

## R8C/56E Group

R01AN0975EJ0100

Rev.1.00

### Serial I/O Operation in Clock Asynchronous Serial I/O Mode

---

July 15, 2012

#### Abstract

This document describes using the UART0\_0 channel in clock asynchronous serial I/O mode.

#### Products

R8C/56E Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

## Contents

1. Specifications .....	3
2. Operation Confirmation Conditions .....	4
3. Software .....	5
3.1 Operation Overview .....	5
3.2 Required Memory Size .....	7
3.3 Constant.....	7
3.4 Variables .....	7
3.5 Functions.....	7
3.6 Function Specifications .....	8
3.7 Flowcharts.....	9
3.7.1 Main Processing .....	9
3.7.2 System Clock Setting.....	10
3.7.3 Initial Setting of Timer RJ_0 .....	11
3.7.4 Initial Setting of UART0_0 .....	12
3.7.5 Setting of UART0_0 in Clock Asynchronous Serial I/O Mode.....	13
4. Sample Code.....	14
5. Reference Documents.....	14

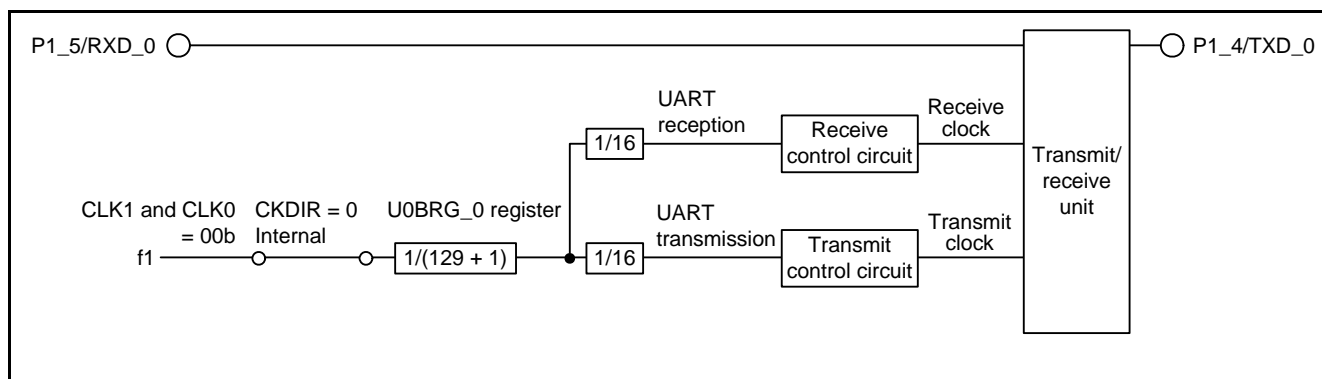
## 1. Specifications

Transmit and receive 8 bytes of data using UART0\_0 in clock asynchronous serial I/O mode.

Table 1.1 lists the Peripheral Function and Its Application and Figure 1.1 shows the Block Diagram.

**Table 1.1 Peripheral Function and Its Application**

Peripheral Function	Application
UART0_0	Transmit and receive data.



**Figure 1.1 Block Diagram**

## 2. Operation Confirmation Conditions

The sample code accompanying this application note has been run and confirmed under the conditions below.

**Table 2.1 Operation Confirmation Conditions**

Item	Contents
MCU used	R8C/56E Group
Operating frequencies	<ul style="list-style-type: none"><li>• XIN clock: 20 MHz</li><li>• System clock: 20 MHz</li><li>• CPU clock: 20 MHz</li></ul>
Operating voltage	5.0 V (2.7 to 5.5 V)
Integrated development environment	Renesas Electronics Corporation High-performance Embedded Workshop Version 4.09
C compiler	Renesas Electronics Corporation M16C Series, R8C Family C Compiler V.5.45 Release 01
	Compile options -D__UART0__ -c -finfo -dir "\$(CONFIGDIR)" -R8C (Default setting is used in the integrated development environment.)

### 3. Software

#### 3.1 Operation Overview

Read the UART0 receive buffer register (U0RB\_0) and transmit 1 byte of data every 5 ms.

