R8C/56E Group

Serial I/O Operation in Clock Synchronous Serial I/O Mode

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Abstract

This document describes using the UART0_0 channel in clock synchronous 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

Transmit and receive 10 bytes of data consecutively using UART0_0 in clock synchronous 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.

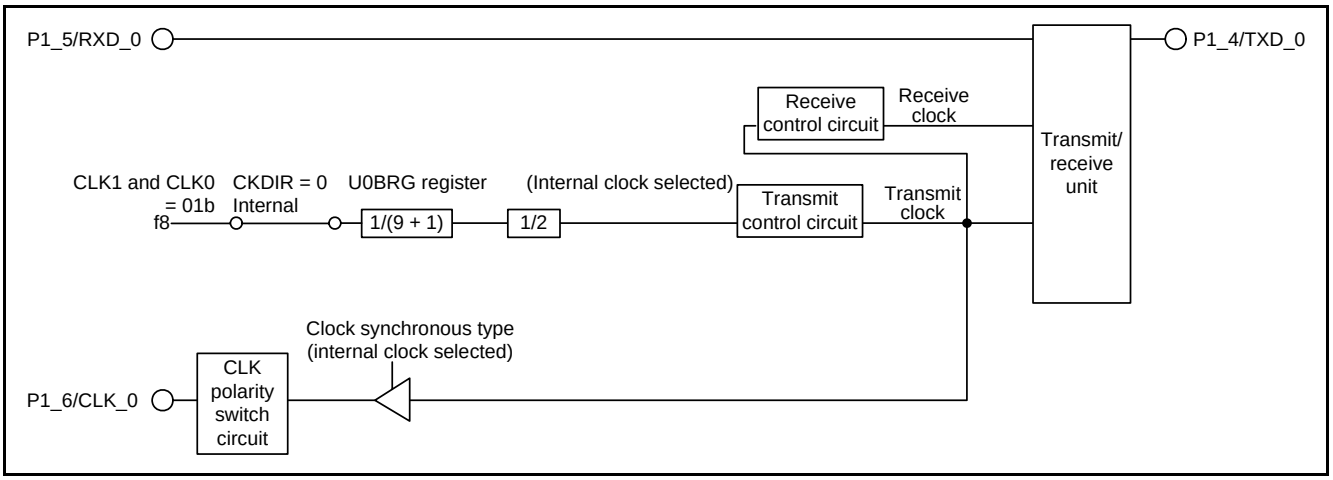

Figure 1.1 Block Diagram

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	• XIN clock: 20 MHz • System clock: 20 MHz • CPU clock: 20 MHz
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 Complier 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

Transmit and receive 10 bytes of data consecutively in 1-byte units every 250 µs. After transmitting and receiving 10 bytes of data, wait 1 ms before repeating the process. Repeat this 3.5 ms cycle.

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.
- Use the P1_6/CLK_0 pin for transfer clock output.
- Set the P1_4/TXD_0 pin to CMOS output.
- Use clock synchronous serial I/O mode.
- Use the internal clock for the transfer clock.
- Use LSB first for the transfer format.
- For CLK polarity, select transmit data is output at the falling edge and receive data is input at the rising edge of the transfer clock.
- Set the bit rate to 125 Kbps (transfer clock is 8 ms cycle).
- Use f8 for the BRG count source.
- Use timer RJ_0 to generate the transmission/reception period.
- Disable continuous receive mode.
- Do not use the UART0_0 transmit interrupt or UART0_0 receive interrupt.

Formula for bit rate calculation

125 Kbps = 20 MHz × 1/8 × 1/(9 + 1) × 1/2

Figure 3.1 shows a Transfer Format.

