Introduction

These data describe the information on the demonstration which reproduces a sound using the Renesas Demonstration Kit for RL78G14 or the middleware evaluation board which is RL78/G14 64pin CPU board.

Audio data is stored in MMC formatted by FAT file system as a file. A file is audio voice compressed by ADPCM. A file is read from MMC using 3 lines serial I/O (CSI) of the serial array unit which RL78/G14 are a built-in circumference function. RL78/G14 read a file and elongates and a sound is reproduced with the sampling rate of 8 kHz, 11.025 kHz, 16 kHz, and 22.050 kHz.

This demonstration aims at offering the technical information for building a voice reproduction system relatively cheap. This demonstration is used combining the following middleware products and middleware evaluation boards. Moreover, the sample program is attached and which produce audio playback using the following middleware products.

<table>
<thead>
<tr>
<th>Function</th>
<th>Middleware Product Name</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio playback</td>
<td>M3S-S2-Tiny (abbr,S2)</td>
<td><a href="http://www.renesas.com/mw/s2">http://www.renesas.com/mw/s2</a></td>
</tr>
<tr>
<td></td>
<td>(Document No. :R20AN0122)</td>
<td></td>
</tr>
<tr>
<td>File system</td>
<td>M3S-TFAT-Tiny (abbr,TFAT)</td>
<td><a href="http://www.renesas.com/mw/tfat">http://www.renesas.com/mw/tfat</a></td>
</tr>
<tr>
<td></td>
<td>(Document No. :R20AN0159)</td>
<td></td>
</tr>
<tr>
<td>MMC driver(1)</td>
<td>SPI mode MultiMediaCard driver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Document No. :R20AN0158)</td>
<td></td>
</tr>
</tbody>
</table>

(Note 1)The SD(less 2GB size) card that has compatible command for MMC is available on this software.

Target Device

RL78/G14
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1. Application Note structure

Table 1 Application Note structure

<table>
<thead>
<tr>
<th>Folder/File</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>r20an0194ej0102_rl78_s2.pdf</td>
<td>Application Note (this document)</td>
</tr>
</tbody>
</table>

workspace

<table>
<thead>
<tr>
<th>Document(doc)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English(en)</td>
<td></td>
</tr>
<tr>
<td>r20an0194ej0102_rl78_s2.pdf</td>
<td>Application Note (this document)</td>
</tr>
<tr>
<td>Japanese(ja)</td>
<td></td>
</tr>
<tr>
<td>r20an0194jj0102_rl78_s2.pdf</td>
<td>Application Note</td>
</tr>
</tbody>
</table>

Sample Program (sample)

<table>
<thead>
<tr>
<th>For YRDKRL78G14(yrdkr78g14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS+ for CA</td>
</tr>
<tr>
<td>CS+ for CC</td>
</tr>
<tr>
<td>IAR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>For RL78G14 64pin CPU Board (rl78g14_board)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS+ for CA</td>
</tr>
<tr>
<td>CS+ for CC</td>
</tr>
<tr>
<td>IAR</td>
</tr>
</tbody>
</table>

Sound data (sound)

| adpcm_data.zip | sampling.txt and sample sound data(*.dat) |

Reference(ref)

<table>
<thead>
<tr>
<th>r20ut0684ej0010_rl78g14.pdf</th>
<th>RL78/G14 64pin CPU board schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>r20ut0685ej0010_rl78g14.pdf</td>
<td>RL78/G14 64pin CPU board User's Manual(English)</td>
</tr>
<tr>
<td>r20ut0685jj0010_rl78g14.pdf</td>
<td>RL78/G14 64pin CPU board User's Manual(Japanese)</td>
</tr>
</tbody>
</table>

Schematic_Design__RL78_MiddlewareEvaluation_Board-V3_2.pdf | Middleware Evaluation Board schematic |
2. Development Environment

Please use the same or a later version of the toolchain listed below:

2.1 Hardware

(Board 1)
Renesas Demonstration Kit for RL78G14  
Renesas (type : YRDKRL78G14)

(Board 2)
RL78/G14 64pin CPU Board  
Renesas (type : R0K50104LC000BR)
Middleware Evaluation Board  
Renesas

