

## RX600 Series

R20AN0104EJ0100

Rev.1.00

## M3S-JPEGD-LIB: JPEG Decoder Introduction Guide

Jun 06, 2011

### Introduction

This material explains usage of M3S-JPEGD-LIB for the RX Family (hereafter JPEG decoder) and sample programs. JPEG decoder has two libraries.

JPEG decode library : Reverse DCT, Reverse Quantization, Huffman decoding.

Expand library : Expand JPEG data to bitmap data (16bit color, RGB565) using JPEG decoder library.

### Target Device

RX600 series

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## 1. Structure of product

- M3S-JPEGD-LIB V.2.01 Release00E
- M3S-JPEGD-LIB V.2.01 Release00E Introduction Guide (r20an0104ej0100\_rx\_jpegd.pdf)

part number of this product : R0MRX60JP0010RRC

Please execute setup.exe to install this product. And user has to confirm agreement displayed when user installs.

This product includes files below, but free evaluation version has some limitation of installed files.

**table.1 JPEG Decoder product files**

name	discription
<b>installer (setup.exe)</b>	For Windows installer. Installer will show the T4 product agreement. If user admits this agreement, installer will copy the T4 file to the path below. [Free evaluation version] C:\Renesas\an_r20an0104ej_rx_jpegd_v201r00 [Version for a fee] C:\Renesas\an_r20an0104ej_rx_jpegd_v201r00p
<b>document (doc)</b>	
r20an0104ej0100_rx_jpegd.pdf	Introduction Guide (this document)
r20uw0075ej0100_jpegd.pdf	User's Manual (*)
<b>library (lib)</b>	
jpegd_rx_little.lib, jpegd_rx_big.lib r_jpegd.h (*)	JPEG decode library and header file
expand_jpegd_rx_little.lib, expand_jpegd_rx_big.lib r_expand_jpegd.h	Expand library and header file
<b>sample data (sample)</b>	
jpegd_rx_sample directory	High-performance Embedded Workshop workspace for sample program
expand_jpegd_rx directory	Source code and development environment for Expand library (*)

(\*) Free evaluation version dose not have these files.

## 2. Specification of library

### 2.1 Structure of software stack

This figure explains structure of software stack of JPEG decoder.