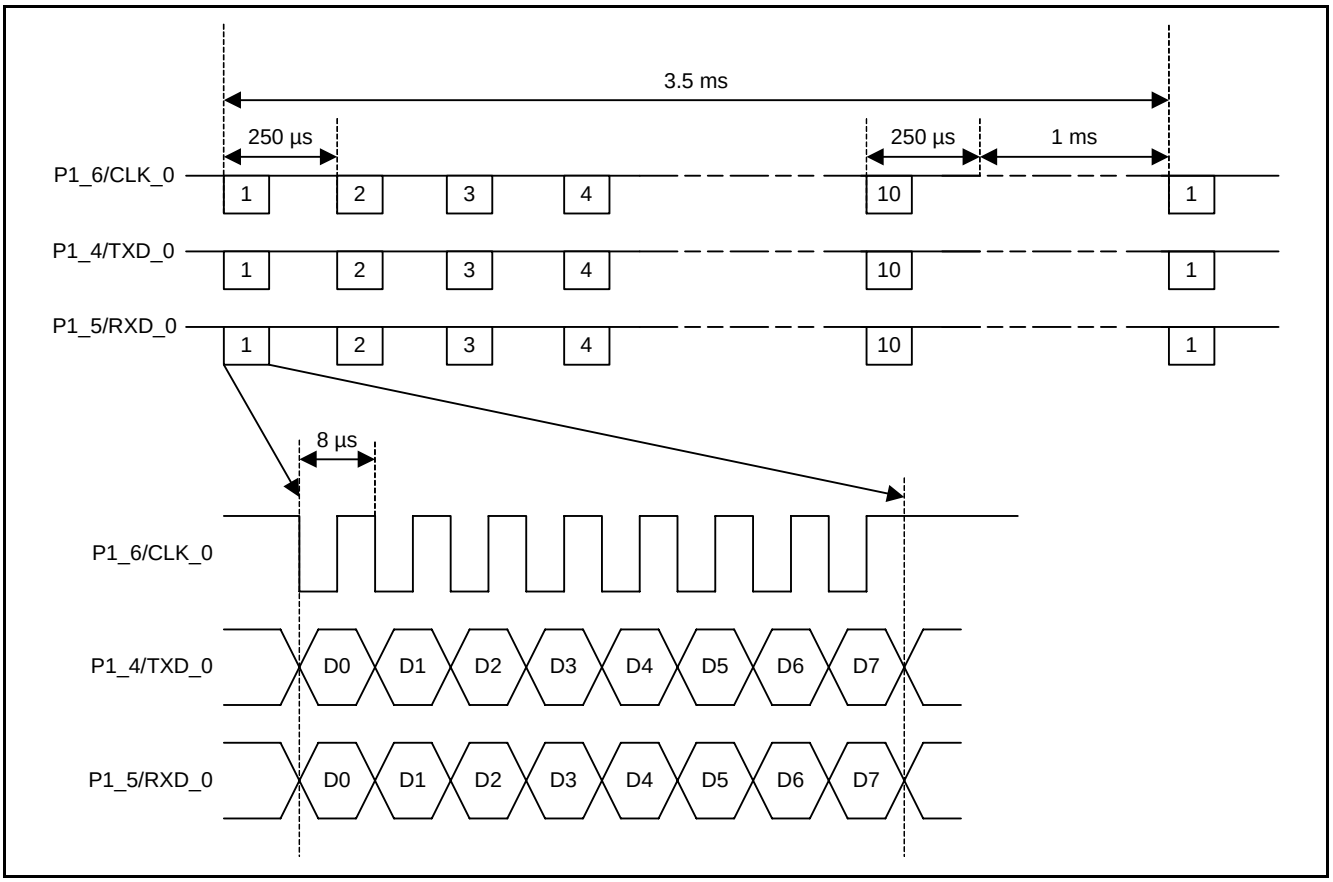

Figure 3.1 Transfer Format

3.2 Required Memory Size

Table 3.1 lists the Required Memory Size.

Table 3.1 Required Memory Size

Memory Used	Size	Remarks
ROM	250 bytes	In the r01an0976_src.c.module
RAM	20 bytes	In the r01an0976_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 Constants

Table 3.2 lists the Constants Used in the Sample Code.

Table 3.2 Constants Used in the Sample Code

Constant Name	Setting Value	Contents
BUFF_SIZE	10	Number of transmit and receive buffers
PERIOD	14	Value compared with the transmit and receive counter to generate 3.5 ms (250 µs × 14 = 3.5 ms)

3.4 Variables

Table 3.3 lists the Global Variables.

