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R8C/25 Group

UART Communication with PC Terminal Software Using High-Speed OCO

1. Abstract

This document describes a program for UART communication with PC terminal software using the high-speed on-chip oscillator (OCO).

2. Introduction

The application example described in this document applies to the following MCU and condition(s):

- MCU : R8C/25 Group

This program can be used with other R8C/Tiny Series MCUs which have analogous special function registers (SFRs) as the R8C/25 Group. Check the manual for any additions and modifications to functions. Careful evaluation is recommended before using this application note.

3. Application Example Description

Transmit/receive processing with PC terminal software is performed in clock asynchronous serial I/O (UART) mode for the R8C/25 Group.

The specifications for this program are as follows:

(1) Use the keyboard to input numbers up to three digits, + (0x2B), numbers up to three digits, and return key (0x0D).
Example: 123 + 123 (return key)

(2) Add the data input in the above (1) on the R8C/25 Group side, and transmit LF/NL (0x0A), = (0x3D), (calculation result), CR (0x0D), and LF/NL (0x0A) to the terminal software.
Example: (0xA) = 246 (0x0D, 0x0A)

The setting conditions for this program are as follows:

- Pins used :TXD0 and RXD0
- Transfer data length :8 bits
- Stop bit :1 stop bit
- Parity :Parity disabled
- BRG count source :f1
- Data output select bit :TXD0 pin is set to CMOS output
- Transfer format :LSB first
- Bit rate :19200 bps

Figure 3.1 shows the Bit Rate Setting Values.

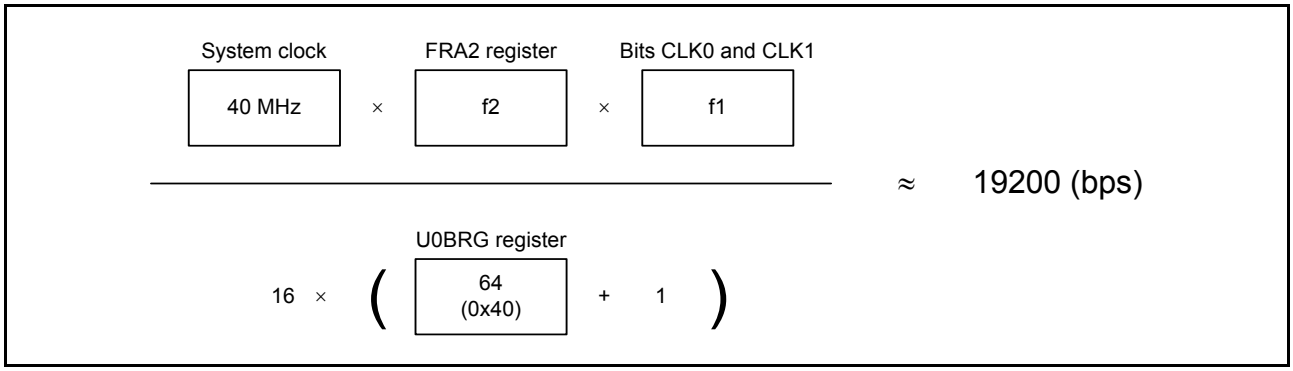


Figure 3.1 Bit Rate Setting Values

This sample program may include bit operations of unused functions for the SFR bit layout. Set these values according to the operating conditions of the user system.

3.1 Pins Used

Table 3.1 Pins Used and Their Function

Pin Name	I/O	Function
P1_4/TXD0	Output	Serial data output
P1_5/RXD0	Input	Serial data input

