RENESAS

R8C/56E Group

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

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.
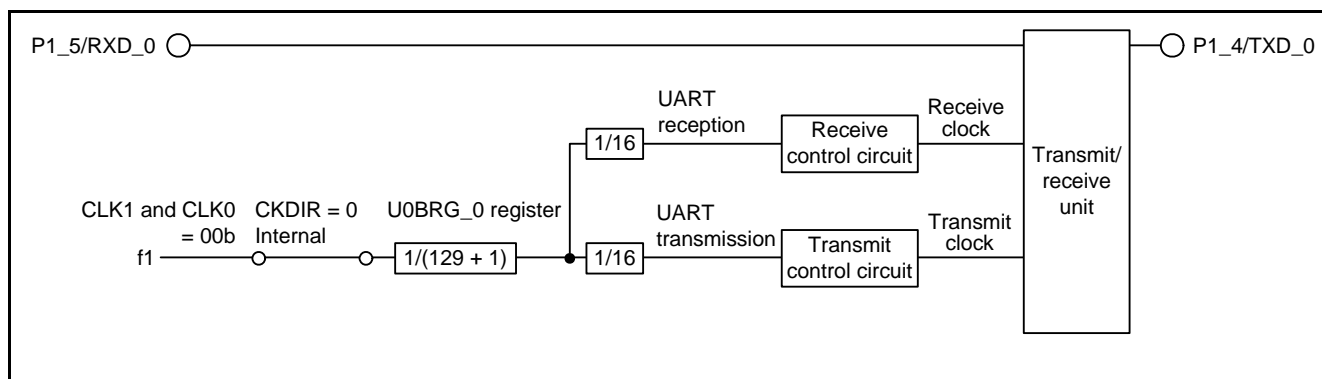
Contents

1.   Specifications

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	• 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

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 μs 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

$9615 \text{ bps} = 20 \text{ MHz} \times 1/1 \times 1/130 \times 1/16$
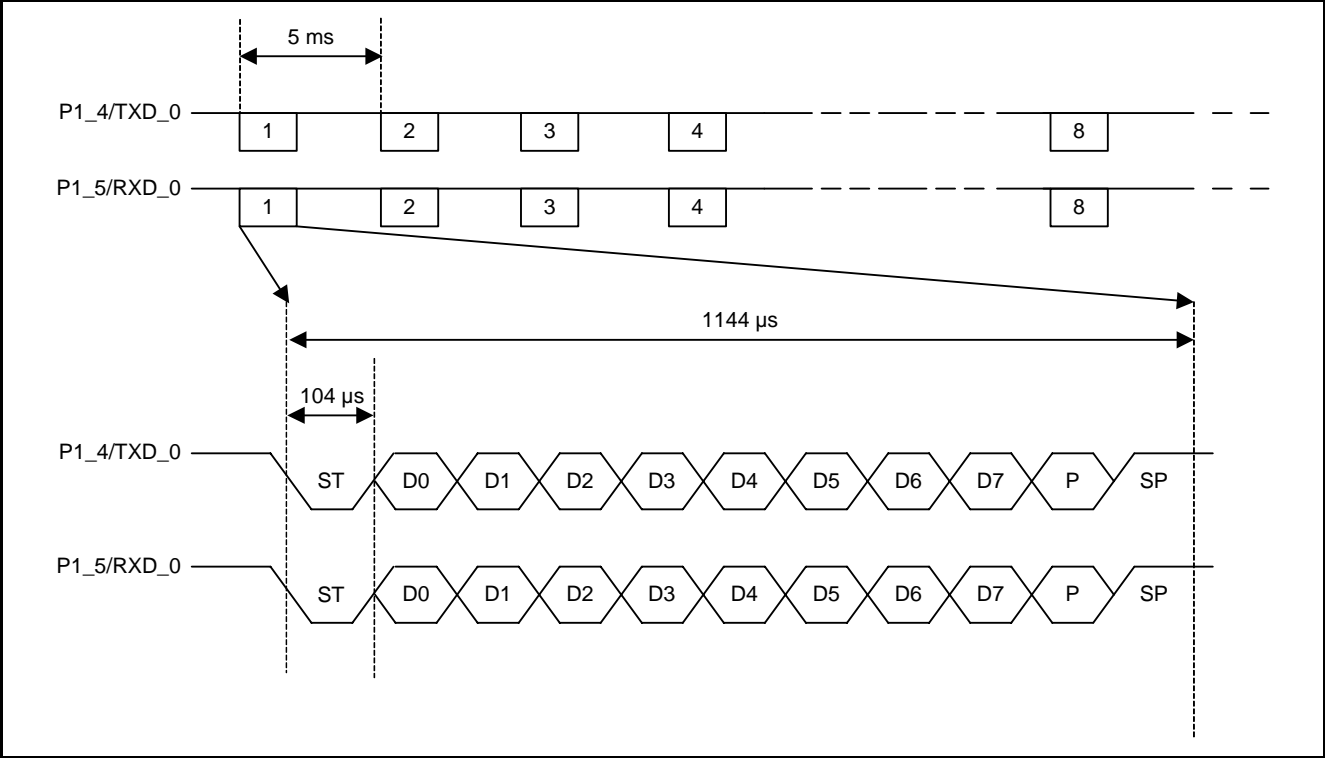
Figure 3.1 shows a Transfer Format.