Table 3.3 Global Variables

Type	Variable Name	Contents	Function Used
unsigned char	serial_cont	Transmit and receive counter	cs_serial
unsigned char	rcv_buf[BUFF_SIZE]	Receive buffer	cs_serial
unsigned char	trn_buf[BUFF_SIZE]	Transmit buffer	cs_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 synchronous serial I/O mode
transmit_data_set	Transmit data setting
cs_serial	Setting of UART0_0 in clock synchronous serial I/O mode

3.6 Function Specifications

The following tables list the sample code function specifications.

mcu_init	
Outline	System clock setting
Header	None
Declaration	void mcu_init(void)
Description	Set the system clock.
Arguments	None
Returned Value	None

timer_rj_init	
Outline	Initial setting of timer RJ_0
Header	None
Declaration	void timer_rj_init(void)
Description	Perform initial setting to use timer RJ_0 in timer mode.
Arguments	None
Returned Value	None

uart_init	
Outline	Initial setting of UART0_0 in clock synchronous serial I/O mode
Header	None
Declaration	void uart_init(void)
Description	Perform initial setting to use UART0_0 in clock synchronous serial I/O mode.
Arguments	None
Returned Value	None

transmit_data_set	
Outline	Transmit data setting
Header	None
Declaration	void transmit_data_set(void)
Description	Create transmit data. No processing is performed in this application note. Add processing as needed.
Arguments	None
Returned Value	None

cs_serial	
Outline	Setting of UART0_0 in clock synchronous serial I/O mode
Header	None
Declaration	void cs_serial(void)
Description	Transmit and receive 10 bytes of data consecutively in 1-byte units every 250 µs.
Arguments	None
Returned Value	None

3.7 Flowcharts

3.7.1 Main Processing

Figure 3.2 shows the Main Processing.

