

RX Family

JPEG Encoder Module

Firmware Integration Technology

R20AN0263EJ0101

Rev.1.01

Apr 01, 2016

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

Contents

1. Structure of product.....	3
2. Specification of library.....	4
2.1 Structure of software stack.....	4
2.2 Specification of JPEG File Compress Library.....	4
2.3 Development environment.....	5
2.4 Specification of API	6
2.5 ROM size / RAM size / Stack size.....	7
2.6 Version information	9
2.6.1 RX600 (little endian).....	9
2.6.2 RX600 (big endian).....	9
2.6.3 RX200 (little endian).....	10
2.6.4 RX200 (big endian).....	10
3. Usage of Libraries	11
3.1 Usage of JPEG File Compress library	11
3.2 Usage of JPEG Encode Library	11
4. Adding Library to Your Project.....	12
4.1 Adding Library to CS+ Project.....	12
4.2 Adding Library to e ² studio Project.....	12
5. Notes	13
6. Software Update Information.....	14

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 jpege_rx600_big.lib jpege_rx200_little.lib jpege_rx200_big.lib r_jpeg.h	JPEG Encode Library and header file
compress_jpege_rx600_little.lib compress_jpege_rx600_big.lib compress_jpege_rx200_little.lib compress_jpege_rx200_big.lib 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.

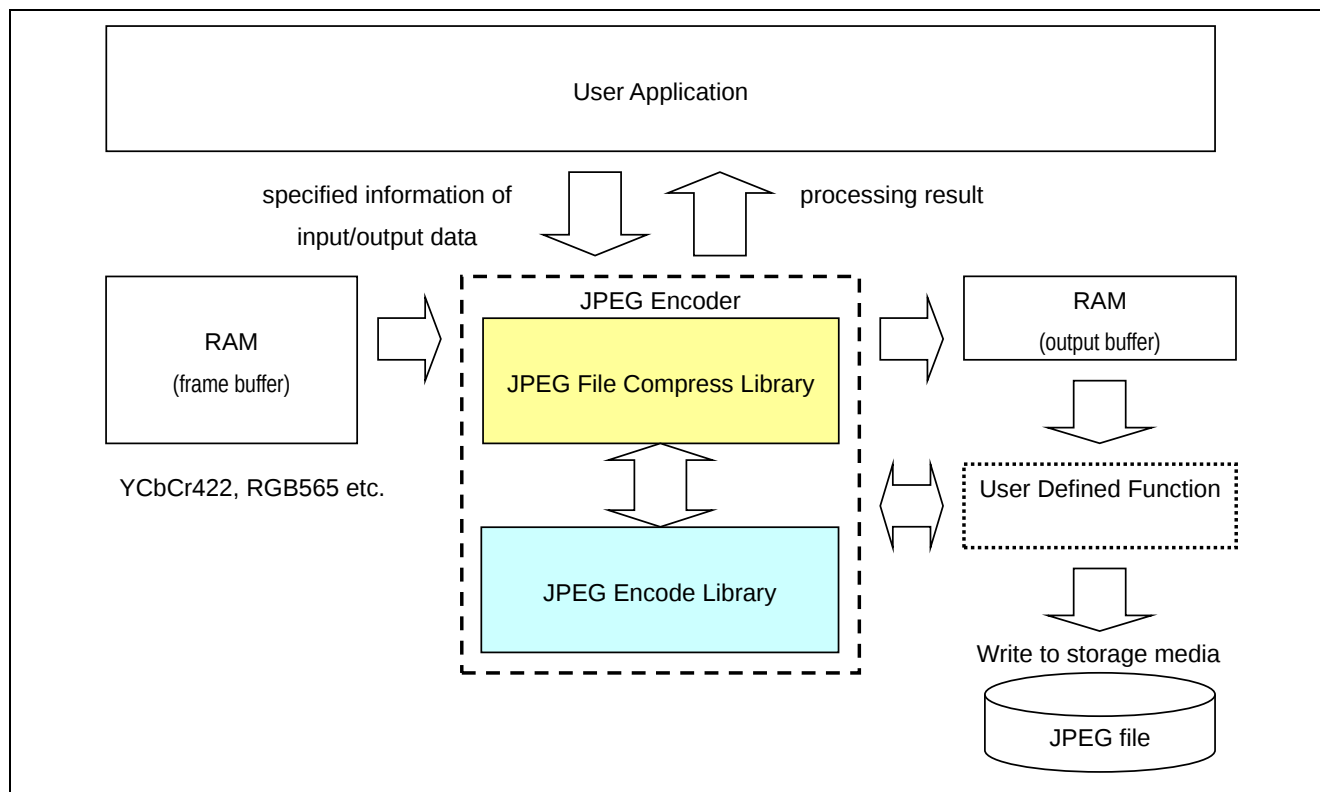


Figure 2.1 Structure of Software Stack

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 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
Input Image data	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.
	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

e²studio 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, Alignment	size [byte]	
			RX600, RX200 little endian	RX600, RX200 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	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 little endian	RX600, RX200 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 little endian	RX600, RX200 big endian
R_compress_jpeg	296	296

Table 2.7 Stack size (JPEG Encode Library)

API function name	stack size [byte]	
	RX600, RX200 little endian	RX600, RX200 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_jpegd_rx600_little.lib)

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

Version information of a Library

```
R_compress_jpegd_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 (jpegd_rx600_little.lib)

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

Version information of a Library

```
R_jpegd_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_jpegd_rx600_big.lib)

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

Version information of a Library

```
R_compress_jpegd_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 (jpegd_rx600_big.lib)

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

Version information of a Library

```
R_jpegd_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 e² 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 `fintr_register=0` (Fast interrupt vectorregister [None]). The default for this option is `fintr_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

Package version	Date	Description
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.

Website and Support

Renesas Electronics Website

<http://www.renesas.com/>

Inquiries

<http://www.renesas.com/contact/>

All trademarks and registered trademarks are the property of their respective owners.

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.

- The characteristics of Microprocessing unit or Microcontroller unit products in the same group but having a different part number may differ in terms of the 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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
3. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from such alteration, modification, copy or otherwise misappropriation of Renesas Electronics product.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; and safety equipment etc.

Renesas Electronics products are neither intended nor authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems, surgical implantations etc.), or may cause serious property damages (nuclear reactor control systems, military equipment etc.). You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application for which it is not intended. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for which the product is not intended by Renesas Electronics.
6. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You should not use Renesas Electronics products or technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. When exporting the Renesas Electronics products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, who distributes, disposes of, or otherwise places the product with a third party, to notify such third party in advance of the contents and conditions set forth in this document, Renesas Electronics assumes no responsibility for any losses incurred by you or third parties as a result of unauthorized use of Renesas Electronics products.
11. This document may not be reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.



SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "http://www.renesas.com/" for the latest and detailed information.

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

Renesas Electronics Singapore Pte. Ltd.

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