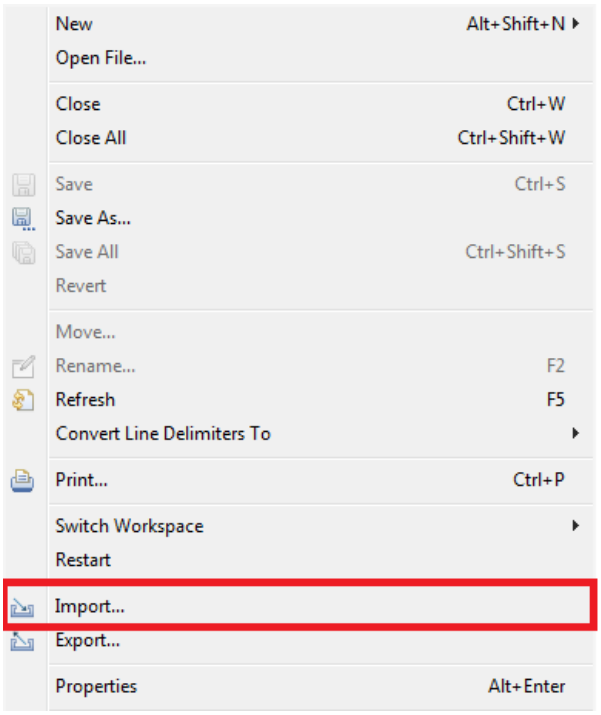

Figure 4. Import option

3. Select “Existing Projects into Workspace” and click next.

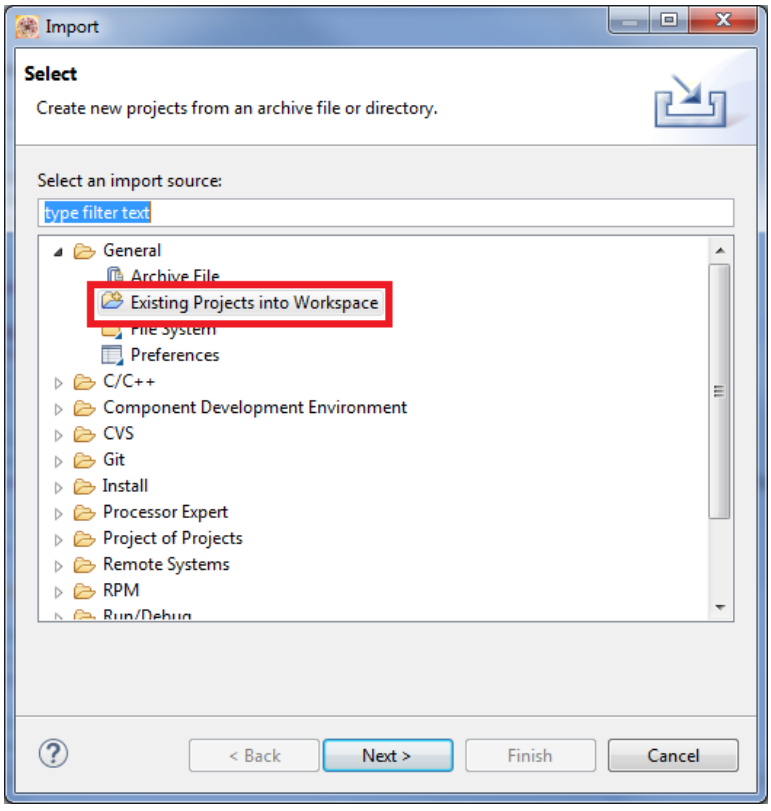

Figure 5. Existing projects into Workspace

4. Click on browse and search for the platform library for baremetal, found at: {KSDK_1.3_path}\lib\ksdk_platform\kds\KL46Z4.
5. Click on finish.
6. Repeat these steps but now import the USB device stack found at:

{KSDK_1.3_path}\usb\usb_core\device\lib\bm\kds\KL46Z4.