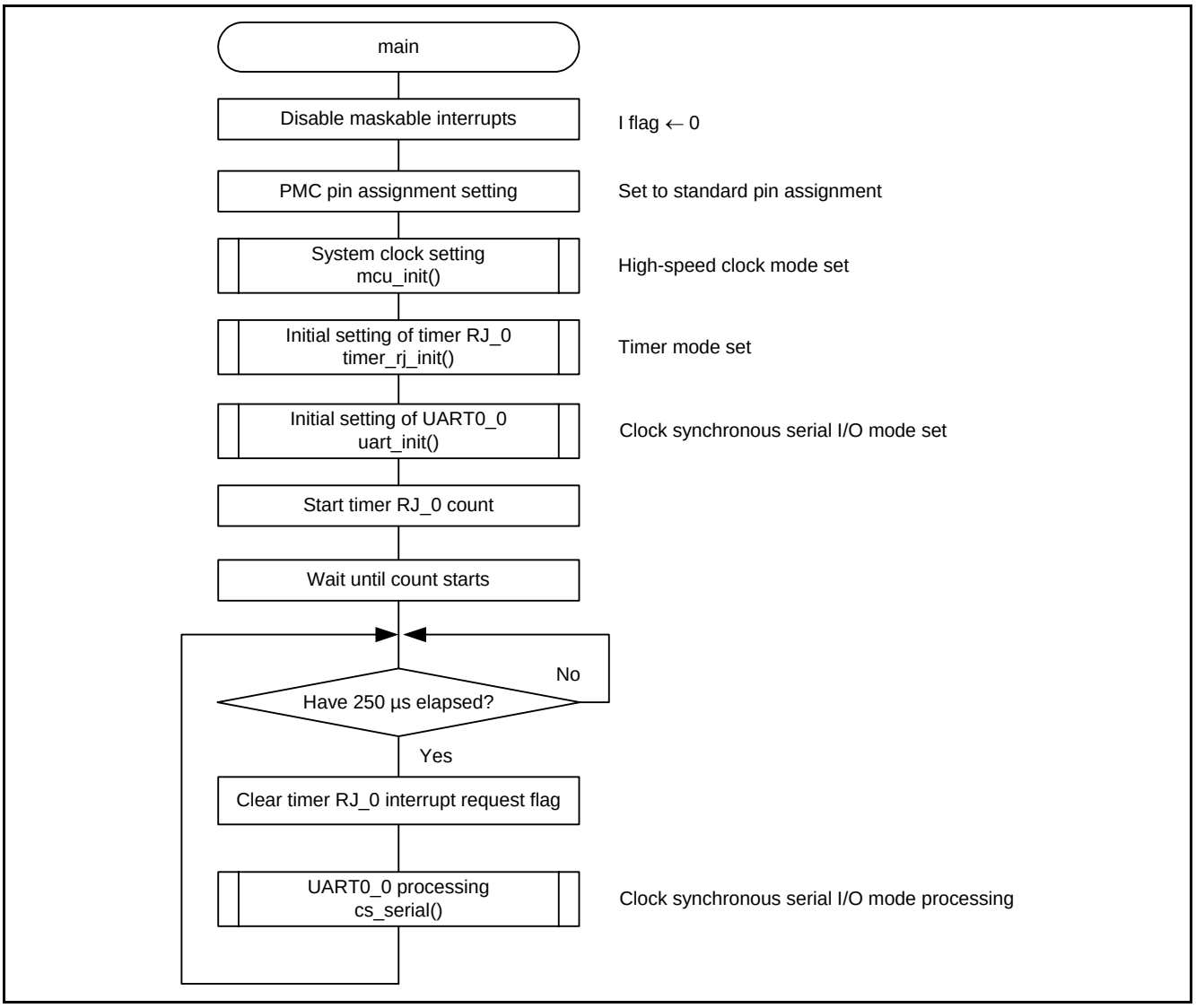

Figure 3.2 Main Processing

3.7.2 System Clock Setting

Figure 3.3 shows the System Clock Setting.

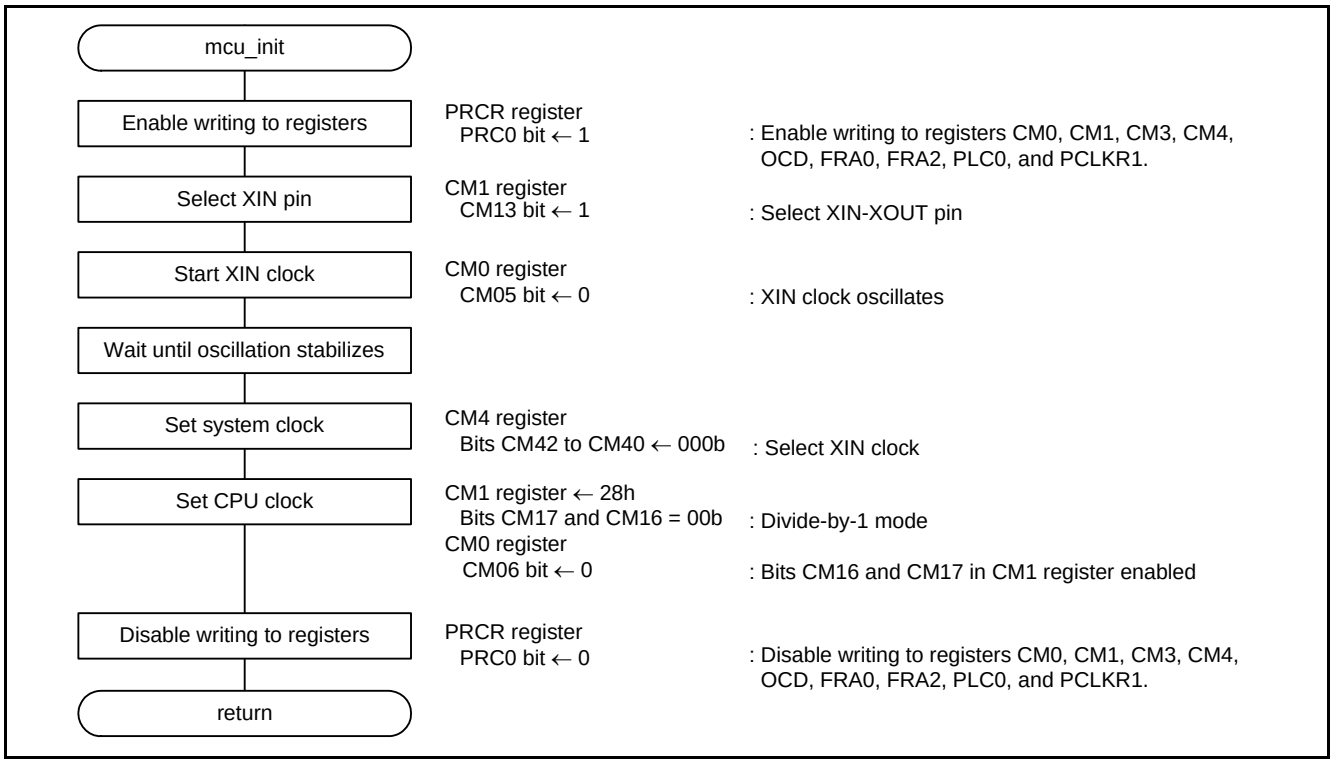

Figure 3.3 System Clock Setting

3.7.3 Initial Setting of Timer RJ_0

Figure 3.4 shows the Initial Setting of Timer RJ_0.

