To our customers,

Old Company Name in Catalogs and Other Documents

On April 1\textsuperscript{st}, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

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

April 1\textsuperscript{st}, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)
Send any inquiries to http://www.renesas.com/inquiry.
Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.

2. 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.

3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.

4. 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.

5. When exporting the 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. You should not use Renesas Electronics products or the 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. 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.

6. 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.

7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depend on the product’s quality grade, as indicated below. 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 categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. 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 an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheet.

“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.

“High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

“Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.

8. 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.

9. 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 system manufactured by you.

10. 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.

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.
Introduction

This application note describes the controller area network module (RCAN-TL1) and provides an example of its application to remote frame transmission.

Target Devices

SH7263 and SH7203 Groups

Contents

1. Introduction ................................................................................................................... 2
2. Description of the Sample Application ......................................................................... 3
3. Sample Program ............................................................................................................. 11
4. Documents for Reference ............................................................................................ 16
1. Introduction

1.1 Specifications
- Transfer rate: 500 kbps
- Mailbox for transmission: Mailbox 1
- Mailbox for reception: Mailbox 0
- Remote frame for transmission is as follows.
  IDE: 0 (standard format) and data length code (DLC): 2
- Received data frame is as follows.
  IDE: 0 (standard format), data length code (DLC): 2, and data: H'C1C2

1.2 Module Used
- Controller area network (RCAN-TL1): 1

1.3 Applicable Conditions
- MCU SH7263/SH7203 (R5S72630/R5S72030)
- Clock operating mode 3 (the input from the USB_X1 pin is in use as the clock source)
- Operating frequency
  Internal clock: 192 MHz
  Bus clock: 48 MHz
  Peripheral clock: 24 MHz
- C compiler: SuperH RISC engine family C/C++ compiler package Ver.9.01Release01
  from Renesas Technology
- Compiler options:
  -cpu=sh2a -debug -gbr=auto -global_volatile=0 -opt_range=all -infinite_loop=0
  -del_vacant_loop=0 -struct_alloc=1

1.4 Related Application Note
None
2. Description of the Sample Application

This sample program employs the RCAN-TL1 module to transmit a remote frame (DLC: 2) in standard format (IDE: 0) and receive a data frame in standard format (IDE: 0).

2.1 Overview of Operations by the Module Used

The SH7203 CPU has two internal RCAN-TL1 modules that support CAN2.0B and comply with ISO-11898.

The RCAN-TL1 module has 32 programmable mailboxes, each supporting a reception filter mask, and a 16-bit timer function, providing for highly flexible communications. Figure 1 shows the structure of the RCAN-TL1 module. For details on the module, refer to the section on the controller area network in the SH7203 Group Hardware Manual.

![Figure 1 Structure of the RCAN-TL1 Module](image-url)
2.2 Procedure for Setting the Module Used

This section describes initial settings for the transmission of remote frames by the RCAN-TL1 module.

Initial settings of the module are made in reset mode (configuration mode). On subsequent release from reset mode, the RCAN-TL1 module participates in CAN-bus activity. In initial settings in this sample program, one mailbox is set for transmission and reception respectively. Figures 2 and 3 show examples of the flow of initialization for the RCAN-TL1 module. For details on settings made to individual registers, refer to the SH7203 Group Hardware Manual.

![Diagram of Initialization Flow for the RCAN-TL1 Module]

- **Setting bit configuration register 0 (BCR0)**
  BRP[7:0] (baud rate pre-scaler) is set to 0000 0001.
  [Function] One time quantum is set as 4 cycles of the peripheral bus clock.
  Given TSG1 and TSG2 as indicated above, the transfer rate is 500 kbps (refer to 2.3, Bit Configuration and Transfer Rate).

- **Setting bit configuration register 1 (BCR1)**
  TSG1[3:0] (time segment 1) is set to 0110 (7 time quanta).
  TSG2[2:0] (time segment 2) is set to 011 (4 time quanta).
  SJW[1:0] (resynchronization jump width) is set to 00 (4 time quanta).
  [Function] Large-scale shifting of the sampling point is prevented.

- **Setting the interrupt mask (IMR)**
  [Function] Interrupts corresponding to all bits in the interrupt request register (IRR) are masked.

