Renesas Synergy™ Platform

Simple Audio Playback Example for DK-S124

Introduction

This application note describes the process of creating an audio-enabled application using Audio Playback framework and drivers in the Synergy™ Software Package (SSP). This example can be adapted to add sound effects to more complex applications. In addition, this application note includes the project setup and basic debugging operations. When it is running, you can control the playback of two different audio streams using two on-board pushbuttons and a potentiometer.

After completing this application note, you will have imported and run the Simple Audio Example application on the DK-S124 Development Kit. The application configures the peripherals to play samples stored in the internal flash memory of the device. Functional application code, found in the user-thread entry files, is reusable and can be implemented in an existing application to provide audio playback capabilities.

Target Device

Renesas Synergy™ Development Kit, DK-S124 v3.0 & v3.1

Installed Software

- e^2 studio ISDE v7.3.0 or later
- Synergy Software Package (SSP) v1.6.0 or later
- IAR Embedded Workbench® for Renesas Synergy™ v8.23.3 or later
- Renesas Synergy™ Standalone Configurator (SSC) v7.3.0 or later

Contents

1. Configuring the DK-S124 for a Simple Audio Playback Example

The steps to configure the DK-S124 are as follows:

1. Verify that all the headers near the battery are configured with all jumpers to make the connections as shown in the top portion of the following figure.
2. Connect the J-Link®-OB on J18 of the DK-S124 to the PC using a micro USB cable as shown in the bottom portion of Figure 1.
3. Connect the speakers or headphones to the J16 using a 3.5 mm jack plug as shown in Figure 2.

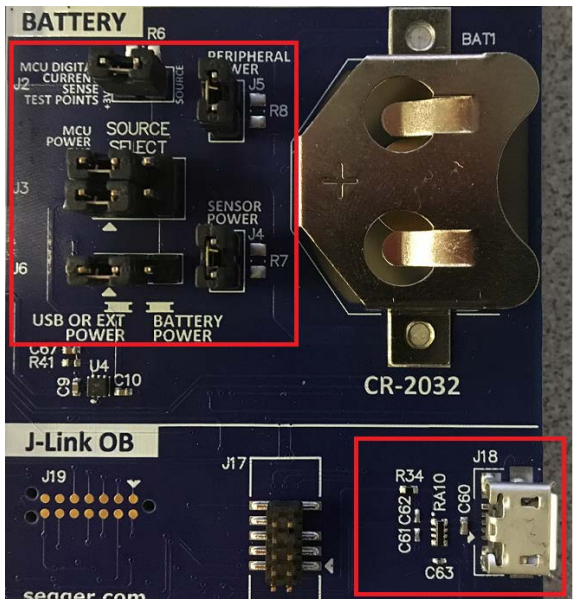


Figure 1. Power setup (top) and J-Link OB connection (bottom)

Figure 2. Audio output, 3.5mm jack

2. Importing the Project into e² studio

Refer to the *Renesas Synergy™ Project Import Guide* (r11an0023eu0121-synergy-ssp-import-guide.pdf) included in this package for instructions on how to import the completed project into e² studio and build the project. Also included is the **SimpleAudioExample.zip** file that contains the completed project.

3. Running the Application

The application is not ready to be run on the target hardware yet. The following steps are necessary to run the application:

1. On the PC, **click** the **drop-down menu** from the **debug** icon.

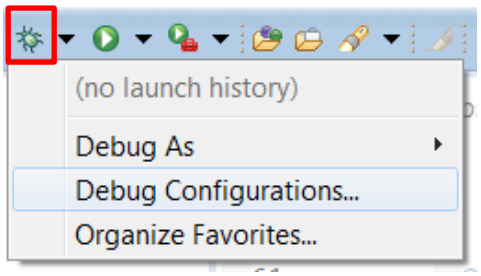


Figure 3. Debug options

2. Select the **Debug Configurations** option as shown in Figure 3.
3. In the **Renesas GDB Hardware Debugging** section, select **SimpleAudioExample Debug** as shown in Figure 4.
4. Click the **Debug** button to start debugging.