Processing at data reception

- When there is receive data in the U0RB\_0 register, read it and increment the receive counter (rcv\_cnt). Store the received data in the receive buffer (rcv\_buf[rcv\_cnt]). After receiving 8 bytes of data, initialize the receive counter (rcv\_cnt) to 0.

Processing at data transmission

- Transmit data in the transmit buffer (trn\_buf[trn\_cnt]) when the transmit start flag (transmit\_start\_flag) is set to 1. Increment the transmit counter (trn\_cnt) for every 1 byte of data transmitted. After transmitting 8 bytes of data, initialize the transmit counter (trn\_cnt) and the transmit start flag (transmit\_start\_flag) to 0 to complete the transmission.

Settings

- Use channel UART0\_0.
- Use the P1\_4/TXD\_0 pin for serial data output.
- Use the P1\_5/RXD\_0 pin for serial data input.
- Set the P1\_4/TXD\_0 pin to CMOS output.
- Use clock asynchronous serial I/O mode.
- Set transfer data length to 8 bits.
- Use the internal clock for the transfer clock.
- Use 1 stop bit.
- Use even parity.
- Use LSB first for the transfer format.
- Set the bit rate to 9615 bps (transfer clock is a 104  $\mu$ s cycle).
- Use f1 for the BRG count source.
- Use timer RJ\_0 to generate the transmission/reception period.
- Do not use the UART0\_0 transmit interrupt or UART0\_0 receive interrupt.

Formula for bit rate calculation

$$9615 \text{ bps} = 20 \text{ MHz} \times 1/1 \times 1/130 \times 1/16$$

Figure 3.1 shows a Transfer Format.

