Renesas Microcomputer

M3S-S2-Tiny: ADPCM Encoder/Decoder User's Manual

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Introduction

M3S-S2-Tiny (hereinafter referred to as the S2 Library) is the software library incorporated in the Renesas Microcomputer. This manual explains how to use the S2 Library. Please refer the "Introduction Guide" with this document. "Introduction Guide" explains the information that depends on microcomputer.

Target Device

Renesas Microcomputer

Contents

1. Outline

1.1 Functions

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.

1.2 Data flow of S2 library

S2 library has data processing which shown as below figure1.

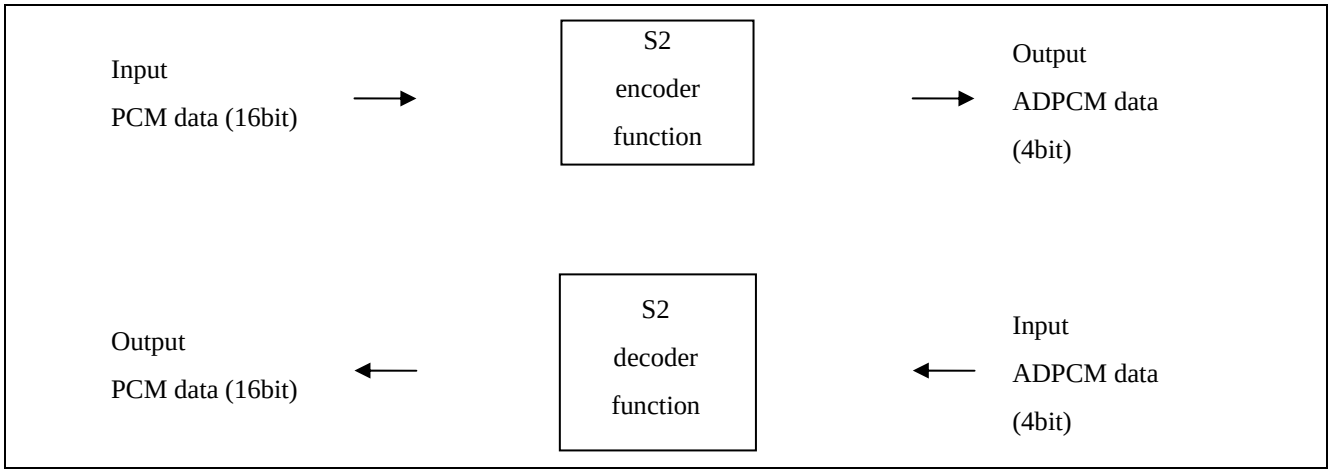

Figure1 data flow of S2 library

2. S2 Library specification

2.1 Library type definitions

This section gives the details about the type definitions.

Datatype	Typedef
uint8_t	unsigned char
uint16_t	unsigned short
uint32_t	unsigned long
int8_t	signed char
int16_t	signed short
int32_t	signed long

2.2 Structure reference

2.2.1 adpcm_env

Description

The structure "adpcm_env" is temporary area for S2 decoding/encoding. When user uses S2 library, please define "adpcm_env" variable and passes encode/decode functions as argument. There is no need for user setting any values to "adpcm_env"

Usage

setting any values to "adpcm_env"

```
#define ADPCM_WORKSIZE_IN_UINT32(5)
typedef struct {
        uint32_t work[ADPCM_WORKSIZE_IN_UINT32];/*working environment for ADPCM codec*/
} adpcm_env;
```

2.3 Function reference

2.3.1 R_adpcm_initEnc

Description

R_adpcm_initEnc function is initialization function for encode process. This function initializes the temporary area specified as first argument "wenv". Please execute this function once before encoding PCM data.

Usage

```
#include "r_adpcm.h"
void R_adpcm_initEnc(adpcm_env *wenv);
```

Parameters

wenv	input	Temporary area address for encoding

Return Value

none

Remark

When an invalid pointer (ex. NULL) is passed as a parameter, the function's behavior is undefined.

2.3.2 R_adpcm_refreshEnc

Description

R_adpcm_refreshEnc function sets temporary area for encoding. Please specify encoding PCM data address to the first argument "inputAddr". Please specify encoded ADPCM data address to the second argument "outputAddr". Please specify temporary area initialized in R_adpcm_initEnc to the third argument "wenv". Encode process will be executed when user executes R_adpcm_encode after this function. If user needs encoding repeatedly, please re-call this function and update "inputAddr" and "outputAddr".

Usage

```
#include "r_adpcm.h"

void R_adpcm_refreshEnc(int16_t *inputAddr, uint8_t *outputAddr, adpcm_env *wenv);
```

Parameters

inputAddr	input	Address of encoding PCM data
outputAddr	input	Address of encoded ADPCM data
wenv	input	Address of temporary area for process of encode.

Return Value

none

Remark

When an invalid pointer (ex. NULL) is passed as a parameter, the function's behavior is undefined.