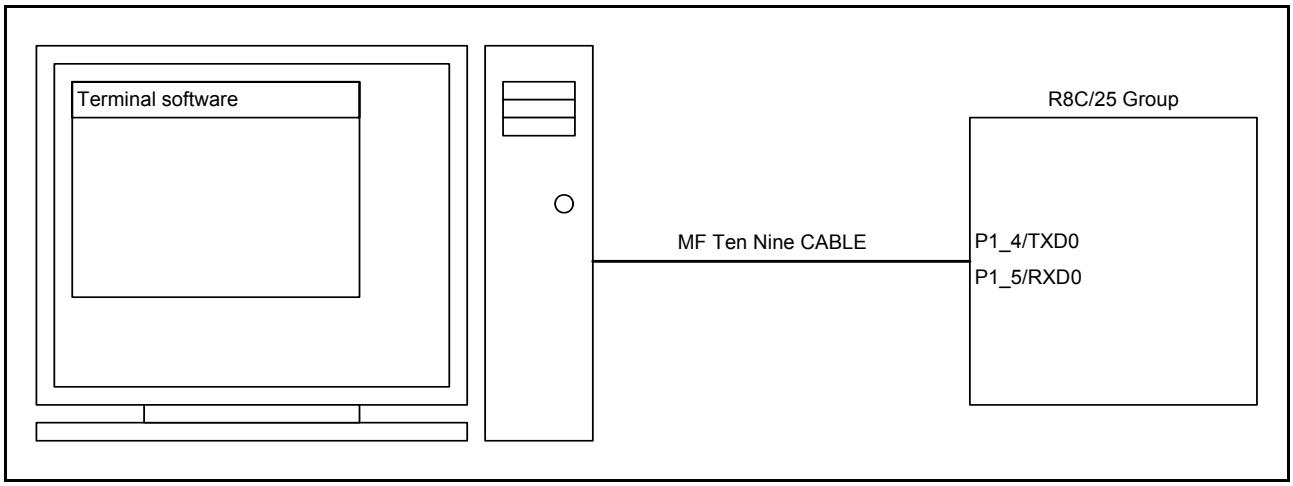


Figure 3.2 Pins Used

3.2 Memory Usage

Table 3.2 Memory Usage

Memory Usage	Size	Remarks
ROM	816 bytes	In main.c module
RAM	15 bytes	In main.c module
Maximum user stack usage	20 bytes	main function: 7 bytes uart_init function: 3 bytes pc_communication function: 3 bytes input_left_part function: 7 bytes input_right_part function: 7 bytes input_data_calc_echo function: 3 bytes calculation_and_transmit function: 3 bytes
Maximum interrupt stack usage	0 bytes	Unused

Memory usage varies depending on the C compiler version and the compile option.
The above applies under the following conditions:

- C compiler: M16C/60, 30, 20, 10, Tiny, R8C/Tiny Series Compiler V.5.40 Release 00
- Compile option: -c -finfo; NOTE: -dir “$(CONFIGDIR)” -R8C

NOTE: Not available in the R8C/Tiny-exclusive free version.

4. Setup

This section shows the initial setting procedures and values to perform the example described in **3. Application Example Description**. Refer to the **R8C/25 Group Hardware Manual** for details on individual registers.

4.1 System Clock Setting

(1) Enable writing to registers CM0, CM1, OCD, FRA0, FRA1, and FRA2.

Protect Register

b7							b0	
							1	PRCR [Address 000Ah]
								PRC0 Protect bit 0
								Writing to registers CM0, CM1, OCD, FRA0, FRA1, and FRA2 enabled

(2) Start the low-speed on-chip oscilltor.

System Clock Control Register 1

b7							b0	
			0					CM1 [Address 0007h]
								CM14 Low-speed on-chip oscillator oscillation stop bit
								Low-speed on-chip oscillator oscillates

(3) Set the division ratio of the high-speed on-chip oscillator clock.

High-Speed On-Chip Oscillator Control Register 2

b7							b0	
0	0	0	0	0	0	0	0	FRA2 [Address 0025h]
								FRA22 to FRA20 High-speed on-chip oscillator frequency switch bits
								Divide-by-2 mode
								($\overline{b7}$-$\overline{b3}$) Reserved bits
								Set to 0.

(4) Start the high-speed on-chip oscilltor.

High-Speed On-Chip Oscillator Control Register 0

b7							b0	
							1	FRA0 [Address 0023h]
								FRA00 High-speed on-chip oscillator enable bit
								High-speed on-chip oscillator oscillates

(5) Wait until oscillation stabilizes.