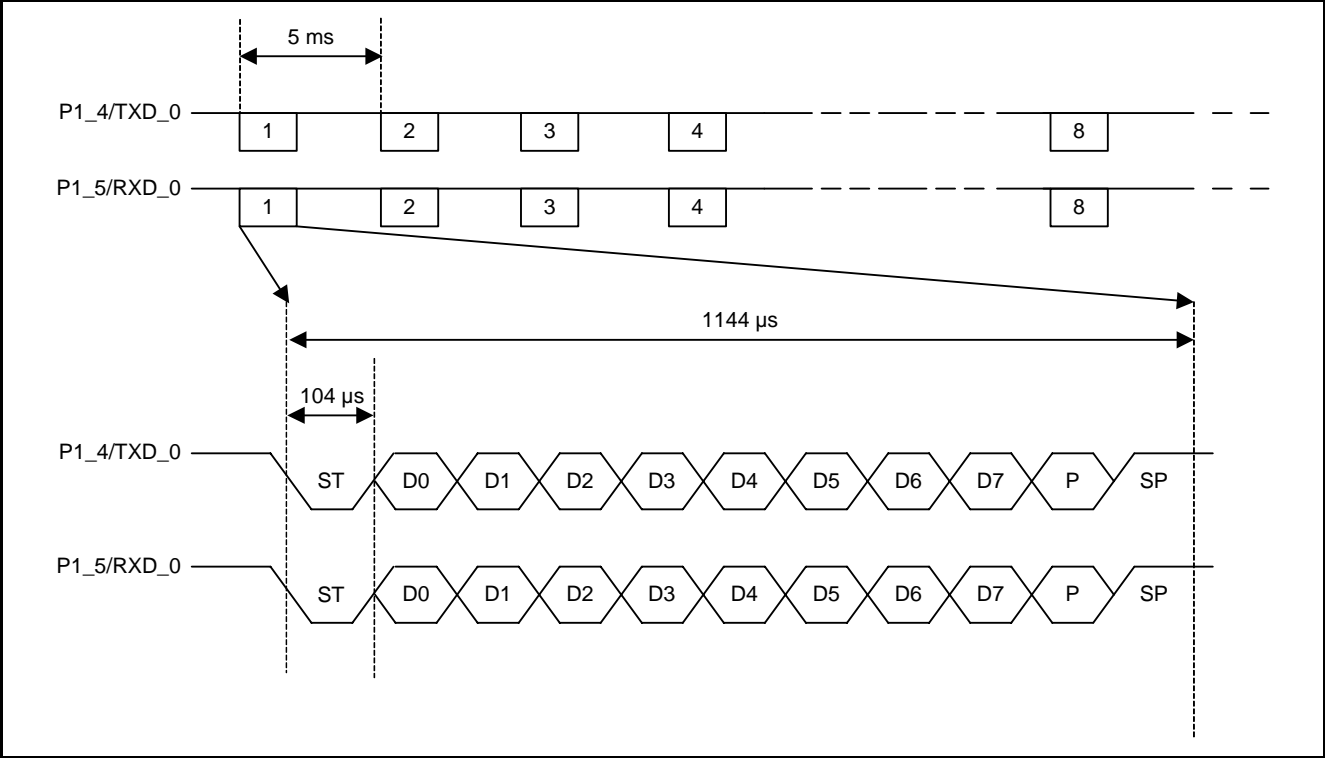


Figure 3.1 Transfer Format

### 3.2 Required Memory Size

Table 3.1 lists the Required Memory Size.

**Table 3.1 Required Memory Size**

Memory Used	Size	Remarks
ROM	232 bytes	In the r01an0975_src.c.module
RAM	21 bytes	In the r01an0975_src.c.module
Maximum user stack usage	13 bytes	

Note: • The required memory size varies depending on the C compiler version and compile options.

### 3.3 Constant

Table 3.2 lists the Constant Used in the Sample Code.

**Table 3.2 Constant Used in the Sample Code**

Constant Name	Setting Value	Contents
BUFF_SIZE	8	Number of transmit and receive buffers

### 3.4 Variables

Table 3.3 lists the Global Variables.

**Table 3.3 Global Variables**

Type	Variable Name	Contents	Function Used
unsigned char	transmit_start_flag	Transmit start flag	ca_serial
unsigned char	rcv_cnt	Receive counter	ca_serial
unsigned char	trn_cnt	Transmit counter	ca_serial
unsigned char	rcv_err[BUFF_SIZE]	Receive error buffer	ca_serial
unsigned char	rcv_buf[BUFF_SIZE]	Receive buffer	ca_serial
unsigned char	trn_buf[BUFF_SIZE]	Transmit buffer	ca_serial

### 3.5 Functions

Table 3.4 lists the Functions.

**Table 3.4 Functions**

Function Name	Outline
mcu_init	System clock setting
timer_rj_init	Initial setting of timer RJ_0
uart_init	Initial setting of UART0_0 in clock asynchronous serial I/O mode
transmit_data_set	Transmit data setting
ca_serial	Setting of UART0_0 in clock asynchronous serial I/O mode

### 3.6 Function Specifications

The following tables list the sample code function specifications.