2.2 Software

2.2.1 CS+ for CA, CX

- Integrated Development Environment
  CS+ for CA,CX V3.00.01

- C compiler
  CA78K0R V1.71

- Code Generator tool
  CS+ for CA,CX Code Generator for RL78 V2.07

2.2.2 CS+ for CC

- Integrated Development Environment
  CS+ for CC V3.01.00

- C compiler
  CC-RL V1.01

- Code Generator tool
  CS+ for CC Code Generator for RL78 V2.07

2.2.3 IAR Embedded Workbench

- Integrated Development Environment and C compiler
  IAR Embedded Workbench for Renesas RL78 V.2.10.1

- Code Generator tool
  Applilet3 for RL78 V1.09.00  
  Renesas
3. Demonstration Manual (YRDKRL78G14)

3.1 System Block Diagram

【Note】SW3 is not used in this demonstration.

Fig.1 System block diagram

3.2 Demonstration Set in Appearance

Fig.2 Demonstration Set in Appearance
3.3 The List of Demonstration Parts Set

Table 1 The list of demonstration parts set

<table>
<thead>
<tr>
<th>Part name</th>
<th>Reference information</th>
</tr>
</thead>
<tbody>
<tr>
<td>YRDKRL78G14</td>
<td>It is supplied with Renesas Demonstration Kit for RL78G14.</td>
</tr>
<tr>
<td>USB Cable</td>
<td>Reference</td>
</tr>
<tr>
<td>Micro SD Card (smaller than 2GB)</td>
<td>Need the command compatibility for the Multi Media Card. Please purchase separately.</td>
</tr>
<tr>
<td>AC adapter(DC5V center plus)</td>
<td>It is not necessary if user connects PC to Board using USB cable directly. Please buy this if necessary.</td>
</tr>
</tbody>
</table>

【Note】Website of Renesas Demonstration Kit for RL78G14
http://am.renesas.com/products/tools/introductory_evaluation_tools/renesas_demo_kits/yrdkr/78g14/index.jsp
Support page of Renesas Demonstration Kit for RL78G14
http://renesasrulz.com/?loc=US

3.4 Setup

3.4.1 Adjust parts on RL78/G14 CPU Board

Please confirm switch and jumper pin settings on board.

- SW5-1 : ON
- SW5-2 : OFF
- JP1: 2-3 short
- JP2: 2-3 short
- JP3: 2-3 short

3.4.2 Program Writing

- Start the project file for CS+ or IAR workspace file sample code(workspace\sample\yrdkrl78g14) of this data attachment
- YRDKRL78G14 is connected with PC by USB cable.
- Build the project.
- Write the generated object file.
3.4.3 Connection Check
- Micro SD card is inserted in the SD card socket.
- Confirm that LCD display module displays as "RENESAS RL78DEMO."

3.4.4 Prepare ADPCM Data
Using ADPCM TOOL of S2 attachment, ADPCM file is generated from WAVE file. Refer to ADPCM TOOL description (r21an0002jj0100_adpcm_tool.pdf) for the directions for ADPCM TOOL. Please save the generated ADPCM file at the root directory of MMC. Please set ".dat" to extension of ADPCM file. ".dat" is default output format of ADPCM TOOL.

In this demonstration, the sampling rate of ADPCM is based on the information read in the text file saved at the root directory of MMC. When you prepare ADPCM data, please store a sampling rate configuration file (sampling.txt) in the root directory of MMC. Please indicate the sampling rate at the time of a file name and reproduction in the following formats in a sampling rate configuration file. The sampling rate which can be indicated is four kinds, 8 kHz, 11.025 kHz, 16 kHz, and 22.050 kHz. Please write value to the “sampling.txt” if 8kHz = “08k”, 11.025kHz = “11k”, 16kHz = “16k”, 22.050kHz = “22k”.

ADPCM data sample is in the Zip file “sound/adpcm_data.zip”.

Format:<ADPCM file name><space> <Sampling rate><Line feed code”LF”>

<table>
<thead>
<tr>
<th>08k adpcm1.dat</th>
<th>Contents of MMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>11k adpcm2.dat</td>
<td></td>
</tr>
<tr>
<td>16k adpcm3.dat</td>
<td></td>
</tr>
<tr>
<td>22k adpcm4.dat</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

Fig.3 The example of a sampling rate configuration file

Notice:
If user uses Windows PC, the Line feed code is “CRLF”.
When edits “Sampling.txt”, please adjust the Line feed code to “LF” using function of text editor.
3.5 Operation method

3.5.1 File selection and voice reproduction

Display explanation of LCD display module

Selection of a file and voice reproduction are performed using SW1 and SW2 on board. The LCD display module shows the character string for 10 seconds "RENESAS <line break> RL78DEMO" after starting.