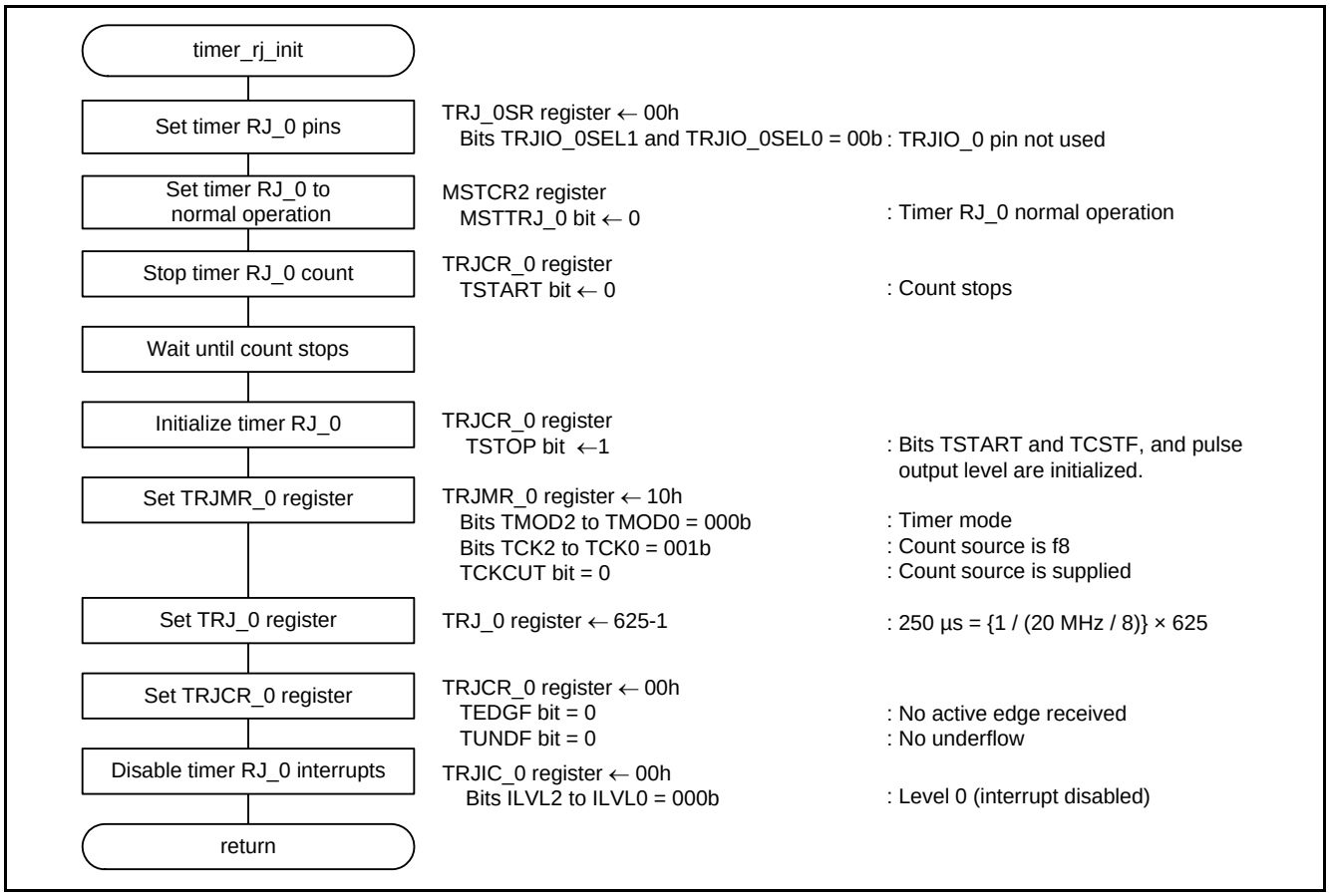

Figure 3.4 Initial Setting of Timer RJ_0

3.7.4 Initial Setting of UART0_0

Figure 3.5 shows the Initial Setting of UART0_0.