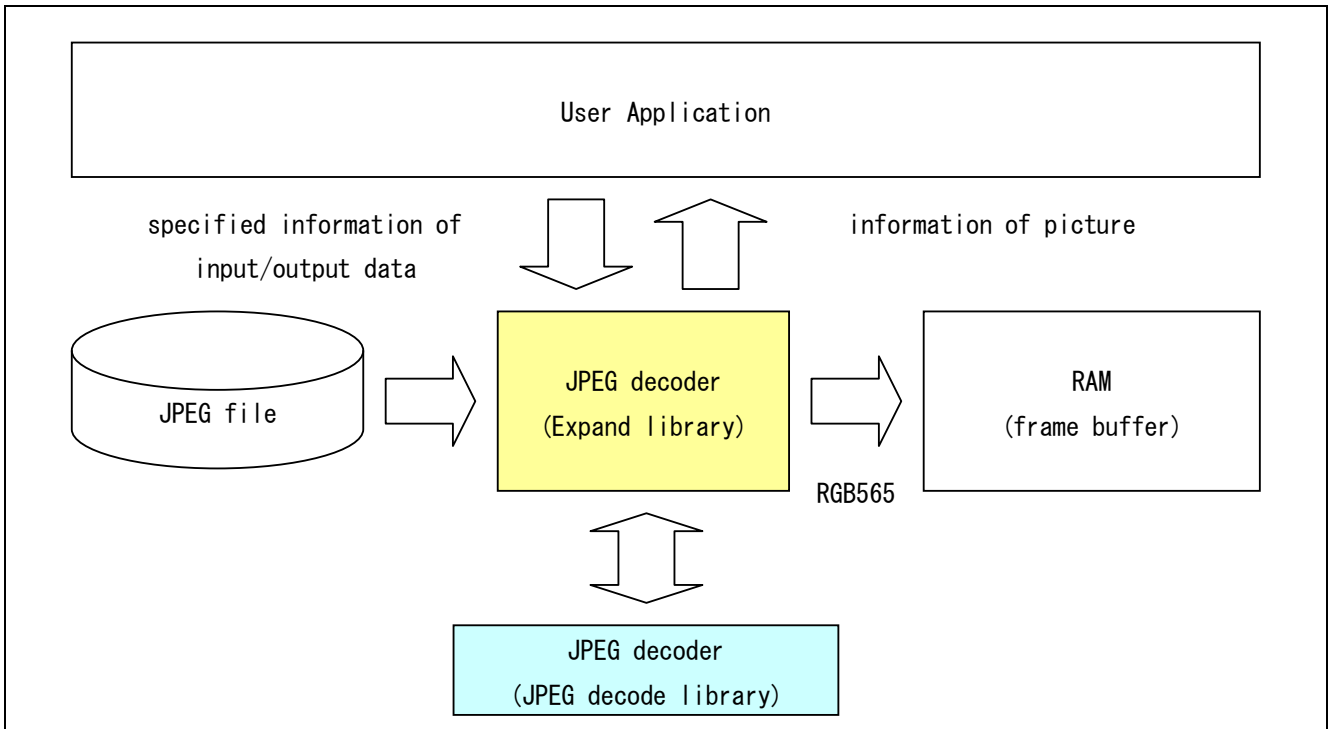


figure1. structure of software stack

### 2.2 Specification of Expand library

Free evaluation version has some limitation of installed files, user cannot directly access to JPEG decode library. So user can expand JPEG data using Expand library only. Specification of this Expand library is below.

table. 2.1 specification of 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 (1x2,1x1,1x1) 4:1:1 (2x2,1x1,1x1)
Output format	RGB565
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]

The following version of High-performance Embedded Workshop V.4.09.00

[C compiler]

The following version of C/C++ Compiler Package for RX Family V.1.01 Release 00

Library file is built with default compile option.

- compile option (little endian)

-cpu=rx600 -output=obj="\$(CONFIGDIR)\\$(FILELEAF).obj" -nologo

- compile option (big endian)

Adding “-endian=big” to default option.

## 2.4 Specification of API

Specification of JPEG decode library APIs are below.

**table.2.2 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_readRST	detect number of re-initialized decode
R_jpeg_decode_one_block	execute Huffman encoding
R_jpeg_IDCT	execute Reverse quantization and Reverse DCT

Refer to the JPEG decode library User's Manual to know details.

Specification of Expand library APIs are below.

**table.2.3 API (Expand library)**

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

### 2.4.1 R\_init\_jpeg

#### Description

This function initialize library.

#### Usage

```
#include <stdint.h>
#include "r_expand_jpegd.h"
void R_init_jpeg(void);
```

#### Parameters

none

#### Return Value

none

#### Remark

none

### 2.4.2 R\_expand\_jpeg

#### Description

This function expands JPEG file specified argument "input", and stores data formatted RGB565 (1 pixel = 2 bytes) to area specified argument "output". User specifies input data size to the argument "fsize".

Input JPEG data needs continuous memory area.

Output data area needs more size than expanded bitmap data.

User specified number of picture cells by 1 line in output area. For example, user specified value to argument "offset" 320, when the frame buffer has 320x240 (horizontal x vertical) pixels.

When the error occurred, this function would cancel processing and return with error code.

#### Usage

```
#include <stdint.h>
#include "r_expand_jpegd.h"
int16_t R_expand_jpeg(uint8_t *input, int32_t fsize, uint16_t *outptr, int32_t offset);
```

#### Parameters

input	Input	Pointer to head of input data
fsize	Input	Size of input data
outptr	Output	Pointer to output data
offset	Input	Number of picture cells by 1 line in output area

#### Return Value

0 (EXPAND_JPEGD_SUCCESS)	normal termination
not 0	error

#### Remark

none

### 2.4.3 R\_get\_info\_jpeg

#### Description

This function judges specified picture file is JPEG file or not.