Note: If the **Debug** button is greyed out, then it is likely that there is an issue with the build. Check all the steps in the document again for mismatched options.

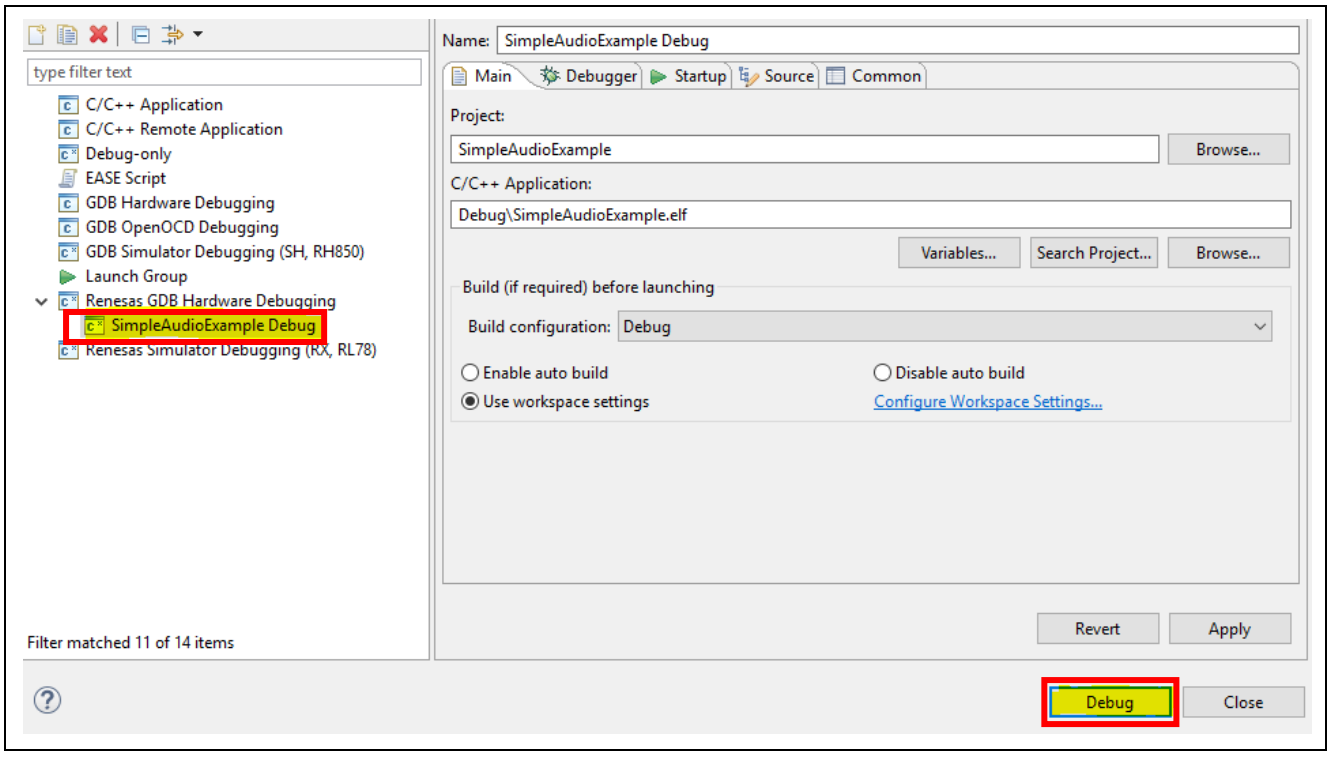


Figure 4. Debug configurations

5. If asked to confirm a Perspective Switch, click **Yes**. If you have previously instructed e² studio to remember your decision, this dialog box will not be displayed.

