RX Family

JPEG Decoder Module

Firmware Integration Technology

R20AN0104EJ0208
Rev.2.08
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Introduction

This material explains usage of JPEG Decoder (JPEGD).

JPEG Decoder is only for decoding, and there are the following two libraries.

JPEG Decode Library: Inverse DCT, Inverse Quantization and Huffman decoding.

JPEG File Expand Library: Expand JPEG data using JPEG Decode Library.

The source code of JPEG File Expand Library is attached so that a user can change specification.

Target Device

RX Family

Contents

1. Structure of product

Package name : JPEG Decoder for the RX Family V.2.08 Release 00

Table 1.1 Product Files of JPEG Decoder

File/Directory name	description
JPEGD FIT Module (r_jpegd_rx_v.2.08.zip)	
JPEGD config (r_config)	
r_jpegd_rx_config.h	JPEGD Config file (default setting)
JPEGD FIT Module body (r_jpegd_rx)	
JPEGD document (doc)	
Japanese (ja)	
r20an0104jj0208_rx_jpegd.pdf	Introduction Guide
r20uw0075jj0103_jpegd.pdf	User's Manual
English (en)	
r20an0104ej0208_rx_jpegd.pdf	Introduction Guide (this document)
r20uw0075ej0103_jpegd.pdf	User's Manual
JPEGD Library (lib)	
jpegd_rx600_little.lib jpegd_rx600_big.lib jpegd_rx200_little.lib jpegd_rx200_big.lib r_jpegd.h	JPEG Decode Library and header file
expand_jpegd_rx600_little.lib expand_jpegd_rx600_big.lib expand_jpegd_rx200_little.lib expand_jpegd_rx200_big.lib r_expand_jpegd.h	JPEG File Expand Library and header file
r_stdint.h	Data type header file
r_mw_version.h	Version data header file
JPEG File Expand Library make environment (make_lib)	
make_lib.zip	JPEG File Expand Library make environment (includes source code)
readme(readme.txt)	readme

2. Specification of library

2.1 Structure of software stack

This figure explains structure of software stack of JPEG Decoder.