- **ID reorder (MCR)**
  The MCR15 (ID Reorder) bit is set.
  [Function] Configuration of bits: STDID, RTR, IDE, and EXTID of message control and local acceptance filter mask can be set up to the HCAN2-compatible configuration.

- **Setting reset request (MCR)**
  The MCR0 (Reset Request) bit is set to 1.
  [Function] Transition to reset mode is made.

- **Enabling clock supply to the RCAN (STBCR5)**
  The MSTP52 (Module Stop 52) bit is set to 0.
  [Function] Clock is supplied to RCAN1.

- **Setting standby control register 5 (STBCR5).**
  [Function] Clock is supplied to RCAN1.

Figure 2 Example of Initialization Flow for the RCAN-TL1 Module (1)
Setting master control register (MCR)

MCR0 (reset request) is cleared.

[Function] Reset mode request is cleared.

MCR1 (halt request) is cleared.

[Function] Halt mode request is cleared.

Clearing interrupt request register (IRR)

IRR0 to IRR15 are cleared.

[Function] All interrupt flags are cleared, including the flag for the soft reset.

Setting message control (MB[1].CONTROLx)

IDE (identifier extension bit) is set to 0.

[Function] Selects standard format.

RTR (remote transmission request bit) is set to 1.

[Function] Remote frame is set.

STDID[10:0] (standard identifier) is set to 0.

[Function] ID = 0

MBC [2:0] (mailbox configuration) is set to 000.

[Function] Enables the transmission of remote frames and data frames from mailbox 1.

Clearing the RAM area of mailbox 0.

Clearing the RAM area of mailbox 1.

Clearing interrupt request register (IRR)

IRR0 to IRR15 are cleared.

[Function] All interrupt flags are cleared, including the flag for the soft reset.

Setting master control register (MCR)

MCR0 (reset request) is cleared.

[Function] Reset mode request is cleared.

MCR1 (halt request) is cleared.

[Function] Halt mode request is cleared.

Figure 3 Example of Initialization Flow for the RCAN-TL1 Module (2)
2.3 Bit Configuration and Transfer Rate

One-bit time for the CAN module has the four segments indicated below.

(1) Synchronization segment (SS)
(2) Propagation time segment (PRSEG)
(3) Phase buffer segment 1 (PHSEG1)
(4) Phase buffer segment 2 (PHSEG2)

Furthermore, the individual segments are structured in units of a base time called the time quantum (Tq). Figure 4 shows an example of the configuration of a bit in the case where SS = Tq, PRSEG = 3Tq, PHSEG1 = 4Tq, and PHSEG2 = 4Tq.

![Figure 4 Configuration of One-Bit Time](image)

In the RCAN-TL1, the Tq of PRSEG + PHSEG1 is set to TSG1[3:0] in bit configuration register 1 (BCR1) and the Tq of PHSEG2 is set to TSG2[2:0] (Tq = set value + 1). Additionally, the number of cycles of the peripheral-bus clock corresponding to 1Tq is set in BRP[7:0] of bit configuration register 0 (BCR0).

In the following description, BRP[7:0], TSEG1[3:0] and TSEG2[2:0] indicate the register settings, and BRP, TSEG1, TSEG2, and SJW indicate the values that correspond to these register settings. For the values corresponding to the values set in registers, refer to the section on the controller area network in the SH7203 Group Hardware Manual.

By definition, Tq for the RCAN-TL1 module is 1Tq = 2 × (BRP[7:0] + 1)/peripheral bus clock, and the transfer rate is calculated as follows.

\[
\text{Transfer rate} = \frac{\text{peripheral bus clock}}{(2 \times (\text{BRP}[7:0] + 1) \times \text{the number of Tq in 1-bit time})} = \frac{\text{peripheral bus clock}}{(2 \times (\text{BRP}[7:0] + 1) \times ((\text{TSEG1}[3:0] + 1) + (\text{TSEG2}[2:0] + 1) + 1)}
\]

The following restrictions apply to settings of the bit-configuration registers.

