

## RX Family

R20AN0263EJ0101

Rev.1.01

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## JPEG Encoder Module

## Firmware Integration Technology

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### Introduction

This material explains usage of JPEG Encoder (JPEGE).

JPEG Encoder is only for encoding, and there are the following two libraries.

JPEG Encode Library: DCT, Quantization and Huffman encoding.

JPEG File Compress Library: Compress JPEG data using JPEG Encode Library.

Normally, the API for the JPEG File Compress Library is used to compress bitmap images into the JPEG image format. But since the source code for the JPEG File Compress Library is provided, users can also change the specifications to match the particular needs of their applications.

JPEGE is provided as Firmware Integration Technology (FIT) Module. Please refer to the URL to know FIT outline.

<http://www.renesas.com/products/mpumcu/rx/child/fit.jsp>

### Target Device

RX Family

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### 1. Structure of product

Package name : JPEG Encoder for the RX Family V.1.01 Release 00

**Table 1.1 Product Files of JPEG Encoder**

| File/Directory name  | description  |
|--|--|
| JPEGE FIT Module (r_jpege_rx_v.1.01.zip)   |  |
| JPEGE config (r_config)  |  |
| r_jpege_rx_config.h  | JPEGE Config file (default setting)                                |
| JPEGE FIT Module body (r_jpege_rx)   |  |
| JPEGE document (doc)   |  |
| Japanese (ja)  |  |
| r20an0263jj0101_rx_jpege.pdf   | Introduction Guide   |
| r20uw0122jj0100_jpege.pdf  | User's Manual  |
| English (en)   |  |
| r20an0263ej0101_rx_jpege.pdf   | Introduction Guide (this document)                                 |
| r20uw0122ej0100_jpege.pdf  | User's Manual  |
| JPEGE Library (lib)  |  |
| jpege_rx600_little.lib<br>jpege_rx600_big.lib<br>jpege_rx200_little.lib<br>jpege_rx200_big.lib<br>r_jpeg.h   | JPEG Encode Library and header file                                |
| compress_jpege_rx600_little.lib<br>compress_jpege_rx600_big.lib<br>compress_jpege_rx200_little.lib<br>compress_jpege_rx200_big.lib<br>r_compress_jpege.h | JPEG File Compress Library and header file                         |
| r_stdint.h   | Data type header file  |
| r_mw_version.h   | Version data header file   |
| JPEG File Compress Library make environment (make_lib)   |  |
| make_lib.zip   | JPEG File Compress Library make environment (includes source code) |
| JPEGE config reference (ref)   |  |
| r_jpege_rx_config_reference.h  | JPEGE config file (template)                                       |
| readme(readme.txt)   | Readme   |

## 2. Specification of library

### 2.1 Structure of software stack

This figure explains structure of software stack of JPEG Encoder.