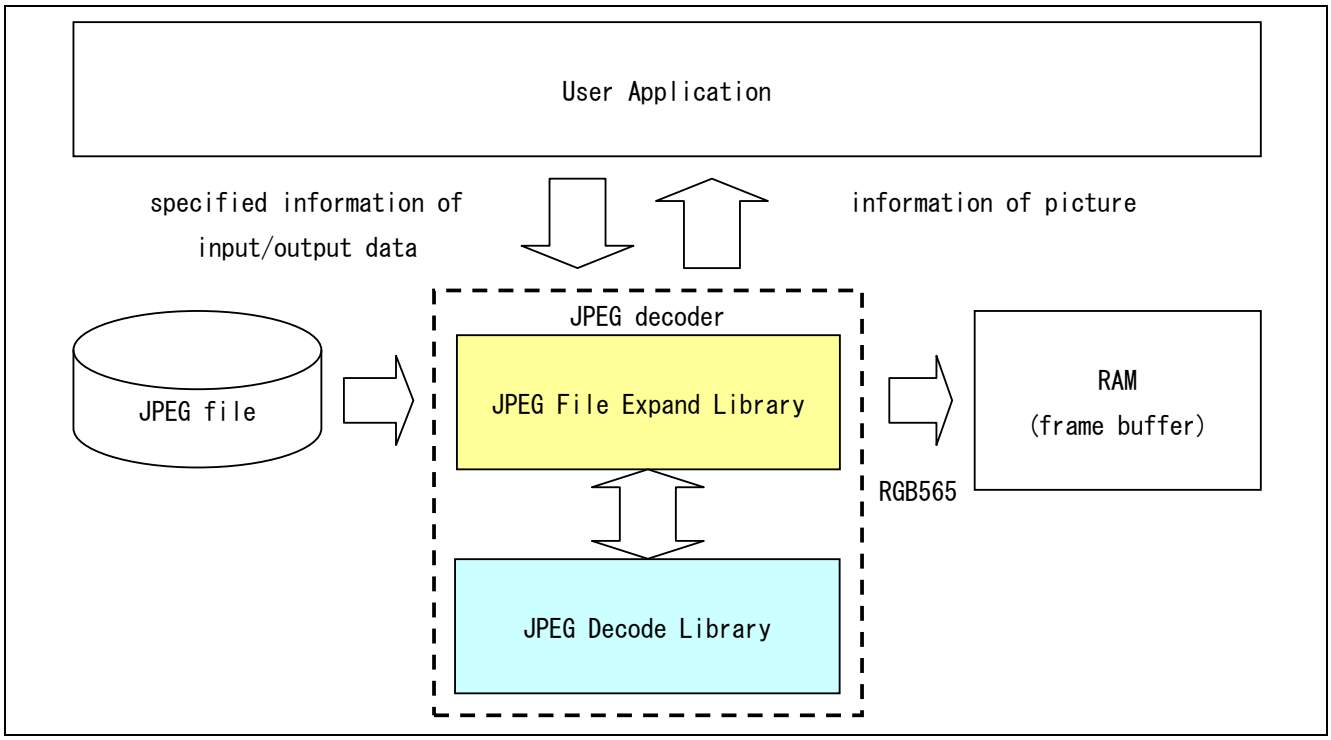

Figure 2.1 Structure of Software Stack

2.2 Specification of JPEG File Expand Library

Specification of this JPEG File Expand Library is below.

Table 2.1 specification of JPEG Expand Library

Items	Specifications
Elements of color	3 colors (YCbCr)
Ratio of sample	4:4:4 (1x1,1x1,1x1) 4:2:2 (2x1,1x1,1x1) 4:2:2 vertical (1x2,1x1,1x1) 4:2:0 (2x2,1x1,1x1)
Output format	RGB565 (16bit color)
Input data	All data has to be prepared.
Clipping of expansion	No support
Progressive	No support
Exif	No support

2.3 Development environment

JPEG Decoder can run with this development environment below.

[IDE]

CS+ V8.13.00

e^{2}studio 2025-01

[C compiler]

C/C++ Compiler Package for RX Family V.1.02 Release 01 or later

Library file is built with default compile option.

- compile option (RX600 little endian)
  -cpu=rx600 -output=obj="$(CONFIGDIR)\$(FILELEAF).obj" –nologo
- compile option (RX600 big endian)
  Adding “-endian=big” to default option.

- compile option (RX200 little endian)
  -cpu=rx200 -output=obj="$(CONFIGDIR)\$(FILELEAF).obj" –nologo
- compile option (RX200 big endian)
  Adding “-endian=big” to default option.

2.4 “for”, “while” and “do while” statements

In this module, “for”, “while” and “do while” statements (loop processing) are used in processing to wait for register to be reflected and so on. For these loop processing, comments with “WAIT_LOOP” as a keyword are described. Therefore, if user incorporates fail-safe processing into loop processing, user can search the corresponding processing with “WAIT_LOOP”.

The following shows example of description.

```
while statement example :
/* WAIT LOOP */
while(0 == SYSTEM.OSCOVFSR.BIT.PLOVF)
{
    /* The delay period needed is to make sure that the PLL has stabilized. */
}

for statement example :
/* Initialize reference counters to 0. */
/* WAIT_LOOP */
for (i = 0; i < BSP_REG_PROTECT_TOTAL_ITEMS; i++)
{
    g_protect_counters[i] = 0;
}

do while statement example :
/* Reset completion waiting */
do
{
    reg = phy_read(ether_channel, PHY_REG_CONTROL);
    count++;
} while ((reg & PHY_CONTROL_RESET) && (count < ETHER_CFG_PHY_DELAY_RESET)); /* WAIT_LOOP */
```

2.5 Specification of API

Specification of JPEG Expand Library APIs are below.

Table 2.2 API (JPEG File Expand Library)

function name	outline
R_init_jpeg	initialize library
R_expand_jpeg	process JPEG expansion
R_get_info_jpeg	get information of JPEG

Note: Refer to the JPEG Expand Library User's Manual to know details.

Specification of JPEG Decode Library APIs are below.

Table 2.3 API (JPEG Decode Library)

function name	outline
R_jpeg_make_huff_table	register table for Huffman encoding
R_jpeg_add_iquant_table	register table for quantization
R_jpeg_decode_one_block	execute Huffman encoding
R_jpeg_IDCT	execute Reverse quantization and Reverse DCT
R_jpeg_readRST	detect number of re-initialized decode

Note: Refer to the JPEG Decode Library User's Manual to know details.