- TSEG1 (Min) > TSEG2 ≥ SJW (Max) (SJW = 1 to 4)
- SJW: Jump width for resynchronization. This segment is used to correct phase errors by extending phase buffer segment 1 or shortening phase buffer segment 2.
- \(8 \leq \text{TSEG1} + \text{TSEG2} + 1 \leq 25 \text{ time quanta}\)
- TSEG2 ≥ 2

Since the settings in this sample program are as follows: peripheral bus clock = 24 MHz, BRP[7:0] = 1, TSEG1[3:0] = 6, TSEG2[2:0] = 3, the transfer rate is calculated with the following formula.

\[
\text{Transfer rate (bps)} = \frac{24 \text{ M} \times 2 \times (1+1) \times (6 + 1) + (3 + 1) + 1)}{= 500 \text{ k}}
\]
2.4 Operation of the Sample Program

In this sample program, a remote frame (DLC: 2) in standard format (IDE: 0) is transmitted from mailbox 1 once and then a data frame in standard format (IDE: 0) is received in mailbox 0 at a transfer rate of 500 kbps. Figure 5 shows the waveform for remote frame transmission.

![Waveform for Remote Frame Transmission by the RCAN-TL1](image)

- **SOF (Start of frame)**: Indicates start of data frame and remote frame.
- **ID (Identifier)**: Indicates priority of data.
- **RTR (Request for remote transmission)**: Indicates distinction between data frame and remote frame.
- **IDE (Identifier extension)**: Indicates distinction between standard format and extended format.
- **r0**: Reserved bit
- **DLC (Data length code)**: Indicates the number of bytes in the data field. Setting range: 0 to 8 bytes
- **CRC sequence**: This value is used to check frames.
- **CRC delimiter**: This bit is used to delimit the CRC field and ACK field.
- **ACK slot**: The receiving unit is dominant, and overwrites this when no errors are detected in a transmitted message.
- **ACK delimiter**: This bit is used to delimit the ACK field and EOF.
- **EOF (End of frame)**: Indicates the end of the frame.

**Figure 5** Waveform for Remote Frame Transmission by the RCAN-TL1
## 2.5 Processing Procedure by the Sample Program

Tables 1 and 2 give an example of the settings for the controller area network (RCAN-TL1). Figures 6 and 7 show an example of the flow of processing by this sample program.

### Table 1  Register Settings for Controller Area Network (RCAN-TL1) (1)

<table>
<thead>
<tr>
<th>Register Name</th>
<th>Address</th>
<th>Setting Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby control register (STBCR5)</td>
<td>H'FFFFE 0410</td>
<td>H'FB</td>
<td>• MSTP52 = 0: RCAN1 runs</td>
</tr>
<tr>
<td>Master control register_1 (MCR_1)</td>
<td>H'FFFFF 0800</td>
<td>H'0001</td>
<td>• MCR0 = 1: Reset mode transition request</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H'8001</td>
<td>• MCR15 = 1: RCAN-TL1 is not the same as HCAN2</td>
</tr>
<tr>
<td>Interrupt mask register_1 (IMR_1)</td>
<td>H'FFFF 080A</td>
<td>H'FFFF</td>
<td>• Enables all interrupts of RCAN1</td>
</tr>
<tr>
<td>Bit configuration register 1_1 (BCR1_1)</td>
<td>H'FFFF 0804</td>
<td>H'6300</td>
<td>• TSG1[3:0] = 0110: PRSEG + PHSEG1 = 6 Tq</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• TSG2[2:0] = 011: PHSEG2 = 4 Tq</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• SJW = 0: SJW = 2 Tq</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• BSP = 0: Bit sampling at one point</td>
</tr>
<tr>
<td>Bit configuration register 0_1 (BCR0_1)</td>
<td>H'FFFF 0806</td>
<td>H'0001</td>
<td>BRP[7:0] = 1: 1 Tq = 4 × Pφ</td>
</tr>
<tr>
<td>Message control field (MB[0].CONTROL1_1)</td>
<td>H'FFFF 0910</td>
<td>H'0200</td>
<td>MBC[2:0] = 010: Enables reception of data frames and remote frames</td>
</tr>
</tbody>
</table>