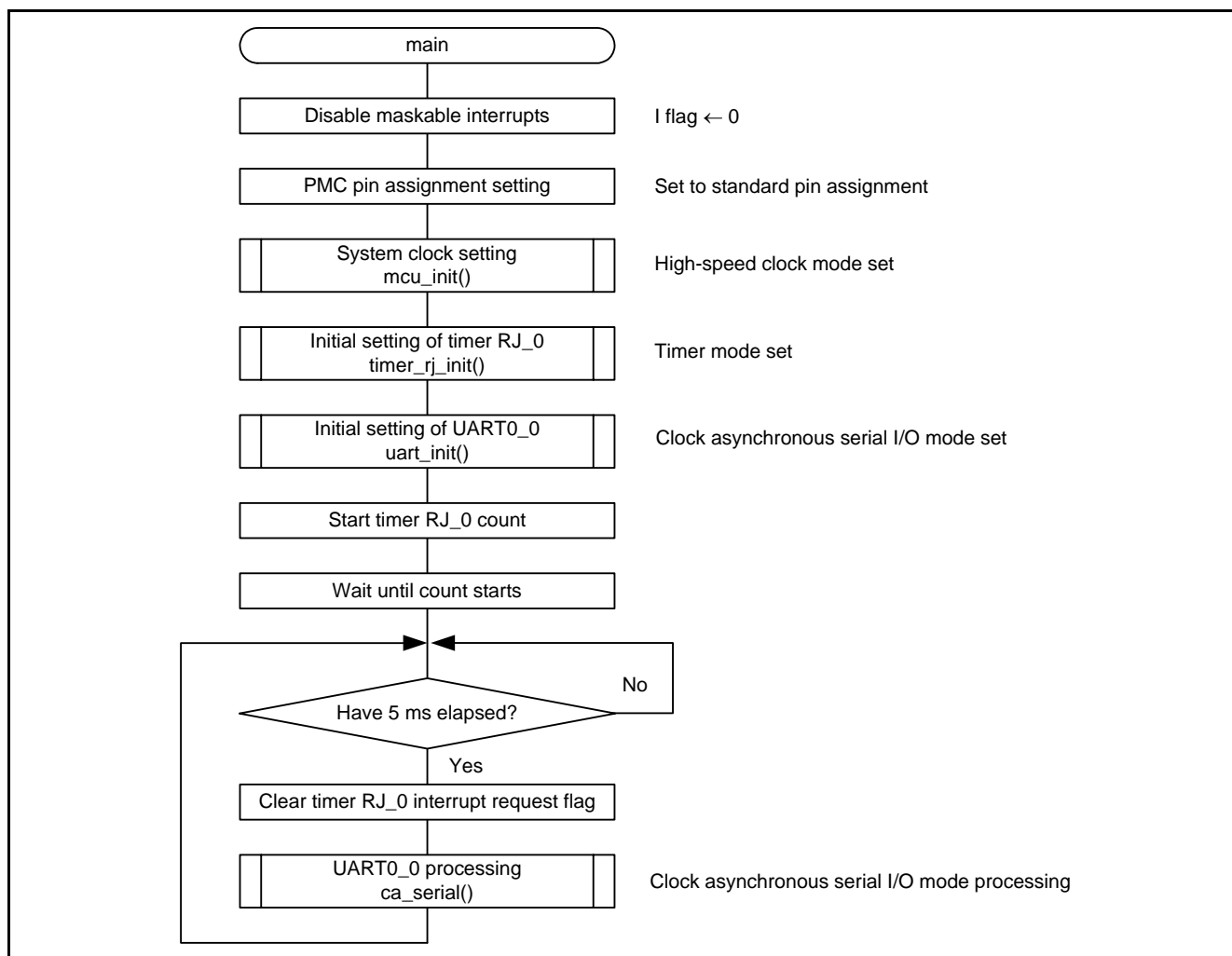
mcu_init	
<b>Outline</b>	System clock setting
<b>Header</b>	None
<b>Declaration</b>	void mcu_init(void)
<b>Description</b>	Set the system clock.
<b>Arguments</b>	None
<b>Returned Value</b>	None
timer_rj_init	
<b>Outline</b>	Initial setting of timer RJ_0
<b>Header</b>	None
<b>Declaration</b>	void timer_rj_init(void)
<b>Description</b>	Perform initial setting to use timer RJ_0 in timer mode.
<b>Arguments</b>	None
<b>Returned Value</b>	None
uart_init	
<b>Outline</b>	Initial setting of UART0_0 in clock asynchronous serial I/O mode
<b>Header</b>	None
<b>Declaration</b>	void uart_init(void)
<b>Description</b>	Perform initial setting to use UART0_0 in clock asynchronous serial I/O mode.
<b>Arguments</b>	None
<b>Returned Value</b>	None
transmit_data_set	
<b>Outline</b>	Transmit data setting
<b>Header</b>	None
<b>Declaration</b>	void transmit_data_set(void)
<b>Description</b>	Create transmit data. No processing is performed in this application note. Add processing as needed.
<b>Arguments</b>	None
<b>Returned Value</b>	None
ca_serial	
<b>Outline</b>	Setting of UART0_0 in clock asynchronous serial I/O mode
<b>Header</b>	None
<b>Declaration</b>	void ca_serial(void)
<b>Description</b>	Read the U0RB_0 register and transmit 1 byte of data every 5 ms. When there is receive data in the U0RB_0 register, read the data and state of all error flags.
<b>Arguments</b>	None
<b>Returned Value</b>	None