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	
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 asynchronous serial I/O mode
Header	None
Declaration	void uart_init(void)
Description	Perform initial setting to use UART0_0 in clock asynchronous 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

ca_serial	
Outline	Setting of UART0_0 in clock asynchronous serial I/O mode
Header	None
Declaration	void ca_serial(void)
Description	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.
Arguments	None
Returned Value	None

3.7   Flowcharts

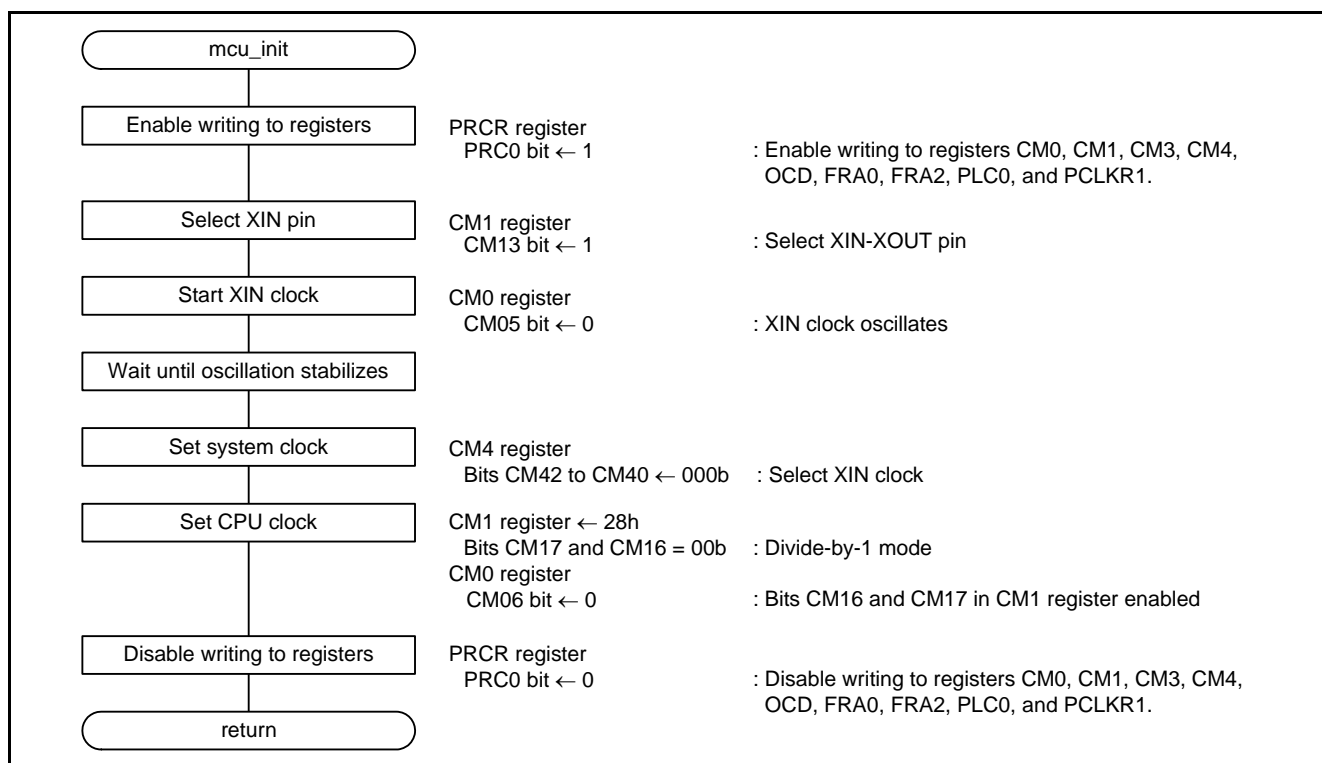### 3.7.1   Main Processing

Figure 3.2 shows the Main Processing.
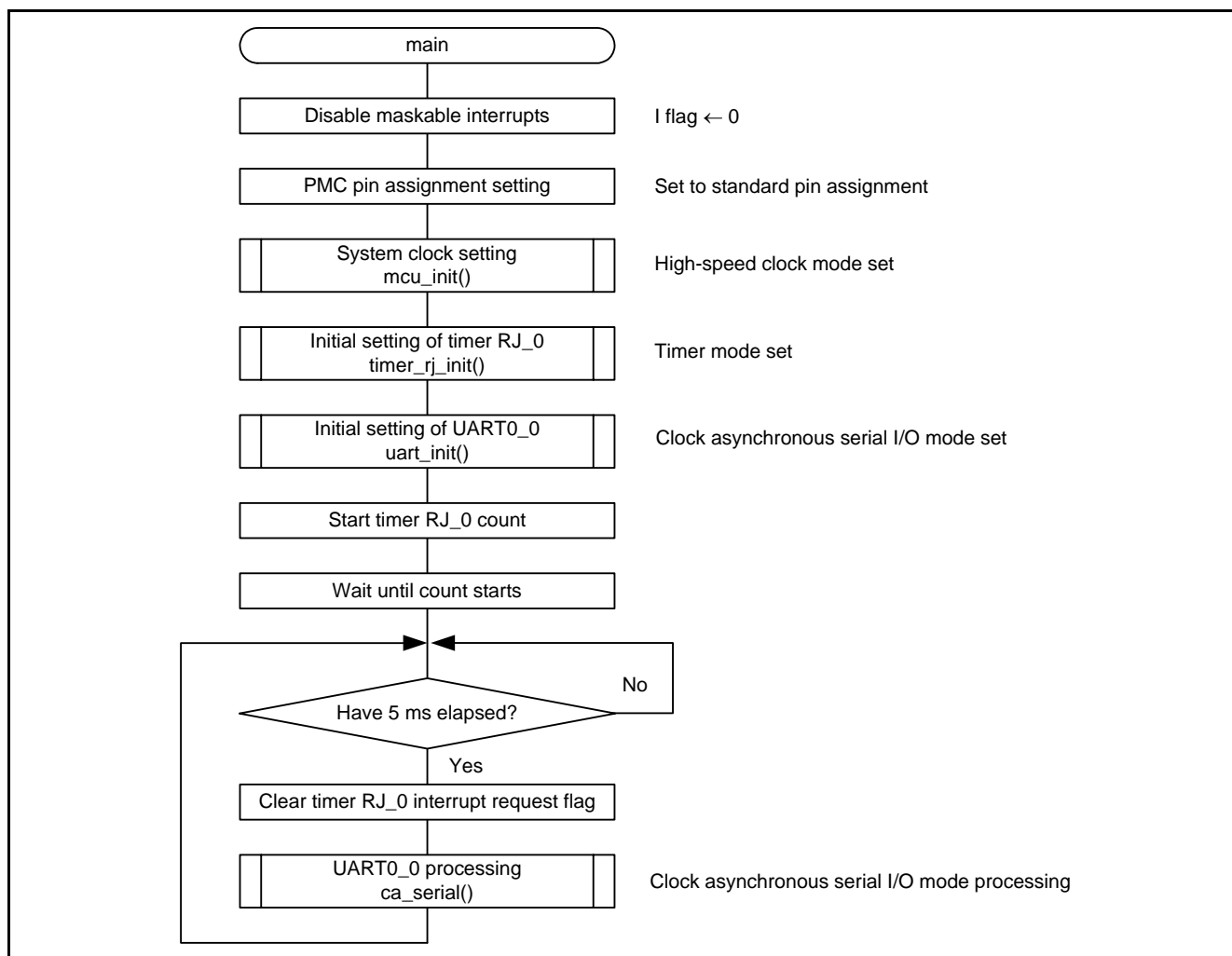
Figure 3.2   Main Processing