### Table 2  Register Settings for Controller Area Network (RCAN-TL1) (2)

<table>
<thead>
<tr>
<th>Register Name</th>
<th>Address</th>
<th>Setting Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message control field (MB[1].CONTROL1_1)</td>
<td>H'FFFFF 0942</td>
<td>H'0002</td>
<td>• MBC[2:0] = 000: Enables transmission of data frames and remote frames.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• DLC[3:0] = 0010: 2-byte data length</td>
</tr>
<tr>
<td>Message control field (MB[1].CONTROL0_1)</td>
<td>H'FFFFF 0932</td>
<td>H'4000 0000</td>
<td>IDE = 0: Standard format</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RTR = 0: Remote frame</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>STDID[10:0] = 0: Standard ID = 0</td>
</tr>
<tr>
<td>Local acceptance filter mask_1 (MB[1].LAFM_1)</td>
<td>H'FFFF 0904</td>
<td>H'0000 0000</td>
<td>Clear: MASK is not set</td>
</tr>
<tr>
<td>Transmit pending register_1 (TXPR_1)</td>
<td>H'FFFF 0820</td>
<td>H'0000 0002</td>
<td>TXPR[31:0] = H'0000 0002: Generates a transmission request in mailbox 1</td>
</tr>
<tr>
<td>Transmit acknowledge register 0_1 (TXACK0)</td>
<td>H'FFFF 0832</td>
<td>H'0002</td>
<td>Clears the transmit acknowledge flag</td>
</tr>
<tr>
<td>Data frame receive pending register 0_1 (RXPR0)</td>
<td>H'FFFF 0842</td>
<td>H'0001</td>
<td>Clears the data frame reception-completed flag</td>
</tr>
</tbody>
</table>
main function

Setting of pin function controller (PFC): io_init_pfc();

Initialization of controller area network (RCAN-TL1): io_init_can();

Transmission of remote frame: io_remote_send();

Reception of data frame: io_remote_receive();

Setting of pin function controller

Set the port-B control register (to select CRx1 and CTx1 pin functions).

END

Figure 6  Example of Flow of Processing by the Sample Program (1)
Transmission of remote frame

Set the remote frame (IDE = 0, data length = 2 bytes, remote frame, LAFM = 0).

Is writing in mailbox enabled? (TXPR = 0?)

Yes

Set request to transmit the remote frame.

Completion of transmission? (TXACK0 = 1?)

No

Clear the transmission-completed flag (TXACK0).

Yes

Completion of reception? (RXPR0 = 1?)

No

Clear the data frame reception-completed flag (RXPR0).

Yes

Confirm received data.

END

Figure 7  Example of Flow of Processing by the Sample Program (2)
3. Sample Program

```c
/*"FILE COMMENT*************************************************************/
*       System Name : SH7203 Sample Program
*       File Name   : main.c
*       Contents    : Application of CAN Module (Data Frame Transmission)
*       Version     : 1.00.00
*       Model       : M3A-H530
*       CPU         : SH7203
*       Compiler    : SHC9.0.3.0
*       note        : The module transmits a remote frame (DLC: 2) in standard format
*       IDE: 0) from mailbox 1 of CAN at a 500-kbps transfer rate over the
*       CAN bus once. After transmission, it receives a data frame from
*       mailbox 0 of CAN1 and writes the received frame to RAM.
*       The information described here may contain technical inaccuracies or
*       typographical errors. Renesas Technology Corporation and Renesas Solutions
*       assume no responsibility for any damage, liability, or other loss rising
*       from these inaccuracies or errors.
*       Copyright (C) 2007 Renesas Technology Corp. All Rights Reserved
*       AND Renesas Solutions Corp. All Rights Reserved
*       history   : 2007.06.26 ver.1.00.00
"FILE COMMENT END"*********************************************************/
#include <machine.h>
#include "iodefine.h"       /* SH7203 iodefine  */
/* ---- prototype declaration ---- */
void main(void);
void io_init_pfc(void);
void io_init_can(void);
void io_remote_send(void);
void io_data_receive(void);
/* ---- symbol definition ---- */
#define CAN_GSR3 0x0008
#define CAN_MB0  0x0001
#define CAN_MB1  0x0002
#define CAN_MB1  0x0002
/* ---- RAM allocation variable declaration ---- */
unsigned char   nIDE = 0;           /* ide */
unsigned char   nRTR = 0;           /* rtr */
unsigned char   nDLC = 0;           /* dlc */
unsigned int    nSID = 0;           /* sid */
unsigned int    nEID = 0;           /* eid */
unsigned char   gRcv_data[8];       /* data of message */
```