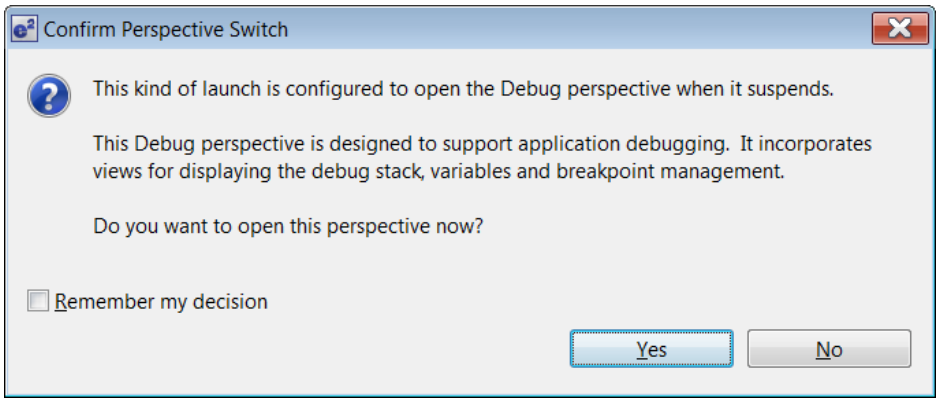


Figure 5. Perspective Switch dialog

6. Click **Resume (F8)** to start the application. It is now stopped at `main()`.

Figure 6. Resume button

7. Press F8 or click the **Resume** button to run the code. At this point, the application is idle. To listen to the audio output, press **S1** or **S2** on the board. If there is no audible output, verify that the potentiometer next to the two buttons is set to its maximum clockwise value and that the jack lead is plugged all the way into the J16 