(6) Select the high-speed on-chip oscillator.

High-Speed On-Chip Oscillator Control Register 0

b7							b0
						1	

FRA0 [Address 0023h]

FRA01 High-speed on-chip oscillator select bit

High-speed on-chip oscillator selected

(7) Set system clock division select bits 1.

System Clock Control Register 1

b7							b0
0	0						

CM1 [Address 0007h]

CM17 and CM16 System clock division select bits 1

No division mode

(8) Set system clock division select bit 0.

System Clock Control Register 0

b7							b0
	0						

CM0 [Address 0006h]

CM06 System clock division select bit 0

CM16 and CM17 enabled

(9) Disable writing to registers CM0, CM1, OCD, FRA0, FRA1, and FRA2.

Protect Register

b7							b0
							0

PRCR [Address 000Ah]

PRC0 Protect bit 0

Writing to registers CM0, CM1, OCD, FRA0, FRA1, and FRA2 disabled

4.2 Clock Asynchronous Serial I/O (UART) Mode Setting

4.2.1 Initial Setting

(1) Set the port P1 direction register.

Port P1 Direction Register

b7							b0
		0	0				

PD1 [Address 00E3h]

PD1_4 Port P1_4 direction bit
Input mode

PD1_5 Port P1_5 direction bit
Input mode

(2) Set the UART0 transmit/receive mode register.

UART0 Transmit/Receive Mode Register 0

b7							b0
0	0	0	0	0	1	0	1

U0MR [Address 00A0h]

SMOD2 to SMOD0 Serial I/O mode select bits
UART mode transfer data length: 8 bits long

CKDIR Internal/external clock select bit
Unavailable. Set to 0.

STPS Stop bit length select bit
1 stop bit

PRY Odd/even parity select bit
Unavailable. Set to 0.

PRYE Parity enable bit
Parity disabled

($\overline{b7}$) Reserved bit
Set to 0.

(3) Set UART0 transmit/receive control register 0.

UART0 Transmit/Receive Control Register 0

b7							b0	
0	0	0	0		0	0	0	U0C0 [Address 00A4h]

CLK1 and CLK0	BRG count source select bits f1 selected
(b2)	Reserved bit Unavailable. Set to 0.
TXEPT	Transmit register empty flag Unavailable.
(b4)	Nothing is assigned Unavailable. Set to 0.
NCH	Data output select bit The TXD0 pin is set to CMOS output
CKPOL	CLK polarity select bit Unavailable. Set to 0.
UFORM	Transfer format select bit LSB first

(4) Set UART0 transmit/receive control register 1.

UART0 Transmit/Receive Control Register 1

b7							b0	
0	0	0	0		0		0	U0C1 [Address 00A5h]

TE	Transmit enable bit Transmission disabled
TI	Transmit buffer empty flag Unavailable.
RE	Receive enable bit Reception disabled
RI	Receive complete flag Unavailable.
U0IRS	UART0 transmit interrupt source select bit Transmit buffer empty (TI = 1)
U0RRM	UART0 continuous receive mode enable bit Set to 0 in UART mode.
(b7-b6)	Nothing is assigned Unavailable. Set to 0.

(5) Set the UART0 bit rate register.

UART0 Bit Rate Register

b7							b0	
0	1	0	0	0	0	0	0	U0BRG [Address 00A1h]

64 (0x40) setting

(6) Set the UART0 transmit interrupt control register (set interrupts to disable).

UART0 Transmit Interrupt Control Register

b7							b0	
0	0	0	0	0	0	0	0	S0TIC [Address 0051h]

ILVL2 to ILVL0	Interrupt priority level select bits 2 to 0
	Level 0 (interrupt disabled)
IR	Interrupt request bit
	No interrupt request
($\overline{b7}$-$\overline{b4}$)	Nothing is assigned
	Set to 0.

(7) Set the UART0 receive interrupt control register (set interrupts to disable).