Figure 8 Sample Program Listing: "main.c" (1)
/*""FUNC COMMENT"*******************************************************
 * Outline     : Sample Program main
 *-----------------------------------------------------------------------
 * Include     : none
 *-----------------------------------------------------------------------
 * Declaration : void main(void);
 *-----------------------------------------------------------------------
 * Function    : Sample Program main
 *-----------------------------------------------------------------------
 * Argument    : none
 *-----------------------------------------------------------------------
 * Return Value: none
 *-----------------------------------------------------------------------
 * Notice      : none
 **""FUNC COMMENT END""***************************************************/

void main(void)
{

   /* ==== Setting of PFC ==== */
   io_init_pfc();

   /* ==== Initializing CAN module ==== */
   io_init_can();

   /* ==== CAN remote frame transmission ==== */
   io_remote_send();

   /* ==== CAN data frame reception ==== */
   io_data_receive();

   while(1){
      /* loop */
      
   }
}

/*""FUNC COMMENT"*******************************************************
 * Outline     : Setting of PFC
 *-----------------------------------------------------------------------
 * Include     : #include "iodefine.h"
 *-----------------------------------------------------------------------
 * Declaration : void io_init_pfc(void);
 *-----------------------------------------------------------------------
 * Function    : Setting of Pin Function Controller (PFC)
 *-----------------------------------------------------------------------
 * Argument    : none
 *-----------------------------------------------------------------------
 * Return Value: none
 *-----------------------------------------------------------------------
 * Notice      : none
 **""FUNC COMMENT END""***************************************************/

void io_init_pfc(void)
{

   /* ==== Setting of PFC ==== */
   /* ---- Port B control register L3 ---- */
   PORT.PBCRL3.BIT.PB10MD = 0x1;   /* Set CRx1 */
   PORT.PBCRL3.BIT.PB11MD = 0x1;   /* Set CTx1 */

   while(1){
      /* loop */
   }
}

Figure 9  Sample Program Listing: "main.c" (2)
void io_init_can(void)
{
    int i;

    /* ---- Setting of power down mode (RCAN1) ---- */
    CPG.STBCR5.BIT.MSTP52 = 0;

    /* ---- Initializing CAN module ---- */
    RCAN1.MCR.WORD |= 0x0001;       /* CAN Interface reset mode */
    while((RCAN1.GSR.WORD & CAN_GSR3) != CAN_GSR3){
        /* Reset state waiting */
    }

    /* ---- RCAN mode selection ---- */
    RCAN1.MCR.WORD |= 0x8000;       /* RCAN-TL1 is not same as HCAN2 */

    /* ---- Disable all can interrupt ---- */
    RCAN1.IMR.WORD = 0xFFFF;

    /* ---- Config baudrate ---- */
    RCAN1.BCR1.WORD = 0x6300;       /* tsg1=6(7bit),tsg2=3(4bit),sjw=0(1bit),bsp=0 */
    RCAN1.BCR0.WORD = 0x0001;       /* 500K bps */
    //  RCAN1.BCR0.WORD = 0x0003;       /* 250K bps */
    //  RCAN1.BCR0.WORD = 0x0007;       /* 125K bps */
    RCAN1.BCR0.WORD = 0x0000;       /* 500K bps */

    /* ---- Config mailbox0 as reception slot ---- */
    RCAN1.MB[0].CONTROL1.WORD = 0x0200;     /* can receive data and remote frame */
    RCAN1.MB[0].CONTROL0.LONG = 0x00000000; /* Initialize the Message Control Field */
    for(i = 0; i < 8; i++){
        RCAN1.MB[0].MSG_DATA[i] = 0x00; /* data clear */
    }

    /* ---- Config mailbox1 as transmission slot ---- */
    RCAN1.MB[1].CONTROL1.WORD = 0x0002;     /* Can send data or remote frame, dlc=2 */
    RCAN1.MB[1].CONTROL0.LONG = 0x00000000; /* standard remote frame, id=0x00 */
    RCAN1.MB[1].LAFM.LONG = 0x00000000;     /* standard remote frame, id=0x00 */
    for(i = 0; i < 8; i++){
        RCAN1.MB[1].MSG_DATA[i] = 0x00; /* data clear */
    }

    /* ---- Clear interrupt flags ---- */
    RCAN1.IRR.WORD = 0xffff;