connector. Some 4- and 5-pin jack plugs (for microphone/remote) do not work in standard 3-pin stereo sockets. Once the audio is playing, you can use the potentiometer to adjust the volume. To stop playback of the alarm sound, press **S2** again.

   Note: You can find a more detailed description of the application processing flow in the **How it Works** section in this document.

8. Press `Ctrl + F2` or click the **Stop** button to end the debug session.

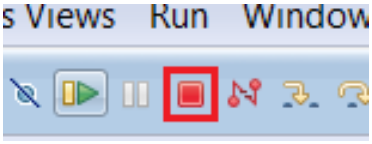
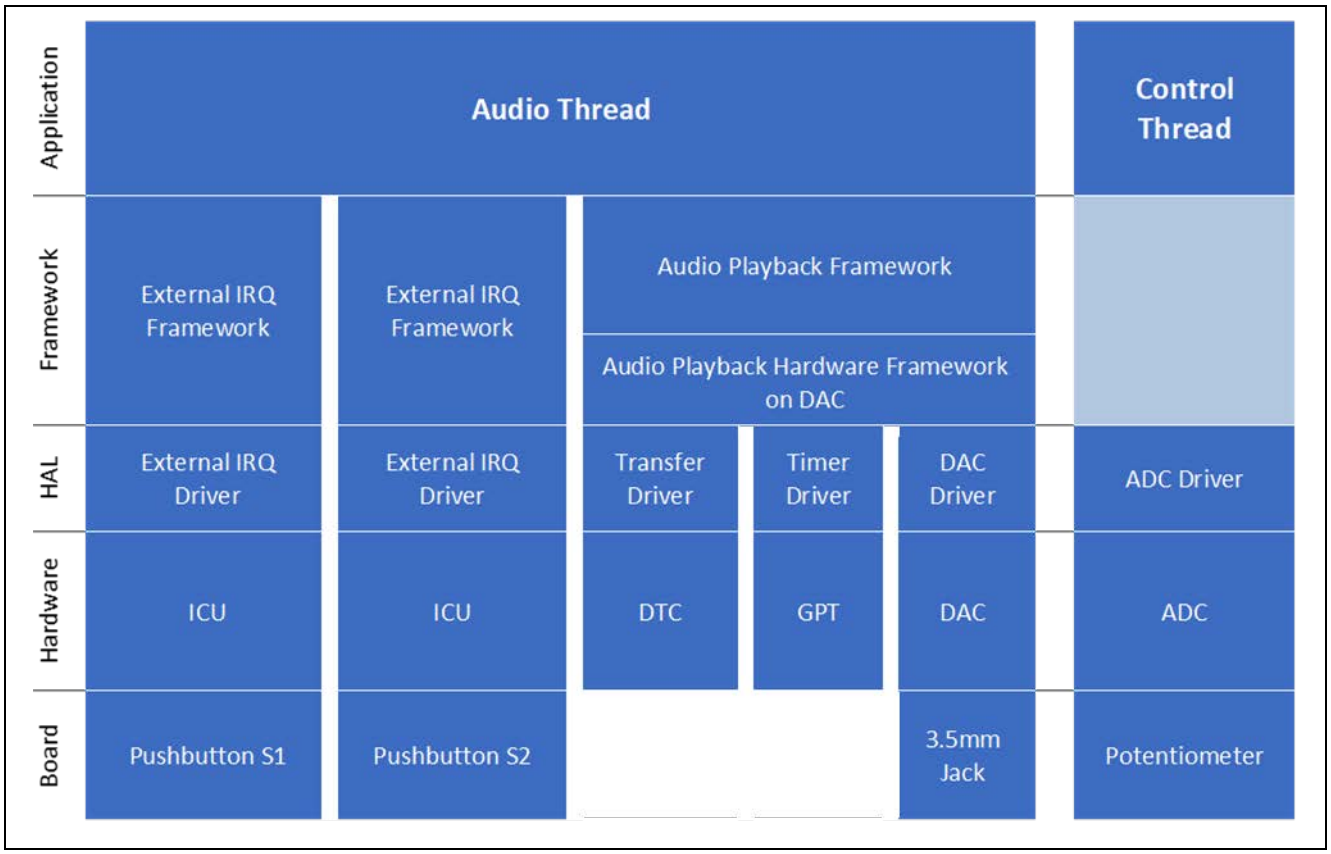