7. Click on the build all button.

4.4. Build and load the project

1. Import the frdmkl46z_usbspeaker_ksdk project from the zip file.
2. Click on the build button.
3. Connect one USB mini cable the OpenSDA connector (J13) and the other end to the PC.

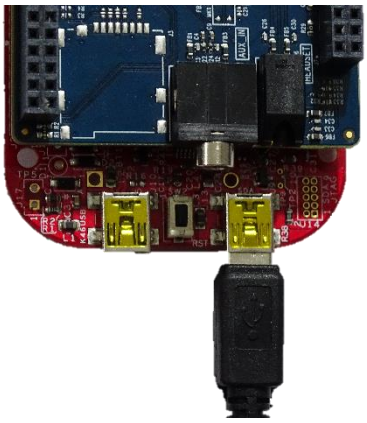

Figure 6. Mini USB connection to SDA

4. Click on debug.
5. Once the debugger finishes loading, click on the run icon.

5. Using the Application

5.1. Running the application

1. Connect the headphones in the headset connector in the ARD-AUDIO-DA7212.

Figure 7. Headphones connection

2. Connect the other USB mini cable into the J10 USB connector on FRDM-KL46Z and the other end to the PC.

Figure 8. Speaker's connection to the audio codec shield

3. Start playback of an audio file in the PC. The audio can be listened on the headphones connected to ARD-AUDIO-DA7212 headphones or speakers connected.
4. To control the volume, use SW1 and SW3 of the FRDM-KL46Z.
5. If the PC does not change the audio output automatically, select the FSL AUDIO HID KL46Z from the OS audio settings. Section 5.3 *Change system output* shows how to do this on different operating systems.

5.2. Modifying the sample rate

If a change on sampling rate is desired, the following changes in the code must be performed:

1. Open the **usb_descriptor.h** file, search for the macro **AUDIO_FORMAT_SAMPLE_RATE** and select one of the following macros to match the desired sampling rate:

a) AUDIO_FORMAT_SAMPLE_RATE_48K
b) AUDIO_FORMAT_SAMPLE_RATE_44K1
c) AUDIO_FORMAT_SAMPLE_RATE_32K
d) AUDIO_FORMAT_SAMPLE_RATE_16K
e) AUDIO_FORMAT_SAMPLE_RATE_8K

2. - Open the **SL/Audio_Buffer_Handler.h** file, search for the macro **AUDIO_BUFFER_HANDLER_SYSTEM_SAMPLING_RATE** and select one of the following macros to match the desired sampling rate:

a) AUDIO_ BUFFER_HANDLER_SAMPLING_RATE_48
b) AUDIO_ BUFFER_HANDLER_SAMPLING_RATE_44_1
c) AUDIO_ BUFFER_HANDLER_SAMPLING_RATE_32
d) AUDIO_ BUFFER_HANDLER_SAMPLING_RATE_16
e) AUDIO_ BUFFER_HANDLER_SAMPLING_RATE_8

3. - Open the **HIL/DA7212/Dialog7212.h** file, search for the macro **DIALOG7212_INITIAL_SAMPLING_RATE** and select one of the following macros to match the desired sampling rate:

a) DIALOG7212_SAMPLING_RATE_48
b) DIALOG7212_SAMPLING_RATE_44_1
c) DIALOG7212_SAMPLING_RATE_32
d) DIALOG7212_SAMPLING_RATE_16
e) DIALOG7212_SAMPLING_RATE_8

After the changes are performed, build the application, and run it again.

NOTE

If Windows OS is used to test the USB Speakers reference design and any of the audio settings are modified, the PC will not be able to playback the audio. To solve this problem, go to the Device Manager of the PC and erase the USB Composite Device that represents the USB Speakers, then disconnect and connect the board. After the device is connected again, the PC will be able to playback audio.

5.3. Change system output

If the OS do not change the audio output automatically, follow the steps below for the relevant supported OS.