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
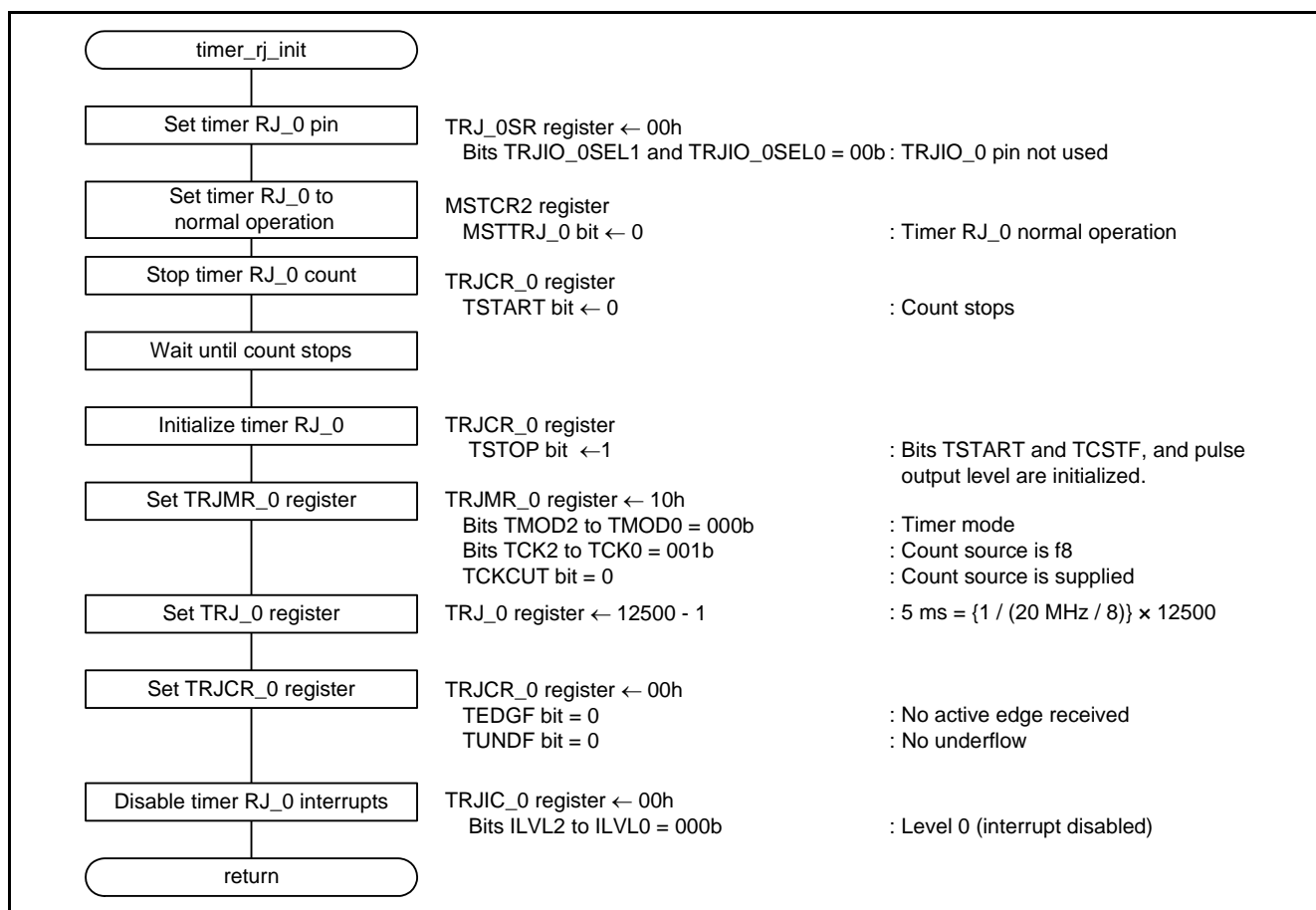
Figure 3.4 shows the Initial Setting of Timer RJ_0.