2.3.3 R_adpcm_encode

Description

R_adpcm_encode function will encode 16bit PCM data to 4bit ADPCM data (compression). The first argument "smpln" specifies number of sample for encoding PCM data. The "smpln" value needs specifying 4 multiple. The second argument "wenv" needs specifying initialized work area in R_adpcm_initEnc function. When this function is executed, this function reads PCM data from area that specified R_adpcm_refreshEnc function with inputAddr. And this function stores ADPCM data to area that specified outputAddr.

Usage

```
#include "r_adpcm.h"

int16_t R_adpcm_encode(int16_t smpln, adpcm_env *wenv);
```

Parameters

smpln	input	Number of sample for encoding
wenv	input	Temporary work area for encoding

Return Value

0	Normal termination
-1	Illegal termination ("smpln" is not 4 multiple)

Remark

Please execute R_adpcm_refreshEnc function before executing this function to decide inputAddr and outputAddr.

When an invalid pointer (ex. NULL) is passed as a parameter, the function's behavior is undefined.

2.3.4 R_adpcm_initDec

Description

R_adpcm_intDec function is initialization function for decoding. This function initializes the area specified in the first argument "wenv". This function needs executing once before ADPCM data decoding.

Usage

```
#include "r_adpcm.h"
void R_adpcm_initDec(adpcm_env *wenv);
```

Parameters

wenv	input	Address of work area for decoding.

Return Value

None

Remark

When an invalid pointer (ex. NULL) is passed as a parameter, the function's behavior is undefined.

2.3.5 R_adpcm_refreshDec

Description

R_adpcm_refreshDec function sets temporary area for decoding. Please specify decoding PCM data address to the first argument "inputAddr". Please specify decoded ADPCM data address to the second argument "outputAddr". Please specify temporary area initialized in R_adpcm_initEnc to the third argument "wenv". Decode process will be executed when user executes R_adpcm_decode after this function. If user needs decoding repeatedly, please re-call this function and update "inputAddr" and "outputAddr".

Usage

```
#include "r_adpcm.h"
void R_adpcm_refreshDec(uint8_t *inputAddr, int16_t *outputAddr, adpcm_env *wenv);
```

Parameters

inputAddr	input	Address that stored ADPCM data for decoding.
outputAddr	input	Address that stored decoded PCM data.
wenv	input	Work area address for decoding.

Return Value

None

Remark

When an invalid pointer (ex. NULL) is passed as a parameter, the function's behavior is undefined.

2.3.6 R_adpcm_decode

Description

R_adpcm_decode function will decode 4bit ADPCM data to 16bit PCM data (de-compression). The first argument "smpln" specifies number of sample for encoding ADPCM data. The "smpln" value needs specifying 4 multiple. The second argument "wenv" needs specifying initialized work area in R_adpcm_initDec function. When this function is executed, this function reads ADPCM data from area that specified R_adpcm_refreshEnc function with inputAddr. And this function stores PCM data to area that specified outputAddr.

Usage

```
#include "r_adpcm.h"

int16_t R_adpcm_decode(int16_t smpln, adpcm_env *wenv);
```

Parameters

smpln	input	Number of sample for decoding
wenv	input	Temporary work area for decoding.

Return Value

0	Normal termination.
-1	Illegal termination. ("smpln" in not even number)

Remark

Please execute R_adpcm_refreshDec function before executing this function to decide inputAddr and outputAddr.

When an invalid pointer (ex. NULL) is passed as a parameter, the function's behavior is undefined.

3. Multiple data encoding / decoding at the same time

S2 library can encode multiple PCM data and decode multiple ADPCM data at the same time.

Please defined variables "adpcm_env" for each multiple encoding / decoding data.

The following program is example for decoding two ADPCM data at the same time.

```
#Define NUM_CHANNELS 2
/* Definition of structure variable of each channel */
adpcm_env ch[NUM_CHANNELS] ;
int16_t output[NUM_CHANNELS][4] ;

for (index=0; index < NUM_CHANNELS; index++)
{
   R_adpcm_initDec( &ch[index] ); /* Initialization for ch data expansion */
}

/* expansion processing */
for (index=0; index < NUM_CHANNELS; index++)
{
   /* Buffer refresh of ch data */
   R_adpcm_refreshDec( input[index], output[index], &ch[index] );

   /* Expansion of ch data */
   R_adpcm_decode( 4, &ch[index] );
}
```

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Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Nov.25.11	—	First edition issued

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1. Handling of Unused Pins
   Handle unused pins in accord 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 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. Unused pins should be handled as described under Handling of Unused Pins in the manual.
2. Processing at Power-on
   The state of the product is undefined at the moment 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 moment 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 moment 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 moment when power is supplied until the power reaches the level at which resetting has been specified.
3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.
4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has 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. Moreover, 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.
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   Before changing from one product to another, i.e. to one with a different type number, confirm that the change will not lead to problems.
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