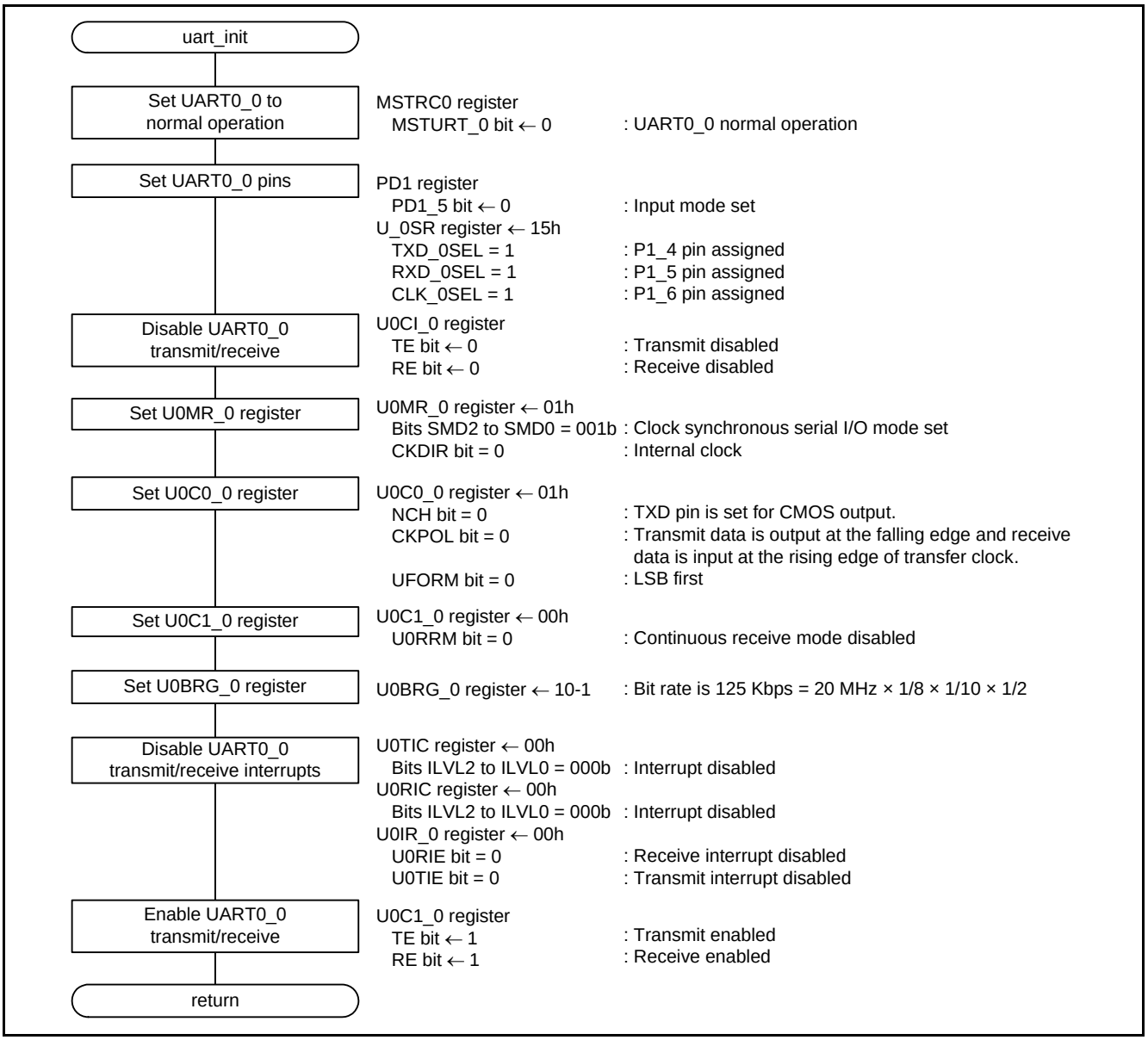

Figure 3.5 Initial Setting of UART0_0

3.7.5 Setting of UART0_0 in Clock Synchronous Serial I/O Mode

Figure 3.6 shows the Setting of UART0_0 in Clock Synchronous Serial I/O Mode.