### 3.7 Flowcharts

#### 3.7.1 Main Processing

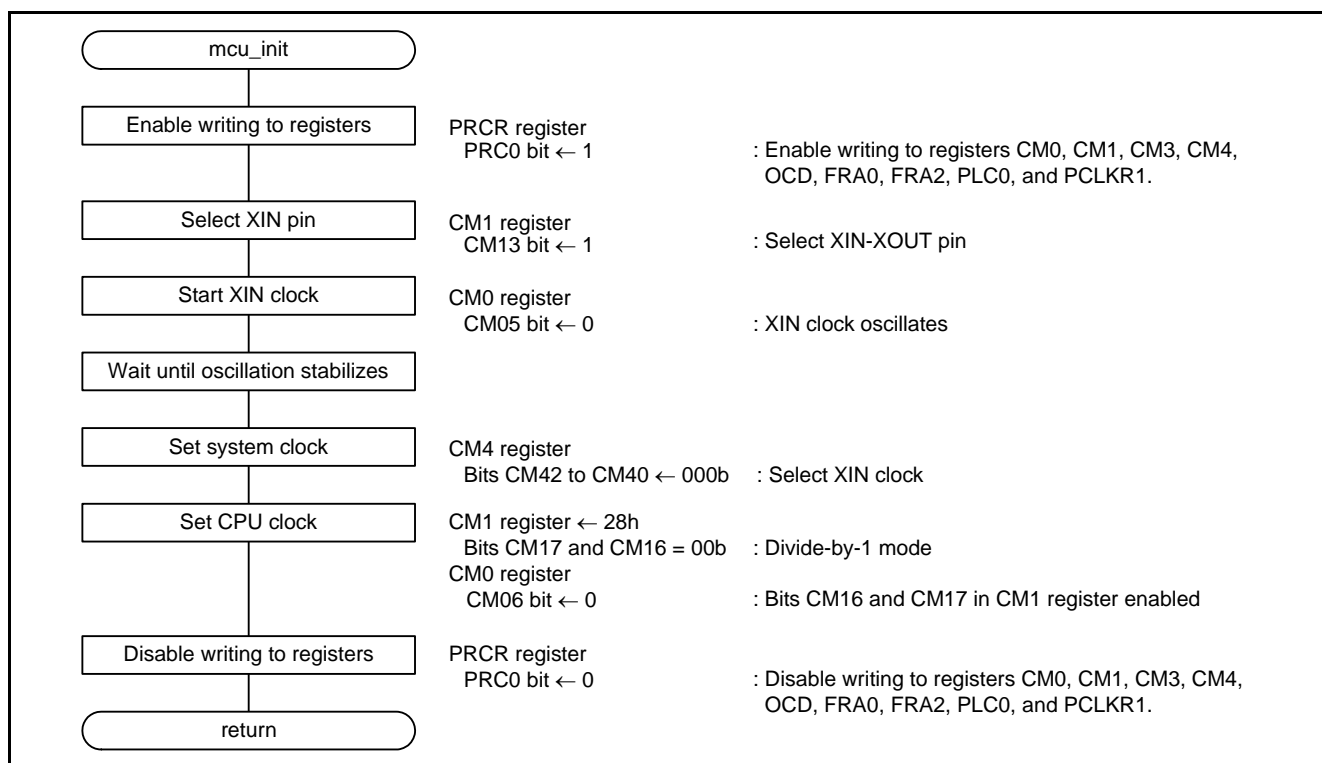
Figure 3.2 shows the Main Processing.



**Figure 3.2 Main Processing**

### 3.7.2 System Clock Setting

Figure 3.3 shows the System Clock Setting.



**Figure 3.3 System Clock Setting**

### 3.7.3 Initial Setting of Timer RJ\_0

Figure 3.4 shows the Initial Setting of Timer RJ\_0.