Figure 3.4 Initial Setting of Timer RJ_0

3.7.4　Initial Setting of UART0_0
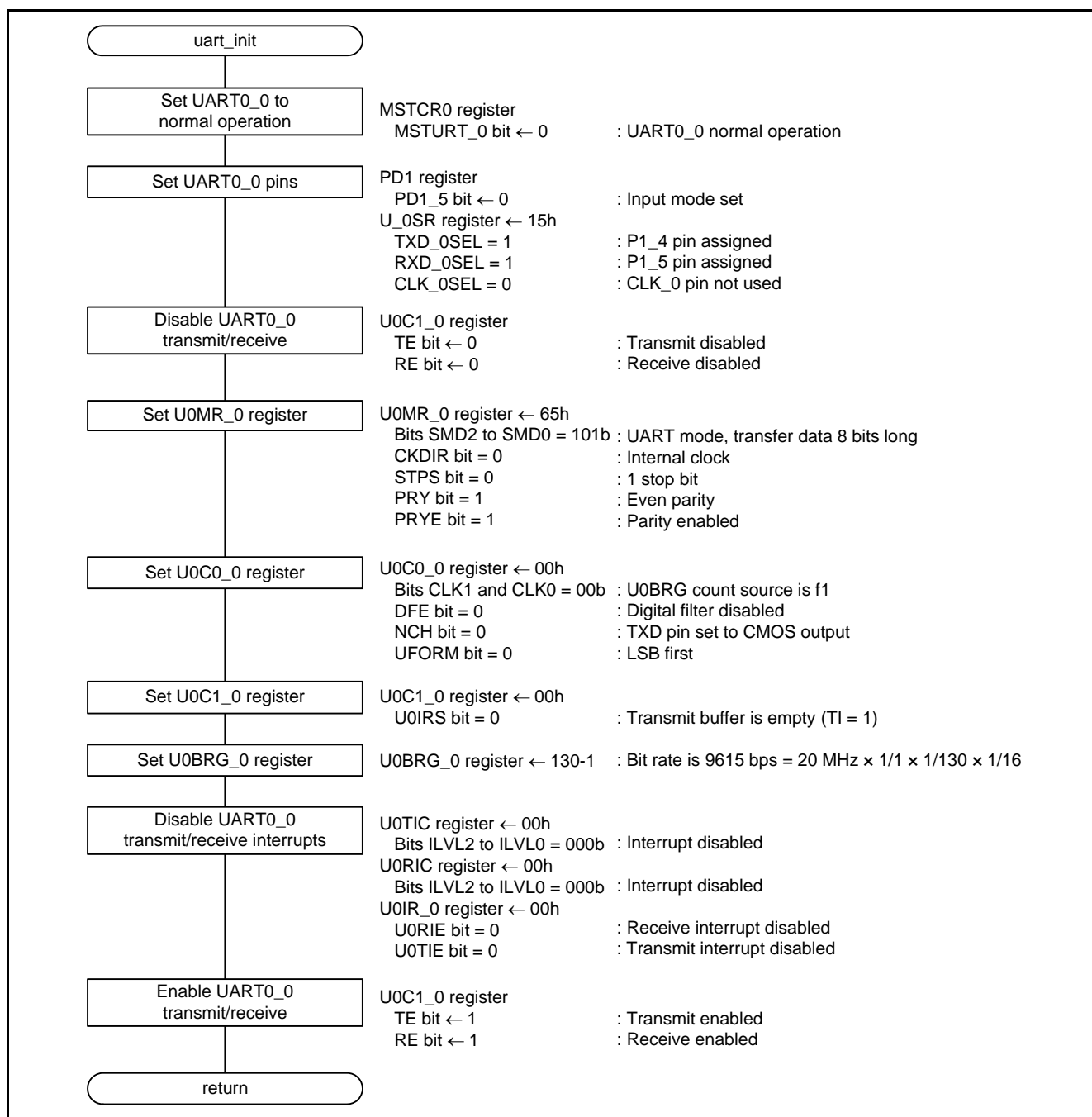
Figure 3.5 shows the Initial Setting of UART0_0.