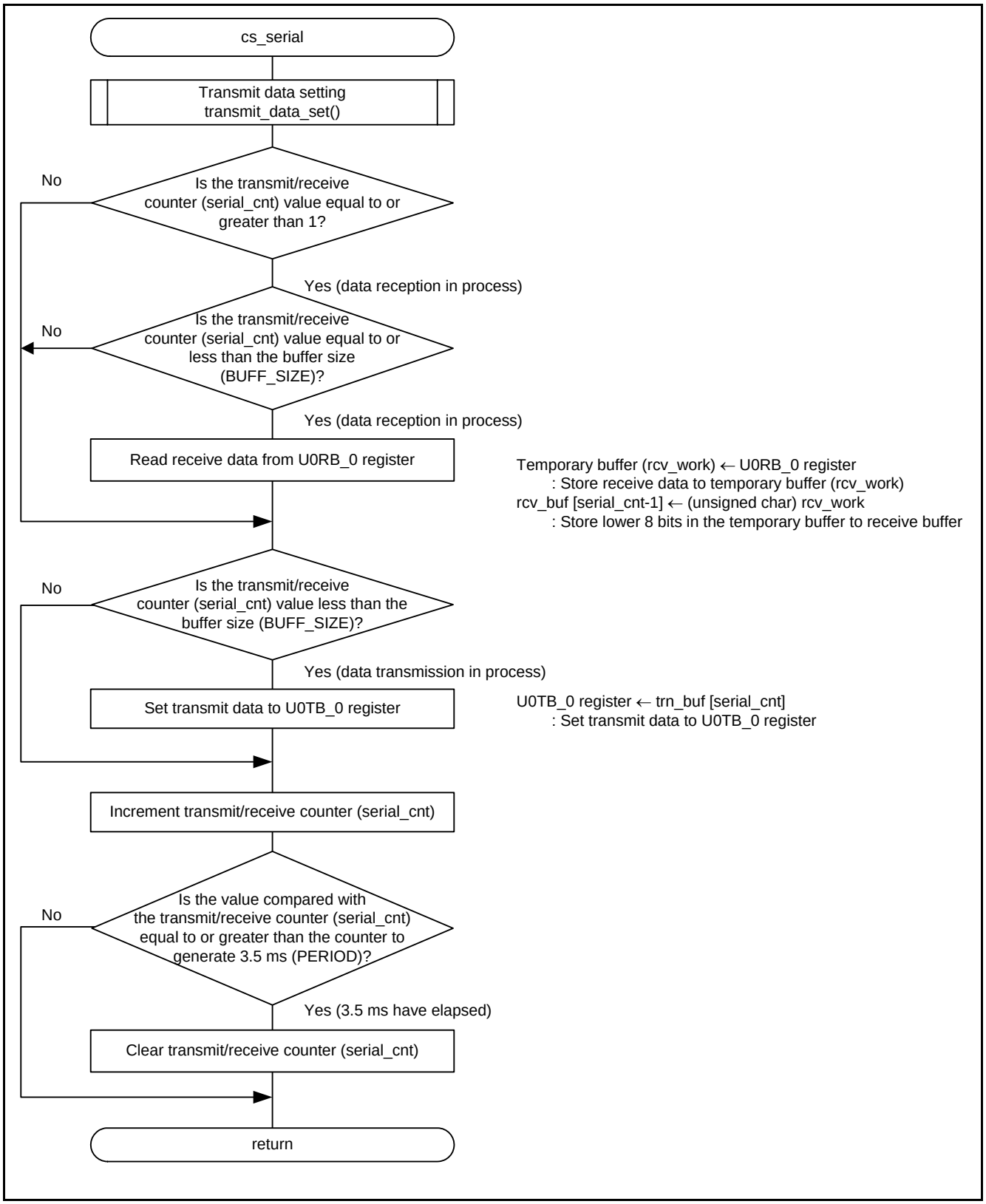

Figure 3.6 Setting of UART0_0 in Clock Synchronous Serial I/O Mode

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.

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REVISION HISTORY	R8C/56E Group Application Note Serial I/O Operation in Clock Synchronous Serial I/O Mode

Rev.	Date	Description	
		Page	Summary
1.00	July 15, 2012	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

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

1. Handling of Unused Pins
   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.
   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.
2. Processing at Power-on
   The state of the product is undefined at the moment when power is supplied.
   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.
3. Prohibition of Access to Reserved Addresses
   Access to reserved addresses is prohibited.
   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.
4. Clock Signals
   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.
   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.
5. Differences between Products
   Before changing from one product to another, i.e. to one with a different type number, confirm that the change will not lead to problems.
   — The characteristics of MPU/MCU in the same group but having different type numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different type numbers, implement a system-evaluation test for each of the products.

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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: +65-6278-8001

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 Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141

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