This demo status moves to record mode when push the SW1 during this 10 seconds.

And moves to playback mode when push the SW2 during this 10 seconds, or passes 10 seconds.
3.5.2 Compression mode

Display explanation of LCD display module

Selection of a file and voice Compression are performed using SW1 and SW2 on board. An eight-line display is possible for LCD display module, and it displays title on the 1\textsuperscript{st} and 2\textsuperscript{nd} line, the file name (without extension display) on the 3\textsuperscript{rd} line, and the state of the sampling rate, and demonstration to the 4\textsuperscript{th} line, and the state of demonstration to the 5\textsuperscript{th} line.

<table>
<thead>
<tr>
<th>File name:</th>
<th>Times New Roman</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling rate</td>
<td>8k/16k</td>
</tr>
<tr>
<td>Demo Status:</td>
<td>REC:SW2 / RECORD /REC ERR</td>
</tr>
</tbody>
</table>

During play display, the character of RECORD blinks for every second.

During demonstration

Unplug MMC: In under reproduction, it displays "NO CARD" promptly after error detection.

In under stop, it displays "NO CARD".

Plug MMC: Display file list

W1, SW2 operate explanation

SW1: Change the sampling late>

Push SW1: Set the sampling rate to 8kHz or 16kHz when recording.

SW2: Start/Stop recording operation>

Push SW2 Start recording using displayed sampling rate.

*Save to the SD card and stop recording when push the SW2 in recording.
### 3.5.3 File selection and voice reproduction mode

**Display explanation of LCD display module**

Selection of a file and voice reproduction are performed using SW1 and SW2 on board.

When this demo status moves to playback mode, the file list of root directories of MMC is displayed. A two-line display is possible for LCD display module, and it displays the selected file name (without extension display) on the 1st line and the state of the sampling rate and demonstration to the 2nd line.

![Display image of files list](image)

- **Sampling rate**
  - 8k/11k/16k/22k

- **Status of demonstration**
  - Stop/Play/Err

  During play display, the character of play blinks for every second.

**Fig.4 The display image of files list**

**The LCD display module showing at the time of MMC plug**

- **<Initial status>**
  - Starts where MMC is put: Title display → File list display
    - There is no sampling.txt, or sampling.txt is illegal format, display “NO CARD”
  - Starts where MMC is extracted: Title display → Display "NO CARD"

- **<During demonstration>**

  Unplug MMC: In under reproduction, it displays "NO CARD" promptly after error detection.
  - In under stop, it displays "NO CARD".

  Plug MMC: Display file list

**SW1, SW2 operate explanation**

- **<SW1 : List operation>**
  - SW1 press: Read 1 piece of file information from MMC and then update the display.

- **<SW2 : Voice reproduction / stop operation>**
  - SW2 press: A file on display is reproduced.
    - When SW2 is pushed during reproduction, the file under reproduction is stopped and a file on display is reproduced.
    - When you want to stop reproduction, please push reset.
3.6 **Change the sound output functions.**

This demo plays the sound using D/A output or PWM output.

This demo’s (board/software) default setting is D/A output.

It is possible to use the PWM output when user changes the YRDKRL78G14 jumper settings and software settings.

Followings are the changing point.

**[Jumper settings in Board]**

- JP1: 1-2 short

**[Software settings]**

Open the “src/sample\r_s2_driver.h” and change the SOUND_OUTPUT_MODULE macro to SOUND_PWM

```c
//define SOUND_OUTPUT_MODULE  SOUND_DA
#define SOUND_OUTPUT_MODULE  SOUND_PWM
```
4. Demonstration Manual (RL78/G14 64pin CPU Board)

4.1 System Block Diagram

[System Block Diagram Image]

**[Note]** SW3 is not used in this demonstration.

Demonstration Set in Appearance

![Demonstration Set in Appearance Image]