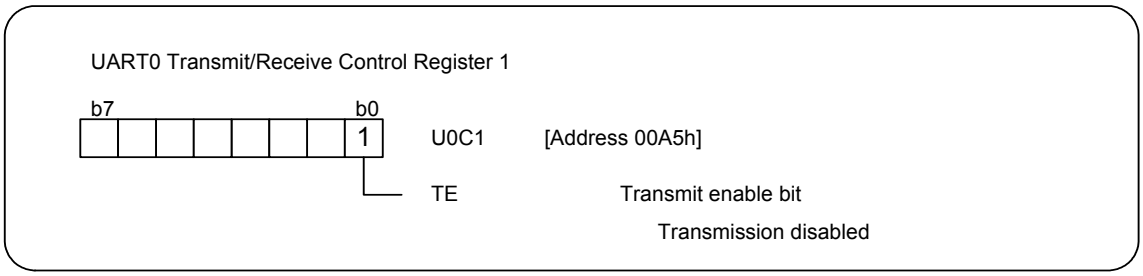
UART0 Receive Interrupt Control Register

b7							b0	
0	0	0	0	0	0	0	0	S0RIC [Address 0052h]

ILVL2 to ILVL0	Interrupt priority level select bits 2 to 0
	Level 0 (interrupt disabled)
IR	Interrupt request bit
	No interrupt request
($\overline{b7}$-$\overline{b4}$)	Nothing is assigned
	Set to 0.

4.2.2 Transmission Setting

(1) Set the TE bit in the U0C1 register to 1.

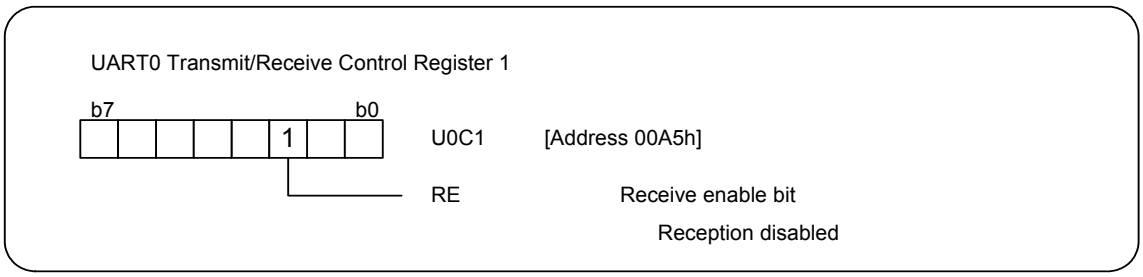


(2) Confirm that the TI bit in the U0C1 register is set to 1.

(3) Write transmit data to the U0TB register.

4.2.3 Reception Setting

(1) Set the RE bit in the U0C1 register to 1.