    /* ---- Clear reset and halt ---- */
    RCAN1.MCR.WORD &= 0xfffc;
    while((RCAN1.GSR.WORD & CAN_GSR3) != 0x0001){
        /* reset state is end */
    }

}
/*"FUNC COMMENT"******************************************************
* Outline     : Transmission of Remote Frame
*-----------------------------------------------------------------------
* Include     : #include "iodefine.h"
*-----------------------------------------------------------------------
* Declaration : void io_remote_send(void);
*-----------------------------------------------------------------------
* Function    : RCAN1 is used to transmit a remote frame.
*-----------------------------------------------------------------------
* Argument    : none
*-----------------------------------------------------------------------
* Return Value: none
*-----------------------------------------------------------------------
* Notice      : none
"FUNC COMMENT END"***************************************************/

void io_remote_send(void)
{
    /* ---- Transmission waiting ---- */
    while((RCAN1.TXPR0.LONG & CAN_MB1) == CAN_MB1){
    }
    /* ---- transmission data set ---- */
    RCAN1.MB[1].CONTROL1.WORD = 0x0002;     /* Can send data or remote frame, dlc=2 */
    RCAN1.MB[1].CONTROL0.LONG = 0x40000000; /* standard remote frame, id=0x000 */
    /* ---- transmit the data ---- */
    RCAN1.TXPR0.LONG = CAN_MB1;
    /* ---- Transmission completion waiting ---- */
    while((RCAN1.TXACK0.WORD & CAN_MB1) != CAN_MB1){
    }
    /* ---- Transmission completion flag clear ---- */
    RCAN1.TXACK0.WORD = CAN_MB1;
}

Figure 11  Sample Program Listing: "main.c" (4)
/*"FUNC COMMENT"*******************************************************
* Outline     : Reception of Data frame
*-----------------------------------------------------------------------
* Include     : #include "iodefine.h"
*-----------------------------------------------------------------------
* Declaration : void io_data_receive(void);
*-----------------------------------------------------------------------
* Function    : RCAN1 is used to receive a data frame.
*-----------------------------------------------------------------------
* Argument    : none
*-----------------------------------------------------------------------
* Return Value: none
*-----------------------------------------------------------------------
* Notice      : none
"FUNC COMMENT END"***************************************************/

void io_data_receive(void)
{
    int i;
    /* ---- Reception completion waiting ---- */
    while((RCAN1.RXPR0.WORD & CAN_MB0) != CAN_MB0){
        }
    /* ---- Receive data storage ---- */
    nIDE = RCAN1.MB[0].CONTROL0.BIT.IDE;
    nRTR = RCAN1.MB[0].CONTROL0.BIT.RTR;
    nDLC = RCAN1.MB[0].CONTROL1.BIT.DLC;
    nSID = RCAN1.MB[0].CONTROL0.BIT.STDID;
    nEID = RCAN1.MB[0].CONTROL0.BIT.EXDID;
    if(nDLC > 8){
        nDLC = 8;
        }
    for(i = 0; i < nDLC; i++){
        gRcv_data[i] = RCAN1.MB[0].MSG_DATA[i];
        }
    /* ---- Reception completion flag clear ---- */
    RCAN1.RXPR0.WORD = CAN_MB0;
    }
/* End of File */
4. Documents for Reference

- Software Manual
  The most up-to-date version of this document is available on the Renesas Technology Website.

- Hardware Manual
  SH7263 Group Hardware Manual
  SH7203 Group Hardware Manual
  The most up-to-date versions of the documents are available on the Renesas Technology Website.
Website and Support

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

Inquiries
http://www.renesas.com/inquiry
csc@renesas.com

Revision Record

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Sep.19.08</td>
<td>— First edition issued</td>
</tr>
<tr>
<td>1.01</td>
<td>Dec.17.08</td>
<td>— Source file is updated</td>
</tr>
</tbody>
</table>

All trademarks and registered trademarks are the property of their respective owners.
1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.

2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.

3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.

4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (http://www.renesas.com)

5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.

6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guaranties regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.

7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or underwater communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.

8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
   (1) artificial life support devices or systems
   (2) surgical implantations
   (3) healthcare intervention (e.g., excision, administration of medication, etc.)
   (4) any other purposes that pose a direct threat to human life
Renesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.

9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.

10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas 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 applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.

11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.

12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.

13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.