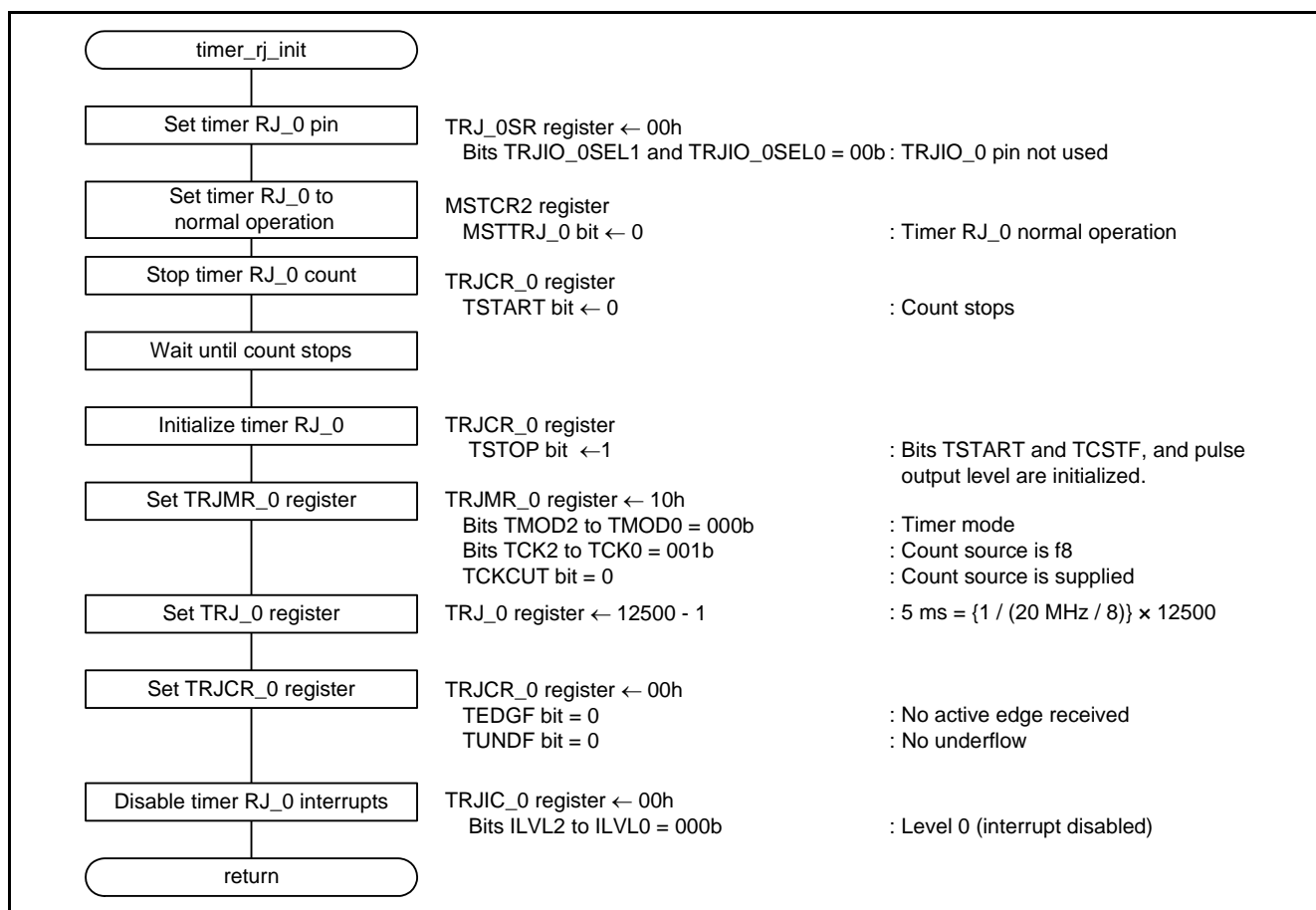


Figure 3.4 Initial Setting of Timer RJ\_0

### 3.7.4 Initial Setting of UART0\_0

Figure 3.5 shows the Initial Setting of UART0\_0.