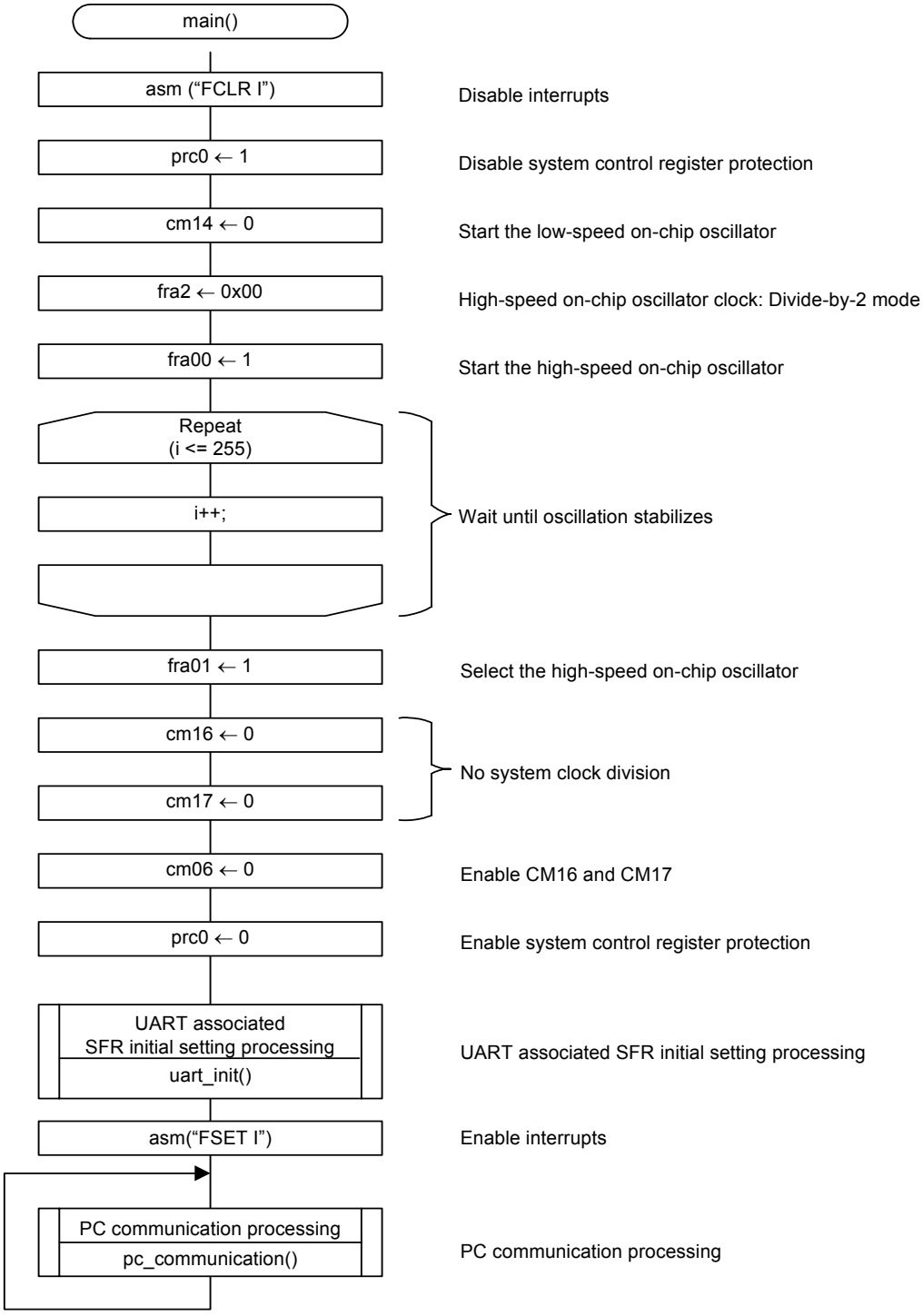


(2) Confirm that the RI bit in the U0C1 register is set to 1.

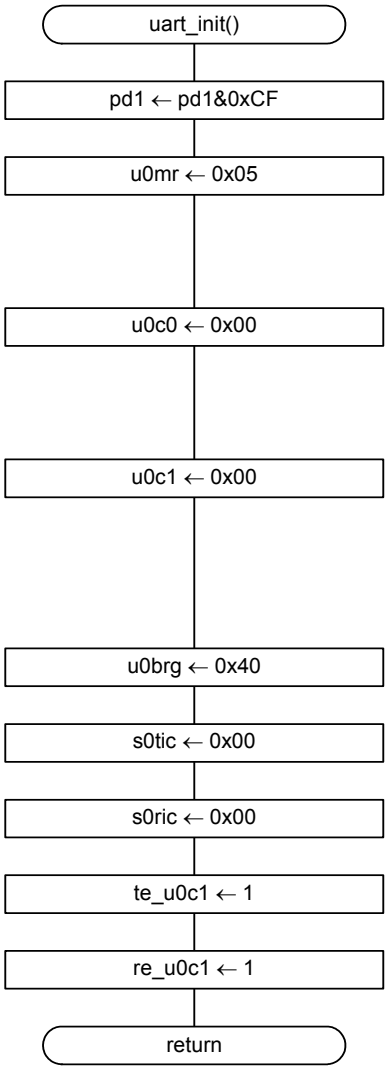
(3) Read the U0RB register.