**Fig. 1. System block diagram**

**Fig. 2 Demonstration Set in Appearance**
4.2 The List of Demonstration Parts Set

<table>
<thead>
<tr>
<th>Part name</th>
<th>Reference information</th>
</tr>
</thead>
<tbody>
<tr>
<td>RL78/G14 64pinCPU board</td>
<td>Please contact Renesas customer support.</td>
</tr>
<tr>
<td>LCD display module</td>
<td>Please purchase separately.</td>
</tr>
<tr>
<td>Middleware evaluation board for RL78/G14</td>
<td>Please purchase separately.</td>
</tr>
<tr>
<td>MultimediaCard</td>
<td>Please purchase separately.</td>
</tr>
<tr>
<td>Phillips screwdriver for volume operation</td>
<td>Please purchase separately.</td>
</tr>
<tr>
<td>E1 emulator</td>
<td>Please purchase separately.</td>
</tr>
<tr>
<td>AC adapter(DC5V center plus)</td>
<td>Please purchase separately.</td>
</tr>
</tbody>
</table>

4.3 Setup

4.3.1 Adjust parts on RL78/G14 64pin CPU Board

Sample code that is included this application note is confirmed working on RL78/G14 64pin CPU board and Middleware evaluation board. Please adjust each parts on RL78/G14 64pin CPU board like below.

- Remove R60, Implement R63, for MMC connection
- Remove R52, Implement R55, for MMC connection
- Remove R71, Implement R74, for MMC connection
- Remove R51, Implement R54, for MMC connection
- Implement JA1, JA2 connector, for Middleware evaluation board connection
- Short R21, for Middleware evaluation board 3.3 power supply
- Short J13 (2-3), for select regulator output
- Open J10, for select regulator output 3.3V power supply
- Short JP1 (on Middleware evaluation board) to PWM-center

4.3.2 Program Writing

- Start the project file for CS+ sample code of this data attachment (OOO.mtpj)
- RL78/G14 64pin CPU board is connected with PC by E1 emulator.
- Build the project.
- Write the generated object file.
4.3.3 Connection Check

- RL78/G14 64pin CPU board and JA1 and JA2 of a middleware evaluation board are connected. MMC is inserted in the MMC socket of middleware evaluation board.
- LCD display module is inserted in LCD display module socket of middleware evaluation board.
- An AC/DC adaptor is inserted in 5VDC connector of RL78/G14 64pin CPU board.
- Confirm that LCD display module displays as "RENESAS RL78DEMO."

4.3.4 Prepare ADPCM Data

Please refer to the section 3.3.4.
4.4 Operation method
Operation method is same with YRDKRL78G14, please refer to the section 3.4.
This section shows difference of displays.

4.4.1 File selection and voice reproduction
No difference from YRDKRL78G14

4.4.2 Compression mode
An two-line display is possible for LCD display module.
When stop the recording, sampling rate is in the 1st line, demo status (REC:SW2) is in 2th line.
When recording, file name is in the 2nd line, demo status (RECORD).

<table>
<thead>
<tr>
<th>Sampling rate</th>
<th>Demo status</th>
</tr>
</thead>
<tbody>
<tr>
<td>8k/16k</td>
<td>REC:SW2</td>
</tr>
</tbody>
</table>

Fig 4 Image of the demo status "stop recording"

<table>
<thead>
<tr>
<th>File name</th>
<th>Demo status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RECORD /REC ERR</td>
</tr>
</tbody>
</table>

File name:
Continued number from zero

Demo Status:
RECORD /REC ERR

Fig 5 Image of the demo status "recording"
4.4.3 **File selection and voice reproduction mode**

A two-line display is possible for LCD display module, and it displays the selected file name (without extension display) on the 1st line and the state of the sampling rate and demonstration to the 2nd line.

<table>
<thead>
<tr>
<th>&lt;File name&gt;</th>
<th>&lt;Sampling rate&gt;</th>
<th>&lt;Demo status&gt;</th>
</tr>
</thead>
</table>

**Sampling rate:**
- 8k/11k/16k/22k

**Status of demonstration**
- Stop/Play/Err
- During play display, the character of play blinks for every second.

**Fig.4 The display image of files list**

4.5 **Volume adjustment of a reproduction sound**

The volume of voice reproduction can be adjusted by operating VR switch(VR2) on a middleware evaluation board.