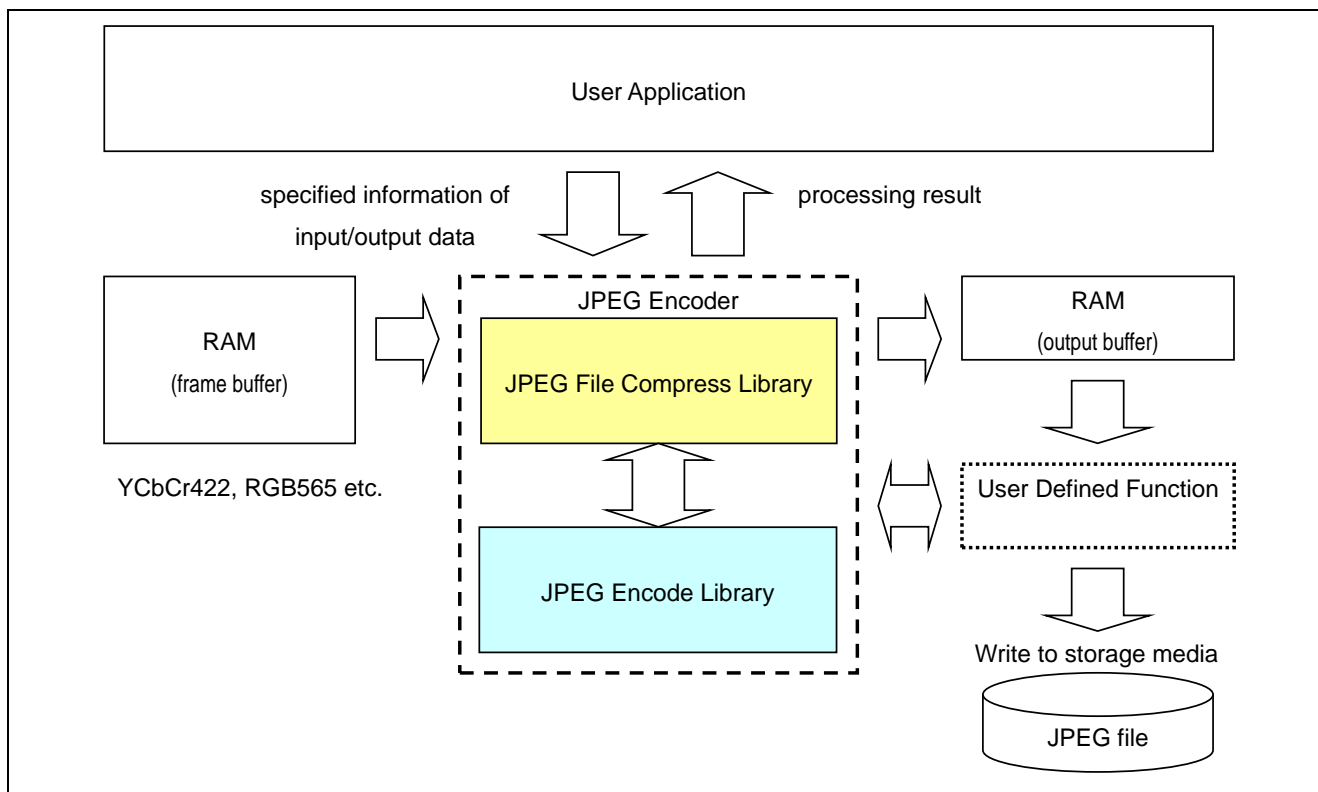


Figure 2.1 Structure of Software Stack

### 2.2 Specification of JPEG File Compress Library

Specification of this JPEG File Compress Library is below.

Table 2.1 specification of JPEG Compress Library

| Items               |  | Specifications   |
|---------------------|--|--|
| Output<br>JPEG File | Support format   | JFIF   |
|                     | Elements of color  | 3 colors (YCbCr)   |
|                     | Ratio of sample  | 4:2:2 (2x1,1x1,1x1) or 4:2:0 (2x2,1x1,1x1)   |
|                     | Image quality  | A value in the range 1 to 128 may be specified.                                    |
|                     | Restart marker   | Either none or an arbitrary interval may be set.                                   |
|                     | Comment  | none   |
|                     | Exif   | No support   |
|                     | Progressive  | No support   |
|                     | Thumbnail  | No support   |
| Output units        | Output buffers with an arbitrary size may be provided and the data can be stored to various media in units of that size. |  |
| Input<br>Image data | Image format   | RGB565 (16bit color), RGB888 (24bit color), YCbCr 4:2:2                            |
|                     | Input units  | Data is read as single unit. (Reading divided into smaller units is not possible.) |

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

## 2.3 Development environment

JPEG Encoder can run with this development environment below.

[IDE]

CS+ V3.03.00

e<sup>2</sup>studio V4.2.0.012

[C compiler]

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

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 Specification of API

Specification of JPEG Compress Library APIs are below.

**Table 2.2 API (JPEG File Compress Library)**

| function name   | outline                                |
|-----------------|--|
| R_compress_jpeg | compress bitmap images into JPEG files |

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

Specification of JPEG Encode Library APIs are below.

**Table 2.3 API (JPEG Encode Library)**

| function name           | outline                              |
|-------------------------|--------------------------------------|
| R_jpeg_add_quant_table  | Registers Quantization table         |
| R_jpeg_DCT              | Executes DCT and quantization        |
| R_jpeg_encode_one_block | Executes Huffman encoding            |
| R_jpeg_writeDRI         | Writes DRI                           |
| R_jpeg_writeRST         | Writes RSTm                          |
| R_jpeg_writeEOI         | Writes EOI                           |
| R_jpeg_flush_bits       | Forcibly writes Huffman encoded data |

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

## 2.5 ROM size / RAM size / Stack size

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

**Table 2.4 ROM/RAM size (JPEG File Compress Library)**

| kind  | section name       | Attribute,<br>Alignment | size [byte]                   |                            |
|-------|--------------------|-------------------------|-------------------------------|----------------------------|
|       |                    |                         | RX600, RX200<br>little endian | RX600, RX200<br>big endian |
| ROM   | P_jpeg_cmp_F (*)   | code                    | 3005                          | 2990                       |
|       | P_jpeg_cmp_S       | code                    | 2980                          | 2980                       |
|       | C_jpeg_cmp_F (*)   | data, align=4           | 16                            | 16                         |
|       | C_jpeg_cmp_F_2 (*) | data, align=2           | 256                           | 256                        |
|       | C_jpeg_cmp_S       | data, align=4           | 388                           | 388                        |
| Total | -                  | -                       | 6645                          | 6630                       |
| RAM   | B_jpeg_cmp_F (*)   | data, align=4           | 1164                          | 1164                       |
|       | B_jpeg_cmp_F_2 (*) | data, align=2           | 128                           | 128                        |
|       | B_jpeg_cmp_F_1 (*) | data, align=1           | 384                           | 384                        |
|       | Total              | -                       | -                             | 1676                       |