2.6 ROM size / RAM size / Stack size

JPEG Decoder requires ROM/RAM/Stack size as below.

Table 2.4 ROM/RAM size (JPEG File Expand Library)

kind	section name	Attribute, Alignment	size [byte]	
			RX600, RX200 little endian	RX600, RX200 big endian
ROM	P_jpeg_exp_F (*)	code	4040	4040
	P_jpeg_exp_S	code	3327	3330
	C_jpeg_exp_F (*)	data, align=4	8	8
	C_jpeg_exp_S	data, align=4	644	644
Total	-	-	8019	8022
RAM	B_jpeg_exp_F (*)	data, align=4	5424	5424
	B_jpeg_exp_F_2 (*)	data, align=2	6	6
	B_jpeg_exp_S	data, align=4	72	72
	B_jpeg_exp_S_2	data, align=2	4	4
Total	-	-	5506	5506

Note: (*): Recommends arranging to a high speed memory.

Table 2.5 ROM/RAM size (JPEG Decode Library)

Kind	section name	Attribute, Alignment	size [byte]	
			RX600, RX200 little endian	RX600, RX200 big endian
ROM	P_jpeg_dec_F8 (*)	code, align=8	2982	2981
	P_jpeg_dec_S	code	48	48
	C_jpeg_dec_F (*)	data, align=4	4	4
	C_jpeg_dec_F_2 (*)	data, align=2	1284	1284
	C_jpeg_dec_S	data, align=4	132	132
Total	-	-	4384	4385
RAM	-	-	0	0
Total	-	-	0	0

Note: (*): Recommends arranging to a high speed memory.

Table 2.6 Stack size (JPEG File Expand Library)

API function name	stack size [byte]	
	RX600, RX200 little endian	RX600, RX200 big endian
R_init_jpeg	4	4
R_expand_jpeg	228	228
R_get_info_jpeg	56	56

Table 2.7 Stack size (JPEG Decode Library)

API function name	stack size [byte]	
	RX600, RX200 little endian	RX600, RX200 big endian
R_jpeg_make_huff_table	52	52
R_jpeg_add_iquant_table	8	8
R_jpeg_decode_one_block	64	64
R_jpeg_IDCT	64	64
R_jpeg_readRST	16	16

2.7 Version information

Version information is stored in this library. Version information can be accessed if the header of this library is included. The data stored in this library is as follows.

2.7.1 RX600 (little endian)

JPEG File Expand Library (expand_jpegd_rx600_little.lib)

```
#include "r_expand_jpegd.h"

Version infomation of a Library
  R_expand_jpegd_version.library[] =
    "JPEG File Expand Library version 1.03 for the RX600 LITTLE endian.(Apr 11 2013, 16:18:02)"

Version infomation of a compiler
  R_expand_jpegd_version.complier = 0x01020100
```

JPEG Decode Library (jpegd_rx600_little.lib)

```
#include "r_jpegd.h"

Version infomation of a Library
  R_jpegd_version.library[] =
    "JPEG Decode Library version 2.06 for the RX600 LITTLE endian.(Feb 18 2016, 17:15:41)"

Version infomation of a compiler
  R_jpegd_version.complier = 0x01020100
```

2.7.2 RX600 (big endian)

JPEG File Expand Library (expand_jpegd_rx600_big.lib)

```
#include "r_expand_jpegd.h"

Version infomation of a Library
  R_expand_jpegd_version.library[] =
    "JPEG File Expand Library version 1.03 for the RX600 BIG endian.(Apr 11 2013, 16:17:58)"

Version infomation of a compiler
  R_expand_jpegd_version.complier = 0x01020100
```

JPEG Decode Library (jpegd_rx600_big.lib)

```
#include "r_jpegd.h"

Version infomation of a Library
  R_jpegd_version.library[] =
    "JPEG Decode Library version 2.06 for the RX600 BIG endian.(Feb 18 2016, 17:15:52)"

Version infomation of a compiler
  R_jpegd_version.complier = 0x01020100
```