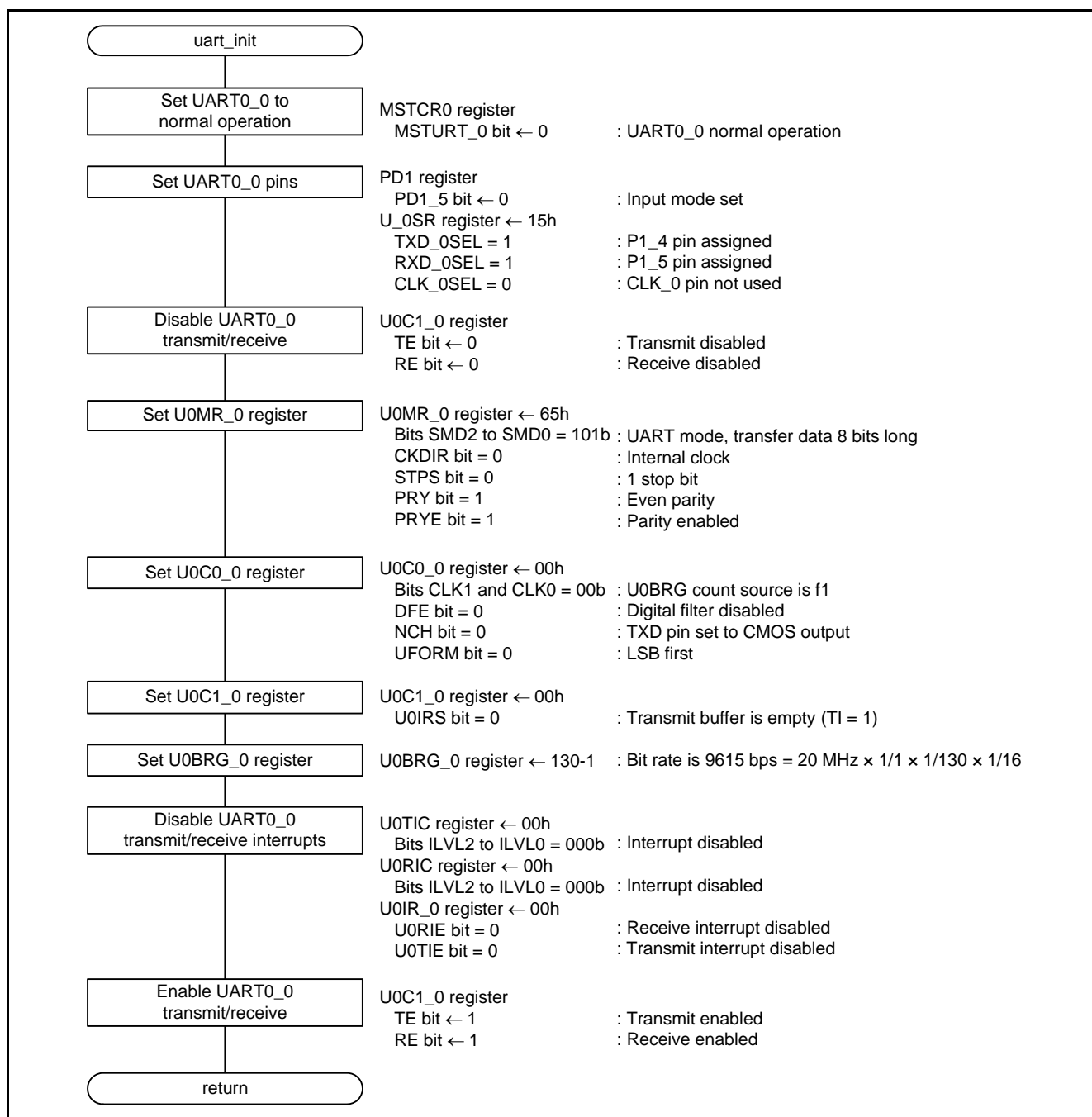


Figure 3.5 Initial Setting of UART0\_0

### 3.7.5 Setting of UART0\_0 in Clock Asynchronous Serial I/O Mode

Figure 3.6 shows the Setting of UART0\_0 in Clock Asynchronous Serial I/O Mode.