Figure 7. Stop button

4. Synergy Project Configuration

The Simple Audio Example application has been configured to use the SSP modules as shown in the following graphic.



The modules are then arranged inside two application threads and one internal thread to provide audio playback functionality with controls as shown in the following figure.

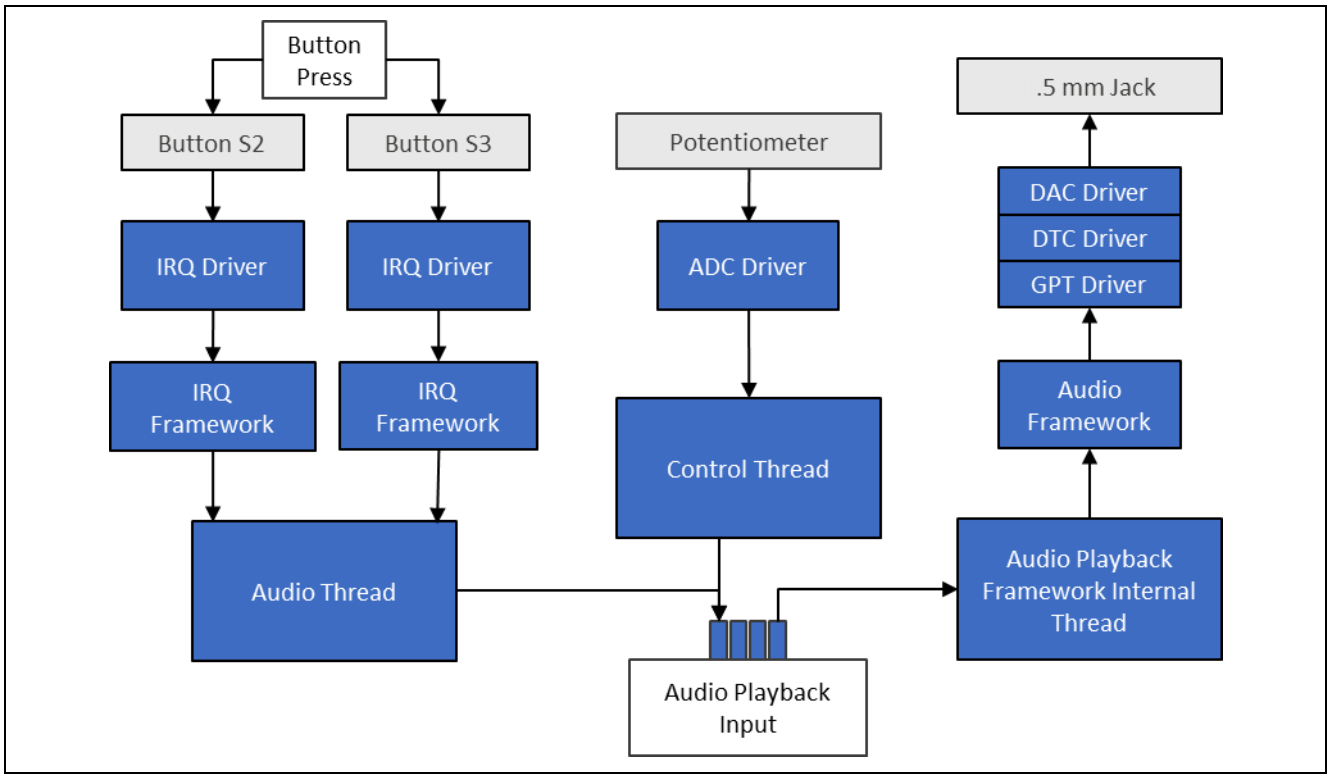


Figure 8. Audio playback function controls

5. How it Works

The Simple Audio Example application is controlled by the **S1** and **S2** push button switches found in the lower-right corner of the DK-S124 board, in addition to the POT1 potentiometer located to the right of the two buttons.

Both pushbuttons are connected to the hardware interrupt pins that are controlled by the external IRQ framework. The framework allows you to control thread execution using hardware IRQs. In most cases, the application uses `sf_irq.p_api->wait` with the `TX_WAIT_FOREVER` argument, to block processing in the thread until the given interrupt request is received. In the simple audio example, the audio playback thread scans through both the button interrupts with a timeout value of zero, and if neither button is pressed, it waits for 20 ms before repeating the process. The IRQs are buffered by the framework before the next IRQ Wait call. This provides adequate processor ticks to lower-priority threads while still providing a responsive interface. A simplified processing flow is shown in the following figure.