2.7.3 RX200 (little endian)

JPEG File Expand Library (expand_jpegd_rx200_little.lib)

```
#include "r_expand_jpegd.h"

Version infomation of a Library
  R_expand_jpegd_version.library[] =
    "JPEG File Expand Library version 1.03 for the RX200 LITTLE endian.(Apr 11 2013, 16:17:55)"

Version infomation of a compiler
  R_expand_jpegd_version.complier = 0x01020100
```

JPEG Decode Library (jpegd_rx200_little.lib)

```
#include "r_jpegd.h"

Version infomation of a Library
  R_jpegd_version.library[] =
    "JPEG Decode Library version 2.06 for the RX200 LITTLE endian.(Feb 18 2016, 17:15:58)"

Version infomation of a compiler
  R_jpegd_version.complier = 0x01020100
```

2.7.4 RX200 (big endian)

JPEG File Expand Library (expand_jpegd_rx200_big.lib)

```
#include "r_expand_jpegd.h"

Version infomation of a Library
  R_expand_jpegd_version.library[] =
    "JPEG File Expand Library version 1.03 for the RX200 BIG endian.(Apr 11 2013, 16:17:51)"

Version infomation of a compiler
  R_expand_jpegd_version.complier = 0x01020100
```

JPEG Decode Library (jpegd_rx200_big.lib)

```
#include "r_jpegd.h"

Version infomation of a Library
  R_jpegd_version.library[] =
    "JPEG Decode Library version 2.06 for the RX200 BIG endian.(Feb 18 2016, 17:16:06)"

Version infomation of a compiler
  R_jpegd_version.complier = 0x01020100
```

3. Usage of Libraries

3.1 Usage of JPEG File Expand library

Please link the library file to user application.

RX600 little endian:	jpegd_rx600_little.lib, expand_jpegd_rx600_little.lib
RX600 big endian:	jpegd_rx600_big.lib, expand_jpegd_rx600_big.lib
RX200 little endian:	jpegd_rx200_little.lib, expand_jpegd_rx200_little.lib
RX200 big endian:	jpegd_rx200_big.lib, expand_jpegd_rx200_big.lib

Please include the header files with library.

```
#include "r_expand_jpegd.h"
```

3.2 Usage of JPEG Decode Library

Please link the library file to user application.

RX600 little endian:	jpegd_rx600_little.lib
RX600 big endian:	jpegd_rx600_big.lib
RX200 little endian:	jpegd_rx200_little.lib
RX200 big endian:	jpegd_rx200_big.lib

Please include the header files with library.

```
#include "r_jpegd.h"
```

4. Notes

- This library uses DSP instructions. Please push/pop accumulator register (ACC) in user interrupts function using accumulator, because DSP instructions uses accumulator (RX600).

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

- This library is using Application Notes "Color Space Conversion Using the DSP Instructions" [R01AN0225EJ0100]. Refer to it to know details.

5. Software Update Information

Package version	Date	Description
V.2.01 Release 00	Jun 17, 2011	first release
V.2.03 Release 00	Oct 15, 2012	Support RX200 For RX600, Use DSP instructions for color space conversion. Correct decode function (big endian).
V.2.04 Release 00	Jun 28, 2013	Update error check function for JPEG file analysis. Improve the processing speed of JPEG decode library.
V.2.05 Release 00	Mar 17, 2015	Support FIT.
V.2.06 Release 00	Apr 01, 2016	Updated version number with the xml file revision.
V.2.07 Release 00	Nov 15 2024	Added support for adding WAIT_LOOP comments.
V.2.08 Release 00	Mar 20, 2025	Changed the disclaimer in program sources

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Revision History

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Jun.06.2011	—	First edition issued
1.01	May.18.2012	—	Support RX200
1.02	Oct.16.2012	—	Update Library Infomation. Clerical error correction.
1.03	Apr.26.2013	—	Update section name. Update format of version information.
2.05	Mar.17.2015	—	Support FIT.
2.06	Apr.01.2016	—	Update the xml file for FIT
2.07	Nov.15.2024	6	Added 2.4“for”, “while” and “do while” statements
2.08	Mar 20, 2025	3	Update 1. Structure of product.
		14	Update 5 Software Update Information

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.
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   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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