5.3.1. MAC OS

1. Go to system preferences.

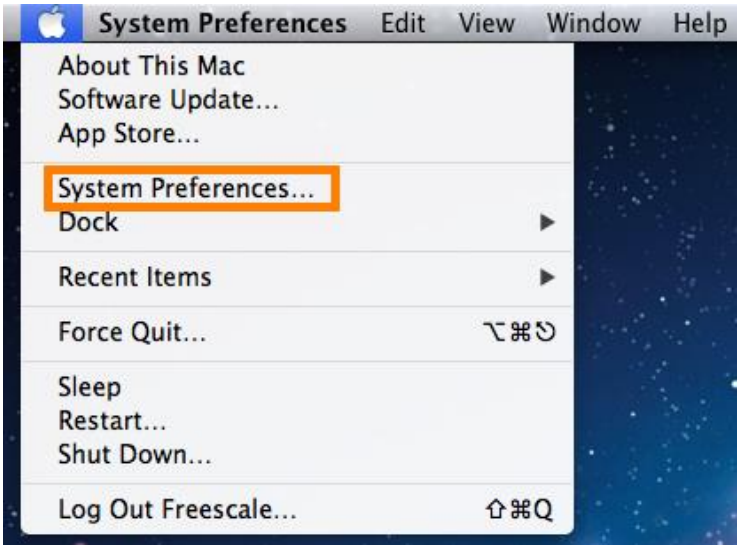

Figure 9. System preferences

2. Select Sound preferences.

Figure 10. Sound preferences

3. Select Output and then choose the NXP AUDIO HID KL46.

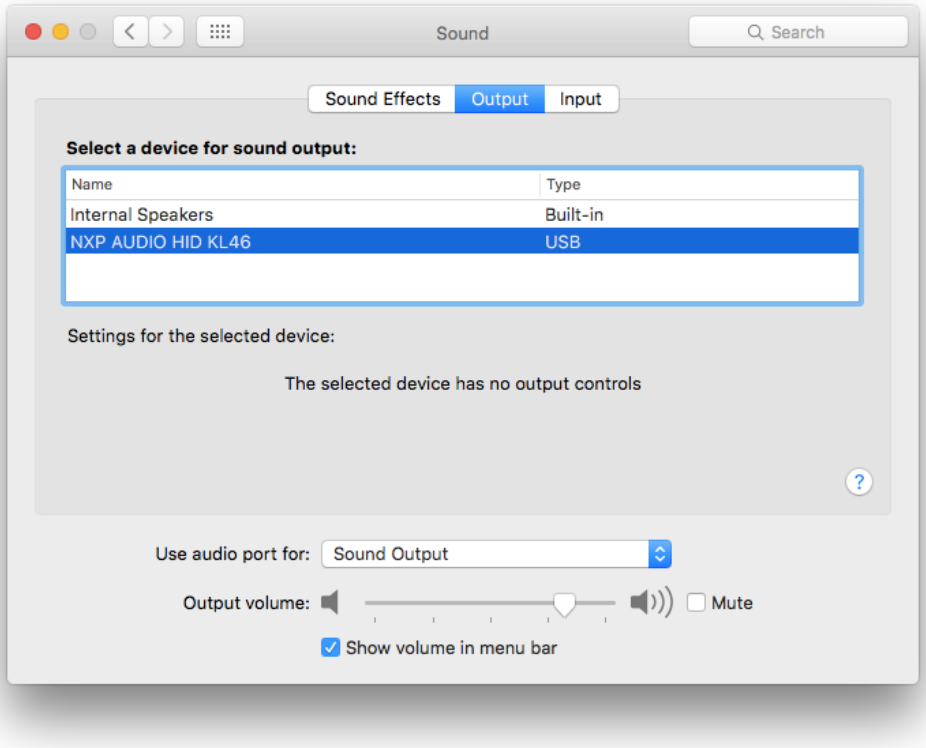

Figure 11. NXP AUDIO HID KL46 option in Sound menu

5.3.2. Ubuntu OS

1. Select System menu, then Preferences and Sound.