If specified picture file is JPEG file, this function outputs picture size to argument “w”, and “h”.

If specified picture file is not JPEG file or has format error, this function would cancel processing and return with error code.

#### Usage

```
#include <stdint.h>
```

```
#include “r_expand_jpegd.h”
```

```
int16_t R_get_info_jpeg(const void *img, uint16_t *w, uint16_t *h);
```

#### Parameters

img	Input	Pointer to head of input data
w	Output	width of picture (number of pixel)
h	Output	height of picture (number of pixel)

#### Return Value

0 (EXPAND_JPEGD_SUCCESS)	normal termination
not 0	error

#### Remark

none

## 2.5 ROM size / RAM size / Stack size

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

**table.2.4 ROM/RAMsize**

kind	size		
	JPEG decode library	Expand library	total
ROM (section P,C)	about 4.7KB	about 9.0KB	about 13.7KB
RAM (section B)	0	about 5.9KB	about 5.9KB

**table.2.5 stack size (JPEG decode library)**

API function name	stack size [byte]
R_jpeg_make_huff_table	44
R_jpeg_add_iquant_table	8
R_jpeg_readRST	16
R_jpeg_decode_one_block	88
R_jpeg_IDCT	104

**table.2.6 stack size (Expand library)**

API function name	stack size [byte]
R_init_jpeg	4
R_expand_jpeg	264
R_get_info_jpeg	12

## 2.6 Version information

JPEG decoder has version information as strings. User can access this version information to use extern variable defined in header file.

define:

```
extern const uint8_t R_jpegd_version[];
extern const uint8_t R_jpegd_expand_version[];
```

JPEG decoder has version information showed below.

little endian:

```
"M3S-JPEGD-LIB version 2.01 for RX LITTLE endian.(Jun 6 2011, 09:05:05)"
```

```
"M3S-JPEGD-LIB(EXPAND) version 1.00 for RX LITTLE endian.(Jun 6 2011, 09:09:13)"
```

big endian:

```
"M3S-JPEGD-LIB version 2.01 for RX BIG endian.(Jun 6 2011, 09:04:54)"
```

```
"M3S-JPEGD-LIB(EXPAND) version 1.00 for RX BIG endian.(Jun 6 2011, 09:08:58)"
```

### 3. Usage of Libraries

#### 3.1 Usage of Expand library

Please link the library file to user application.

little endian:     jpegd\_rx\_little.lib, expand\_jpegd\_rx\_little.lib

big endian:        jpegd\_rx\_big.lib, expand\_jpegd\_rx\_big.lib

Please include the header files with library.

```
#include <stdint.h>
#include "r_expand_jpegd.h"
```

#### 3.2 Usage of JPEG decode library (Only version of fee)

Please link the library file to user application.

little endian:     jpegd\_rx\_little.lib

big endian:        jpegd\_rx\_big.lib

Please include the header files with library.

```
#include <stdint.h>
#include "r_jpegd.h"
```

## 4. Sample program

This sample program runs on RX simulator with High-performance Embedded Workshop. This sample program does not need any machine.

### 4.1 Outline

This sample program decodes the JPEG data stored internal ROM (section C\_JPEGDATA) and stores RGB565 formatted data to internal RAM (section B\_2).