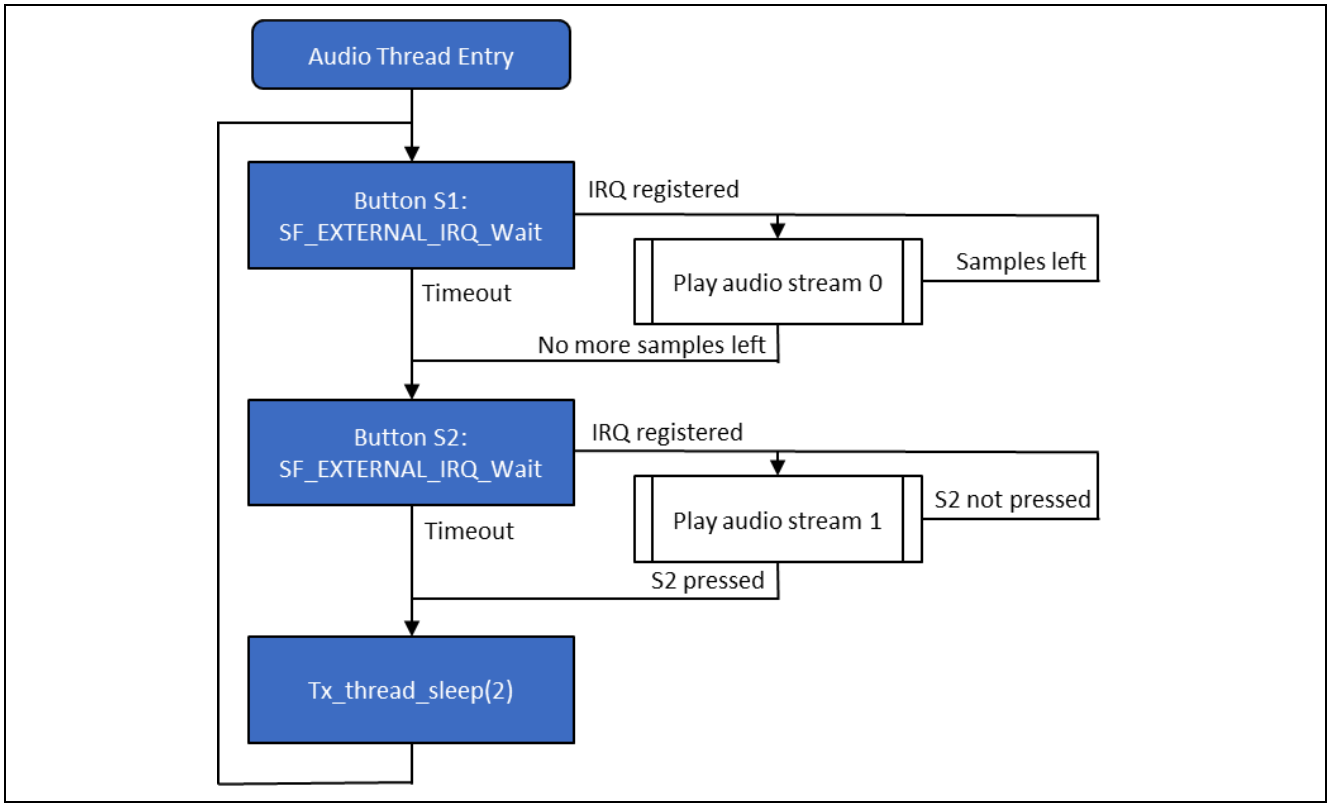


Figure 9. Simplified audio playback framework processing flow

A more detailed view of the audio playback framework processing can be found in the *Synergy Software Package (SSP) User's Manual*.

The simple audio example uses an application-defined structure `app_stream_info_t` to pass basic information about the audio stream stored as an array of characters inside `audio_data.c` file. The information includes the starting pointer and stream size. Both values are used during playback to determine the starting and ending points for the audio samples.

Both streams are played a little bit differently. After the **S1** button press is registered, audio stream 0 is played once. The playback loop sets the `stream_end` property of the stream to true once there are less than 129 bytes until the end of the stream, that is, the remaining data fits in one buffer. The `size_bytes` value is also adjusted to reflect the remaining number of bytes as in most cases, not all the buffer space is filled with audio data. After submitting the audio data for playback, the pointer to the current byte within the data array is incremented by the number of bytes submitted. If the new address is outside of the audio stream, the loop waits for the audio framework to finish playing the current buffer before exiting.

Playback of audio stream 1 is started by pressing the **S2** button, provided that the audio stream 0 is currently not playing, and continues indefinitely until **S2** is pressed again. Most of the processing inside the playback loop is identical to the audio stream 1. The first difference is seen in the `stream_end` value. In this case, it is always false as we expect the playback to restart after the end of the data stream is reached. Once a pointer

to the audio data is outside of the stream, it is reset to the starting point stored in the `app_stream_info_t` structure. Before processing another set of samples, the playback loop checks the IRQ status for the **S2** button. Once pressed, the application waits for the playback of the current buffer to finish before sending the `SF_AUDIO_PLAYBACK_STOP` request to the internal Audio Playback Framework thread.

The application also allows you to control the playback volume using an on-board potentiometer attached to the ADC peripheral. Continuous scan mode is used to acquire periodic readings at 20 Hz, and to pass them on to the Audio Playback Framework as a `SF_AUDIO_PLAYBACK_VolumeSet` request.

