RX Family

Sound Playback/Compression System (Original ADPCM Codec)
[M3S-S2-Tiny] Module
Firmware Integration Technology

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Introduction

This application note explains how to implement the ADPCM Encoder/Decoder Library using Firmware Integration Technology(FIT). S2 Library can playback/record to use RX Family. The S2 library for the Renesas Microcomputer is written in optimized assembler.

S2 Library has translation tool from sound data (WAVE file) to ADPCM compressed sound data for microcomputer.

Please refer to the application note “r20an0291ej0101_rx_s2.pdf” for the each of Renesas Starter Kit.

Target Device

RX Family

Contents

1. Outline

ADPCM(adaptive differential pulse code modulation) is one of the way to recode voice. This has constant period sampling to get voice data, and expects "Difference" from previous input to next input, and recodes this "Difference". ADPCM data is smaller than general PCM data for one sample. ADPCM is recommended for embedded microcomputer having small memory.

S2 library encodes 16bit PCM data and outputs to 4bit ADPCM data. And S2 library decodes 4bit ADPCM data and output 16bit PCM data

1.1 S2 library

S2 Library has the following Libraries.

S2 library	Outline
s2_rx600_little_rtune.lib	S2 library for RX600 little endian assembler tuning ver.(*2)
s2_rx600_big_rtune.lib	S2 library for RX600 big endian assembler tuning ver.(*2)
s2_rx200_little_rtune.lib	S2 library for RX200 little endian assembler tuning ver.(*1)
s2_rx200_big_rtune.lib	S2 library for RX200 big endian assembler tuning ver.(*1)

(*1)RX200 Library can be used as a RX100 Library.
(*2)RX600 Library can be used as a RX700 Library.

1.2 S2 Library ROM / RAM / stack size

This section explains S2 Library performance and memory usage.

1.2.1 ROM/RAM/Stack size

— S2 library for the RX Family assembler tuning version.

ROM : about 800 byte
RAM : 0 byte (Upper layer program needs about 30byte for work area.)

API	Stack size
R_adpcm_initEnc	4
R_adpcm_refreshEnc	4
R_adpcm_encode	12
R_adpcm_initDec	4
R_adpcm_refreshDec	4
R_adpcm_decode	24

1.2.2 Speed (reference value)

Assembler tuning version for RX Family

API	Operarion Cycle	
	Sample=4(*)	Sample=16(*)
R_adpcm_initEnc	10	10
R_adpcm_refreshEnc	10	10
R_adpcm_encode	260	1000
R_adpcm_initDec	10	10
R_adpcm_refreshDec	10	10
R_adpcm_decode	210	770

The value that is specified to first argument of the functions (R_adpcm_encode, R_adpcm_decode)

1.3 Version information

User can access S2 Library information with valuable below.

```
extern const mw_version_t R_s2_version;
```

RX600(little endian) Library file:
"M3S-S2-Tiny version 3.04 for RX600 LITTLE endian.(Feb 19 2016, 15:43:05)"

RX600(big endian) Library file:
"M3S-S2-Tiny version 3.04 for RX600 BIG endian.(Feb 19 2016, 15:43:32)"

RX200(little endian) Library file:
"M3S-S2-Tiny version 3.04 for RX200 LITTLE endian.(Feb 19 2016, 15:44:09)"

RX200(big endian) Library file:
"M3S-S2-Tiny version 3.04 for RX200 BIG endian.(Feb 19 2016, 15:44:18)"

2. API Information

2.1 Hardware Requirements

None.

2.2 Software Requirements

None.

2.3 Supported Toolchains

This library is tested and working with following toolchains:

Renesas RX Toolchain V3.07.00

2.4 Limitations

This library can be used with Microcontroller Options fint_register=0 (Fast interrupt vectorregister [None]). The default for this option is fint_register=0.

2.5 Header Files

All API calls are accessed by including a single file "r_adpcm.h" which is supplied with this software's project code.

Build-time configuration options are selected or defined in the file "r_s2_rx_config.h"

2.6 Configuration Overview

All configurable options that can be set at build time are located in the file "r_s2_rx_config.h".

There is no configuration option.

2.7 Adding Library to Your Project

Please refer to the Adding Firmware Integration Technology Modules to Projects "r01an1723eu0111_rx.pdf" (for e^2 studio) or "r01an1826ej0102_rx.pdf" (for CS+).

Lib folder has all S2 Libraries for RX Family. If user implements using the scheme that is explained in this document, all S2 Libraries will be linked for building. Please remove the Libraries excluding your needing libraries.

3. API(Library) Functions

S2 Library uses the following APIs.

API	Outline
R_adpcm_initEnc	The function is initialization function for encode process.
R_adpcm_refreshEnc	The function sets temporary area for encoding.
R_adpcm_encode	The function will encode 16bit PCM data to 4bit ADPCM data (compression).
R_adpcm_initDec	The function is initialization function for decoding.
R_adpcm_refreshDec	The function sets temporary area for decoding.
R_adpcm_decode	The function will decode 4bit ADPCM data to 16bit PCM data (de-compression).

Please refer to the User's Manual if you needs datails. (r20uw0079ej0100_s2.pdf)

4. Library version information

Ver	change
3.05	Changed the disclaimer in program sources
3.04	Updated version number with the xml file revision.
3.03	Updated version number.
3.02	Updated version number.
3.01	Fixed decode function bug.
1.00	First release

Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/contact/

Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
3.05	Mar 20, 2025	—	Changed the disclaimer in program sources
3.04	Apr 01, 2016	—	Corresponded to RX Family. Updated the xml file for FIT.
3.03	Mar 01, 2015	—	Corresponded to RX231. Updated the xml file for FIT.
3.02	Dec 28, 2014	—	Corresponded to RX71M/RX113. Updated the xml file for FIT.
3.01	Apr 01, 2014	—	First edition issued

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)
   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on
   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state
   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins
   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals
   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses
   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products
   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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