Figure 3.5 below is a flowchart. Text content within the flowchart:

uart_init

Set UART0_0 to normal operation
MSTCR0 register
　MSTURT_0 bit ← 0　　　　　　　: UART0_0 normal operation

Set UART0_0 pins
PD1 register
　PD1_5 bit ← 0　　　　　　　　　: Input mode set
U_0SR register ← 15h
　TXD_0SEL = 1　　　　　　　　　: P1_4 pin assigned
　RXD_0SEL = 1　　　　　　　　　: P1_5 pin assigned
　CLK_0SEL = 0　　　　　　　　　: CLK_0 pin not used

Disable UART0_0 transmit/receive
U0C1_0 register
　TE bit ← 0　　　　　　　　　　　: Transmit disabled
　RE bit ← 0　　　　　　　　　　　: Receive disabled

Set U0MR_0 register
U0MR_0 register ← 65h
　Bits SMD2 to SMD0 = 101b : UART mode, transfer data 8 bits long
　CKDIR bit = 0　　　　　　　　　: Internal clock
　STPS bit = 0　　　　　　　　　　: 1 stop bit
　PRY bit = 1　　　　　　　　　　: Even parity
　PRYE bit = 1　　　　　　　　　　: Parity enabled

Set U0C0_0 register
U0C0_0 register ← 00h
　Bits CLK1 and CLK0 = 00b : U0BRG count source is f1
　DFE bit = 0　　　　　　　　　　: Digital filter disabled
　NCH bit = 0　　　　　　　　　　: TXD pin set to CMOS output
　UFORM bit = 0　　　　　　　　　: LSB first

Set U0C1_0 register
U0C1_0 register ← 00h
　U0IRS bit = 0　　　　　　　　　: Transmit buffer is empty (TI = 1)

Set U0BRG_0 register
U0BRG_0 register ← 130-1 : Bit rate is 9615 bps = 20 MHz × 1/1 × 1/130 × 1/16

Disable UART0_0 transmit/receive interrupts
U0TIC register ← 00h
　Bits ILVL2 to ILVL0 = 000b : Interrupt disabled
U0RIC register ← 00h
　Bits ILVL2 to ILVL0 = 000b : Interrupt disabled
U0IR_0 register ← 00h
　U0RIE bit = 0　　　　　　　　　: Receive interrupt disabled
　U0TIE bit = 0　　　　　　　　　: Transmit interrupt disabled