**Fig 5. Reproductive volume methods for coordination**

4.6 **Arrange the volume when recording.**

The volume of voice can be adjusted by operating VR switch(VR1) on a middleware evaluation board.

4.7 **Change the sound output functions**

RL78/G14 64pin board has no D/A output functions, so only use PWM output.
5. Notes

5.1 Notes of Applilet3 output code

In IAR Embedded Workbench application project, the error will occur. The error is conflict the standard data type between "r_stdint.h" (renesas middleware header file) and "r_cg_macrodriver.h" (Applilet3 output file).

This means the standard data type file stdint.h included by r_stdint.h has different data type that "r_cg_macrodriver.h" defines.

So, we prepare the fixed "r_cg_macrodriver.h" for no conflict.

Please over-write "r_cg_macrodriver.h" to the same name file that is in application project from IAR sample program folder "IAR\code_generator\user_src".

5.2 For about tentative measure for IAR compile bug

The compiler used in the development setting in this application project is reported some bugs from IAR.

Please refer to the following IAR website that shows details.

IAR systems : New versions and product updates

And, Renesas issues technical update for about IAR compiler.

Renesas : IDEs and Project Managers

Document title : Operating Precautions IAR Embedded Workbench for RL78 V2.xx
Document No. : R20UT3407

S2 library is applied tentative measure for this issue.

• Some instructions that have one operand of type imm[BC] can in some cases generate wrong offsets to BC if the offset is a constant (not a label). [EW25763]

This tentative measure has effective for user used compiler version.

• User uses V2.10.1
  Needed tentative measure. Please use S2 library in “no change”.

• User uses version other than the above
  There is a possibility that a compiler is fixed.
  Not needed tentative measure. Please delete the tentative measure code.
  Please update S2 library code like following.
adpcm_encoder_rl78.s87 : line 131-162

_R_adpcm_initEnc:

push bc
push de

movw bc, ax
clrwax

; movw 0800H[bc], ax ;Source code for IARRL78 V2.10.1
movw 0008H[bc], ax ;Source code for IARRL78 V2.1x or Later
versions

; mov a, #2 ;Source code for IARRL78 V2.10.1
; mov 0A00H[bc], a ;Source code for IARRL78 V2.10.1
mov 000AH[bc], #2 ;Source code for IARRL78 V2.1x or Later
versions

movw ax, #2*2
addw ax, #LWRD(adpcm_stepsizeTable)
movw de, ax
movw ax, [de]

; movw 0C00H[bc], ax ;Source code for IARRL78 V2.10.1
movw 000CH[bc], ax ;Source code for IARRL78 V2.1x or Later
versions

pop de
pop bc

ret
Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/contact/

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## Revision History

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Page</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.02</td>
<td>Oct 01, 2015</td>
<td>—</td>
<td>Changed CubeSuite+ to CS+ for CA,CX</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supported CS+ for CC.</td>
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<tr>
<td>1.01</td>
<td>Sep 01, 2014</td>
<td>—</td>
<td>Added sample program for YRDKRL78G14</td>
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<td></td>
<td>Supported IAR Embedded Workbench</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Added RECORD function</td>
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<tr>
<td>1.00</td>
<td>Nov 09, 2012</td>
<td>—</td>
<td>First edition issued</td>
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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.
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SALES OFFICES
Renesas Electronics Corporation http://www.renesas.com

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Renesas Electronics America Inc.
2901 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 8300 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dulux Meadow, Micklewood Road, Bourns End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadistrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709, Quantan Plaza, No.27 Zhichun Lu, Haidian District, Beijing 100191, P.R.China
Tel: +86-10-6233-1155, Fax: +86-10-6233-7879

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 335 Lingsao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2228-8988, Fax: +86-21-2228-0999

Renesas Electronics Hong Kong Limited
Unit 1901-1911, 19FL, Tower Z, Grand Century Place, 193 Prince Edward Road West, Mong kok, Kowloon, Hong Kong
Tel: +852-2265-6888, Fax: +852-2886-0022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 389, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
93 Bendemeer Road, Unit 9/19-02 Jurong Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Ampros, Ampros Trade Centre, No. 18, Jln Persiaran Barat, 46050 Pataling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9100

Renesas Electronics India Pvt. Ltd.
No.777C, 190 Feet Road, HALII Silage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
12F, 334 Toehang-ro, Gangnam-gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

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