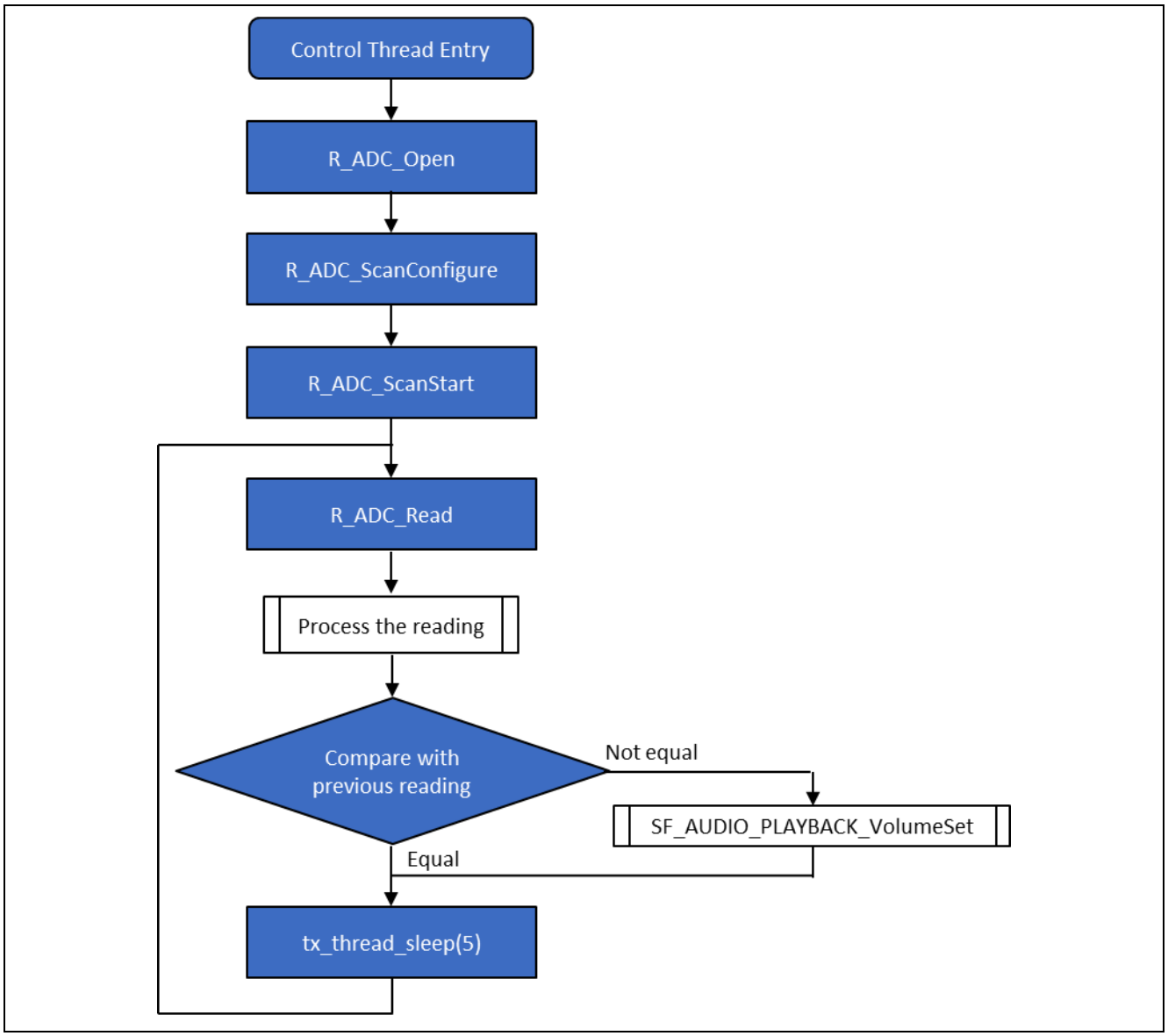


Figure 10. Simple audio playback flow

Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

Synergy Software	www.renesas.com/synergy/software
Synergy Software Package	www.renesas.com/synergy/ssp
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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jan.11.17	—	Initial version
1.01	Feb.23.17	—	Updated for SSP v1.2.0
1.02	Aug.23.17	—	Updated for SSP v1.3.0
1.03	Sep.27.17	1	Required resources of SSP version changed
1.04	Jan.13.18	—	Updated for SSP v1.3.3
1.05	Feb.09.18	—	Updated for SSP v1.4.0
1.06	Mar.15.19	—	Updated for SSP v1.6.0

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

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