Enable UART0_0 transmit/receive
U0C1_0 register
　TE bit ← 1　　　　　　　　　　　: Transmit enabled
　RE bit ← 1　　　　　　　　　　　: Receive enabled

return

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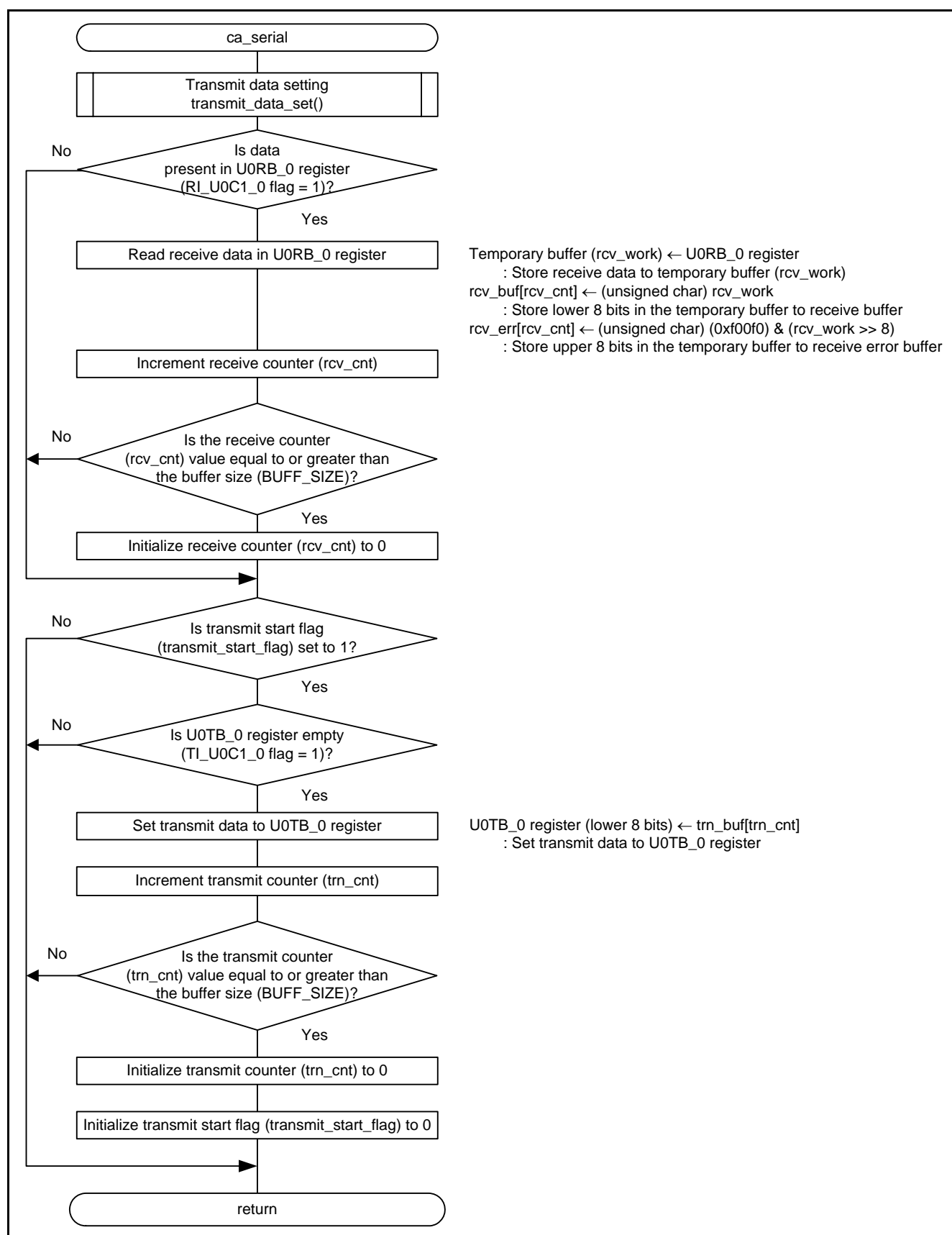
Figure 3.6 Setting of UART0_0 in Clock Asynchronous Serial I/O Mode

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

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