Decoded data can be displayed at RX simulator. (Menu -> display -> graphic -> picture)

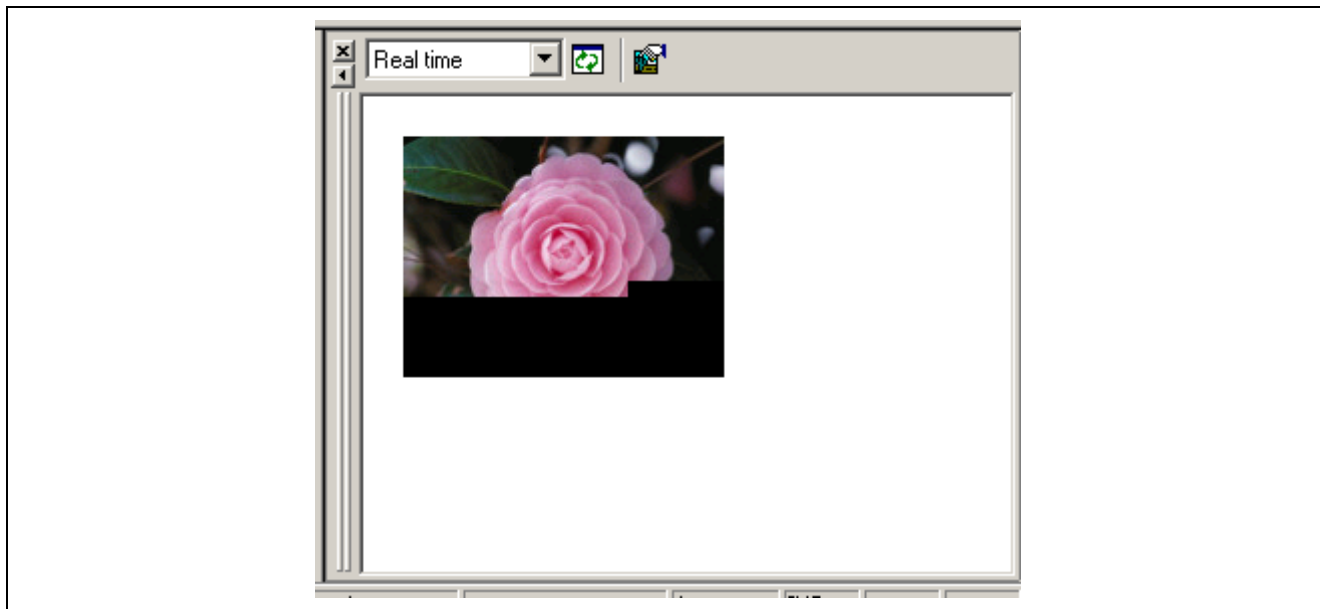


figure 4.1 display of data under JPEG decoding and expanding

This sample program repeats execution JPEG decode and clear displayed area. User can confirm steps under processing using “Realtime” settings to refresh. If this process would be slow, please use “Stop” and set breakpoint to “memset()” and go and wait.

## 4.2 Expand process

Following sample code shows JPEG decode main function. This main function judges picture format using `get_info_jpeg()` and reads picture size of width and height.

If the picture size is smaller than display area, the picture displayed on center of display area.

```
void main(void)
{
    uint16_t w, h;

    version = (uint8_t *)R_jpegd_expand_version;

    R_init_jpeg();
    if (R_get_info_jpeg(input_jpeg_file, &w, &h) == 0)
    {
        if ((w <= SCREEN_WIDTH) && (h <= SCREEN_HEIGHT))
        {
            while(1)
            {
                memset(out_picture, 0, sizeof(out_picture));
                R_expand_jpeg(input_jpeg_file, INPUT_SIZE,
                    &(out_picture[(SCREEN_HEIGHT - h)/2][(SCREEN_WIDTH - w)/2]),
                    SCREEN_OFFSET);
            }
        }
    }
}
```

### 4.2 main function

User can change pictures.

Meny -> Build -> RX Standard Toolchain -> Linker optimize -> category "input" -> binary file

Please do not set data to section "C\_JPEGDATA" excluding specified JPEG files, because this sample program automatic calculate JPEG size using this section size.

## 5. Notes

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

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## Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Jun.06.11	—	First edition issued

## General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

### 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.

### 5. Differences between Products

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.

- The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

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