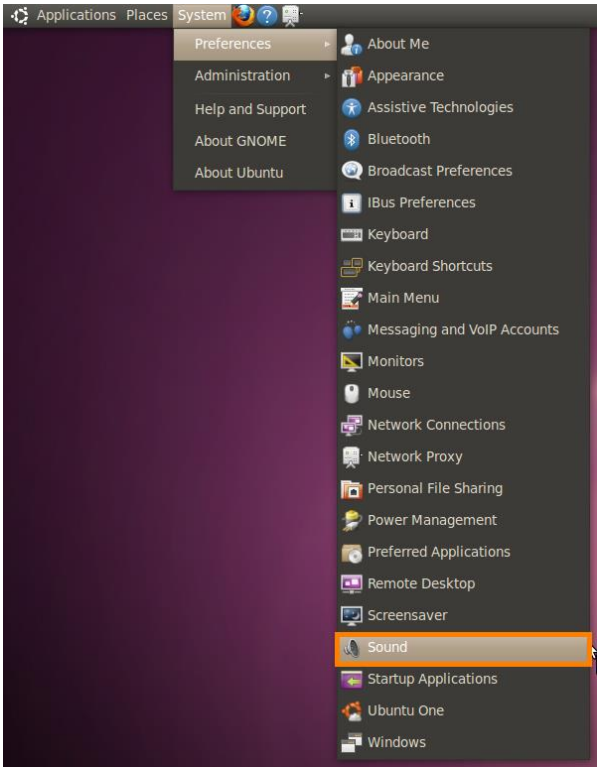

Figure 12. Sound option in preferences menu

2. Select Output from the Sound preferences window and choose NXP AUDIO HID KL46 as the default output.

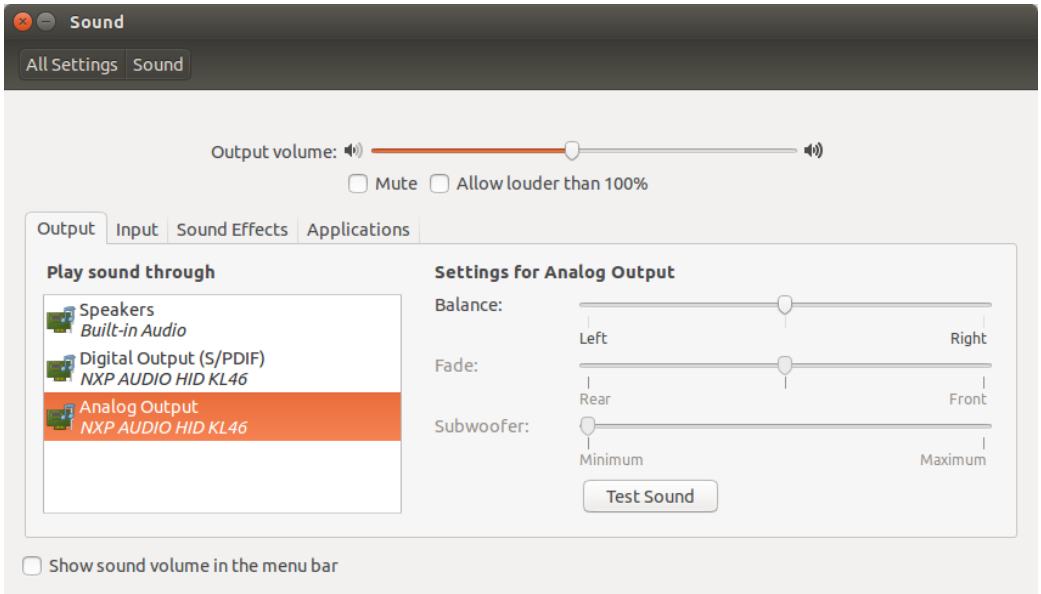

Figure 13. Select NXP AUDIO HID KL46

5.3.3. Windows OS

1. Open the control panel and select Hardware and Sound.

Figure 14. Hardware and Sound

2. Select Manage audio devices.