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

**Table 2.5 ROM/RAM size (JPEG Encode Library)**

| Kind  | section name       | Attribute, Alignment | size [byte]                   |                            |
|-------|--------------------|----------------------|-------------------------------|----------------------------|
|       |                    |                      | RX600, RX200<br>little endian | RX600, RX200<br>big endian |
| ROM   | P_jpeg_enc_F (*)   | code                 | 1050                          | 1050                       |
|       | P_jpeg_enc_F_8 (*) | code, align=8        | 644                           | 644                        |
|       | P_jpeg_enc_S       | code                 | 203                           | 204                        |
|       | C_jpeg_enc_F (*)   | data, align=4        | 2536                          | 2536                       |
|       | C_jpeg_enc_F_1 (*) | data, align=1        | 64                            | 64                         |
| Total | -                  | -                    | 5325                          | 5326                       |
| RAM   | -                  | -                    | 0                             | 0                          |
| Total | -                  | -                    | 0                             | 0                          |

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

**Table 2.6 Stack size (JPEG File Compress Library)**

| API function name | stack size [byte]             |                            |
|-------------------|-------------------------------|----------------------------|
|                   | RX600, RX200<br>little endian | RX600, RX200<br>big endian |
| R_compress_jpeg   | 296                           | 296                        |

**Table 2.7 Stack size (JPEG Encode Library)**

| API function name       | stack size [byte]             |                            |
|-------------------------|-------------------------------|----------------------------|
|                         | RX600, RX200<br>little endian | RX600, RX200<br>big endian |
| R_jpeg_add_quant_table  | 36                            | 36                         |
| R_jpeg_DCT              | 4                             | 4                          |
| R_jpeg_encode_one_block | 60                            | 60                         |
| R_jpeg_writeDRI         | 12                            | 12                         |
| R_jpeg_writeRST         | 36                            | 36                         |
| R_jpeg_writeEOI         | 8                             | 8                          |
| R_jpeg_flush_bits       | 24                            | 24                         |



## 2.6 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.

### 2.6.1 RX600 (little endian)

JPEG File Compress Library (compress\_jpege\_rx600\_little.lib)

```
#include "r_compress_jpegd.h"
```

Version information of a Library

```
R_compress_jpege_version.library[] =  
"JPEG File Compress Library version 1.00 for the RX600 LITTLE endian.(Sep 12 2013, 11:40:46)"
```

Version information of a compiler

```
R_expand_jpegd_version.complier = 0x01020100
```

JPEG Encode Library (jpege\_rx600\_little.lib)

```
#include "r_jpeg.h"
```

Version information of a Library

```
R_jpege_version.library[] =  
"JPEG Encode Library version 1.01 for the RX600 LITTLE endian.(Feb 18 2016, 21:07:57)"
```

Version information of a compiler

```
R_jpegd_version.complier = 0x01020100
```

### 2.6.2 RX600 (big endian)

JPEG File Compress Library (compress\_jpege\_rx600\_big.lib)

```
#include "r_compress_jpege.h"
```

Version information of a Library

```
R_compress_jpege_version.library[] =  
"JPEG File Compress Library version 1.00 for the RX600 BIG endian.(Sep 12 2013, 11:40:42)"
```

Version information of a compiler

```
R_expand_jpegd_version.complier = 0x01020100
```

JPEG Encode Library (jpege\_rx600\_big.lib)

```
#include "r_jpeg.h"
```

Version information of a Library

```
R_jpege_version.library[] =  
"JPEG Encode Library version 1.01 for the RX600 BIG endian.(Feb 18 2016, 21:08:09)"
```

Version information of a compiler

```
R_jpegd_version.complier = 0x01020100
```

### 2.6.3 RX200 (little endian)

JPEG File Compress Library (compress\_jpege\_rx200\_little.lib)

```
#include "r_compress_jpege.h"
```

Version information of a Library

```
R_compress_jpege_version.library[] =  
"JPEG File Compress Library version 1.00 for the RX200 LITTLE endian.(Sep 12 2013, 11:40:37)"
```

Version information of a compiler

```
R_expand_jpegd_version.complier = 0x01020100
```