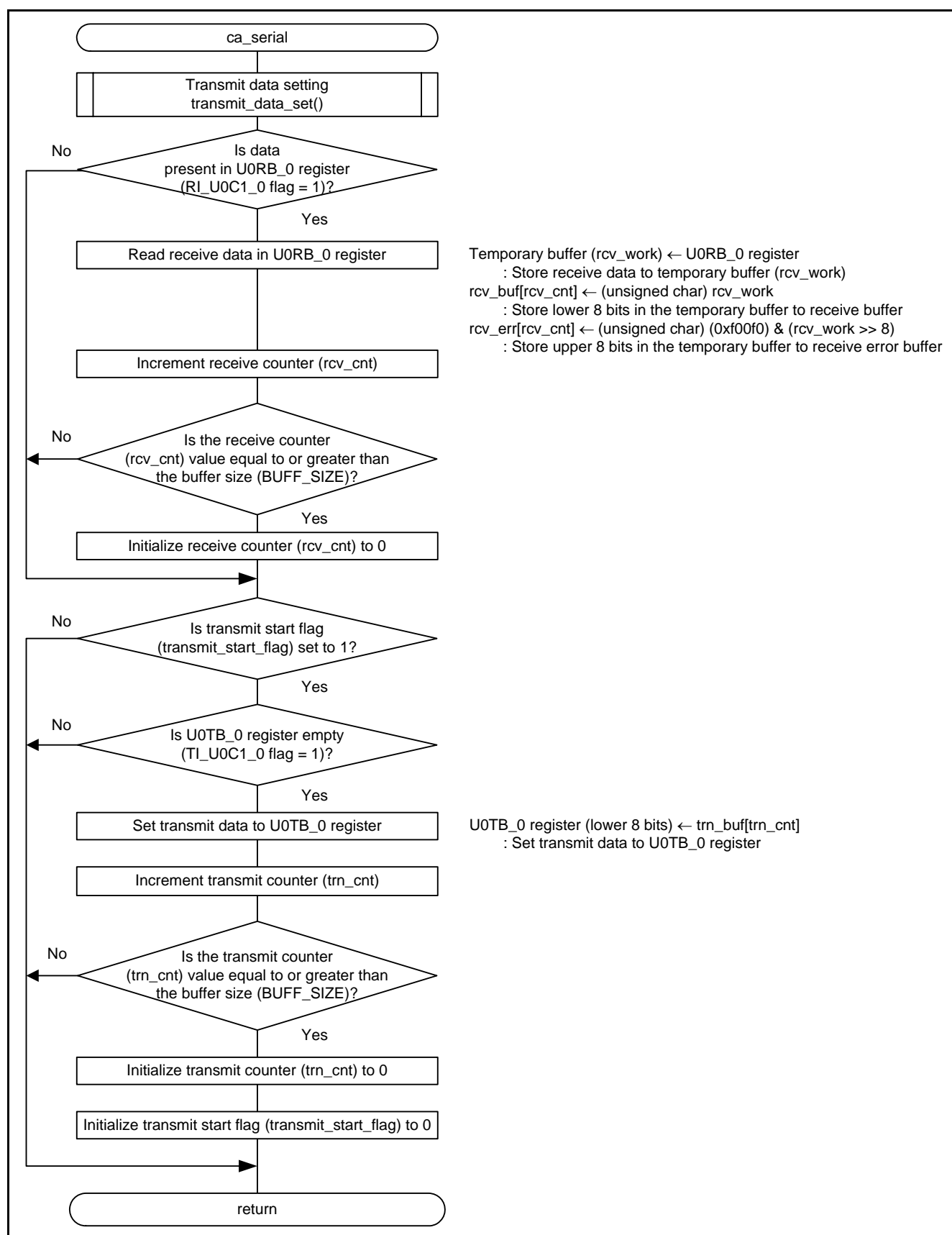


Figure 3.6 Setting of UART0\_0 in Clock Asynchronous Serial I/O Mode

#### 4. Sample Code

Sample code can be downloaded from the Renesas Electronics website.

#### 5. Reference Documents

User's Manual: Hardware

R8C/56E Group User's Manual: Hardware Rev.1.00

The latest version can be downloaded from the Renesas Electronics website.

Technical Update/Technical News

The latest information can be downloaded from the Renesas Electronics website.

#### Website and Support

Renesas Electronics website

<http://www.renesas.com>

Inquiries

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

<b>REVISION HISTORY</b>	R8C/56E Group Application Note Serial I/O Operation in Clock Asynchronous Serial I/O Mode
-------------------------	--

Rev.	Date	Description	
		Page	Summary
<b>1.00</b>	<b>July 15, 2012</b>	—	First edition issued

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

## 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.



## 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.**  
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.  
Tel: +1-408-588-6000, Fax: +1-408-588-6130

**Renesas Electronics Canada Limited**  
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada  
Tel: +1-905-898-5441, Fax: +1-905-898-3220

**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: +49-211-65030, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**  
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**  
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China  
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

**Renesas Electronics Hong Kong Limited**  
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

**Renesas Electronics Taiwan Co., Ltd.**  
13F, No. 363, Fu Shing North Road, Taipei, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

**Renesas Electronics Singapore Pte. Ltd.**  
1 harbourFront Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: +65-6213-0200, Fax: +65-6276-8001

**Renesas Electronics Malaysia Sdn.Bhd.**  
Unit 906, 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 Korea Co., Ltd.**  
11F., Samik Laved' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5141