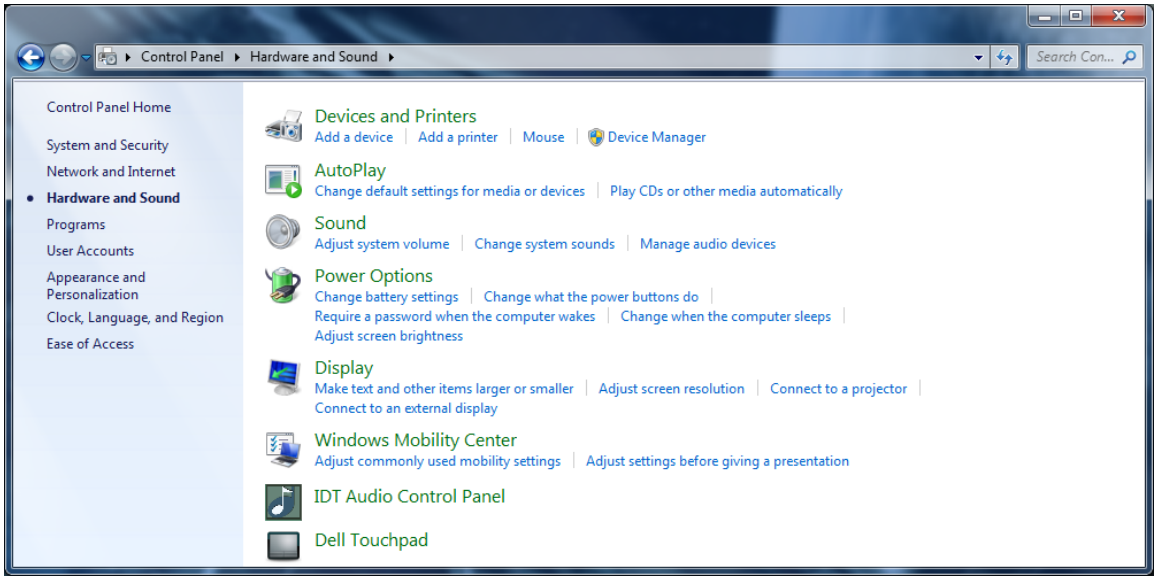

Figure 15. Manage audio devices

3. Select NXP AUDIO HID KL46 and click on Set Default.

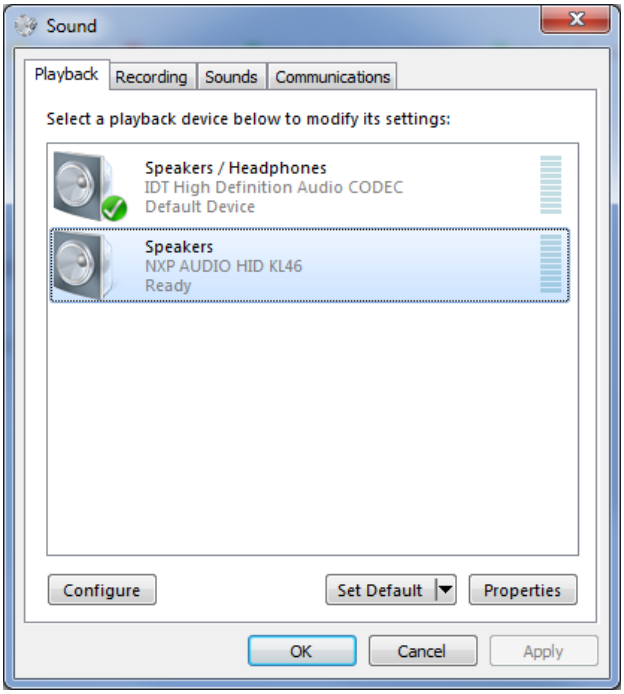

Figure 16. NXP AUDIO HID KL46 on playback tab

6. Revision History

Table 2. Revision history

Revision number	Date	Substantive changes
0	03/2016	Initial release

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