JPEG Encode Library (jpege\_rx200\_little.lib)

```
#include "r_jpeg.h"
```

Version information of a Library

```
R_jpege_version.library[] =  
"JPEG Encode Library version 1.01 for the RX200 LITTLE endian.(Feb 18 2016, 21:08:15)"
```

Version information of a compiler

```
R_jpegd_version.complier = 0x01020100
```

### 2.6.4 RX200 (big endian)

JPEG File Compress Library (compress\_jpege\_rx200\_big.lib)

```
#include "r_compress_jpege.h"
```

Version information of a Library

```
R_compress_jpege_version.library[] =  
"JPEG File Compress Library version 1.00 for the RX200 BIG endian.(Sep 12 2013, 11:40:33)"
```

Version information of a compiler

```
R_expand_jpegd_version.complier = 0x01020100
```

JPEG Encode Library (jpege\_rx200\_big.lib)

```
#include "r_jpeg.h"
```

Version information of a Library

```
R_jpege_version.library[] =  
"JPEG Encode Library version 1.01 for the RX200 BIG endian.(Feb 18 2016, 21:08:22)"
```

Version information of a compiler

```
R_jpegd_version.complier = 0x01020100
```

### 3. Usage of Libraries

#### 3.1 Usage of JPEG File Compress library

Please link the library file to user application.

RX600 little endian:       jpege\_rx600\_little.lib, compress\_jpege\_rx600\_little.lib

RX600 big endian:         jpege\_rx600\_big.lib, compress\_jpege\_rx600\_big.lib

RX200 little endian:      jpege\_rx200\_little.lib, compress\_jpege\_rx200\_little.lib

RX200 big endian:        jpege\_rx200\_big.lib, compress\_jpege\_rx200\_big.lib

Please include the header files with library.

```
#include "r_compress_jpege.h"
```

#### 3.2 Usage of JPEG Encode Library

Please link the library file to user application.

RX600 little endian:       jpege\_rx600\_little.lib

RX600 big endian:         jpege\_rx600\_big.lib

RX200 little endian:      jpege\_rx200\_little.lib

RX200 big endian:        jpege\_rx200\_big.lib

Please include the header files with library.

```
#include "r_jpeg.h"
```

## 4. Adding Library to Your Project

The lib folder has all Libraries for RX Family. Add the required library for your project.

### 4.1 Adding Library to CS+ Project

Please refer to the Adding Firmware Integration Technology Modules to Projects.

- Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)

Adding Library

- (1) Adding FIT modules to projects.
- (2) Open: Project Tree >> File >> [FIT Module name] >> lib.
- (3) All Libraries will be linked for building. Please remove the Libraries excluding your needing libraries. Right click on the removed library file name, select "Remove from Project".

### 4.2 Adding Library to e<sup>2</sup> studio Project

Please refer to the Adding Firmware Integration Technology Modules to Projects.

- Adding Firmware Integration Technology Modules to Projects (R01AN1723)

Adding Library

- (1) Adding FIT modules to projects.
- (2) Right click on the project name in the Project Explorer, then choose "Properties" from the pop-up menu.
- (3) The "Properties" dialog is shown. The right side of this dialog changes as you select categories on the left. Select the following in order:  
"C/C++ Build" >> "Settings" >> "Linker" >> "Input"  
Click the "Add..." button.
- (4) Adding library.

## 5. 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.

**6. Software Update Information**

| <b>Package version</b> | <b>Date</b>  | <b>Description</b>                                 |
|------------------------|--------------|--|
| V.1.00 Release 00      | Mar 17, 2015 | First release                                      |
| V.1.01 Release 00      | Apr 01, 2016 | Updated version number with the xml file revision. |

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## Revision History

| Rev. | Date      | Description |                             |
|------|-----------|-------------|-----------------------------|
|      |           | Page        | Summary                     |
| 1.00 | Mar.17.15 | —           | First edition issued        |
| 1.01 | Apr.01.16 | —           | Update the xml file for FIT |



## 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. 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 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.

### 5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

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#### Renesas Electronics America Inc.

2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.  
Tel: +1-408-588-6000, Fax: +1-408-588-6130

#### Renesas Electronics Canada Limited

9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
Tel: +1-905-237-2004

#### Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: +44-1628-585-100, Fax: +44-1628-585-900

#### Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

#### Renesas Electronics (China) Co., Ltd.

Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

#### Renesas Electronics (Shanghai) Co., Ltd.

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

#### Renesas Electronics Hong Kong Limited

Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852 2886-9022

#### Renesas Electronics Taiwan Co., Ltd.

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

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80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

#### Renesas Electronics Malaysia Sdn.Bhd.

Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

#### Renesas Electronics India Pvt. Ltd.

No.777C, 100 Feet Road, HALII Stage, Indiranagar, Bangalore, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

#### Renesas Electronics Korea Co., Ltd.

12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5141