5. Flowchart

5.1 Main Function



5.2 UART Associated SFR Initial Setting Processing



P1_5 (RXD0) pin, P1_4 (TXD0) pin: Set to an input port

UART mode transfer data 8 bits
1 stop bit
Disable parity

Select f1
Set the TXD0 pin to CMOS output
LSB first

Disable UART0 transmission
Disable UART0 reception
UART0 interrupt source: Transmit buffer empty
Disable UART0 continuous receive mode

UART0 bit rate register: Set to 0x40

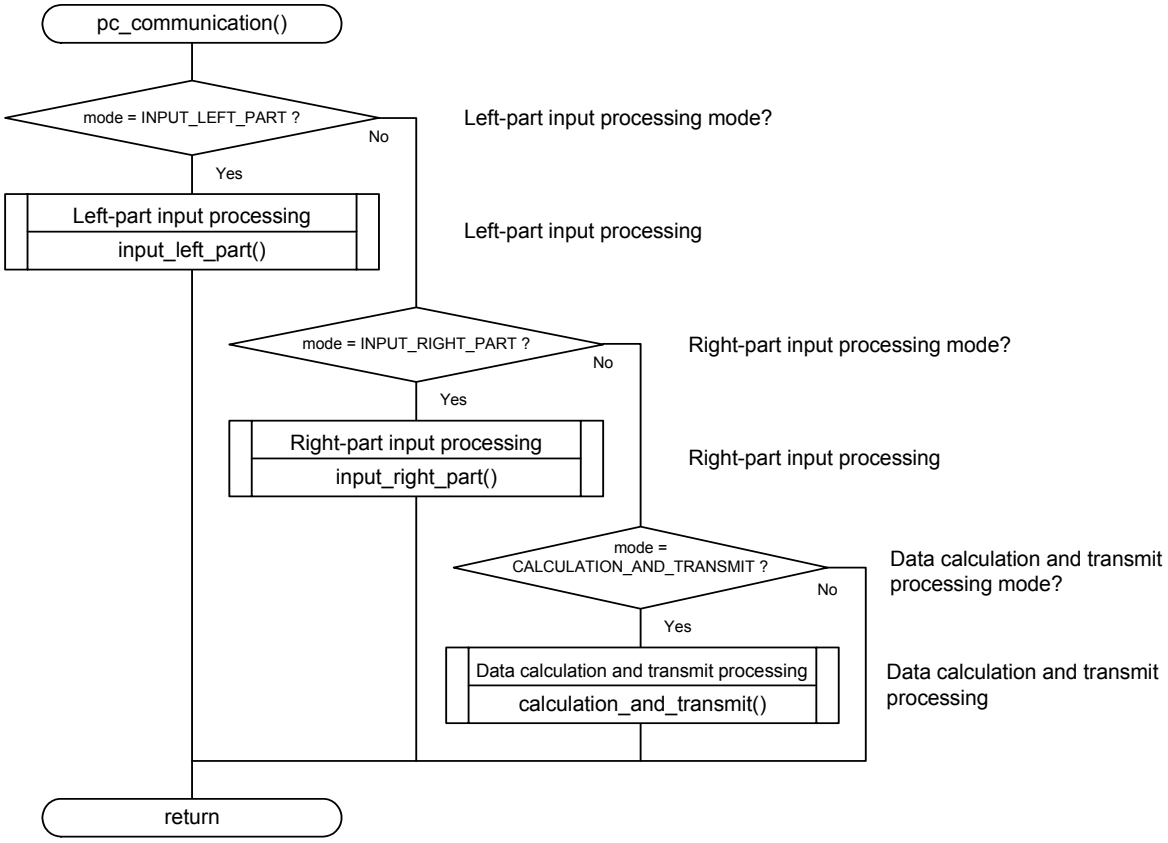
Disable the UART0 transmit interrupt

Disable the UART0 receive interrupt

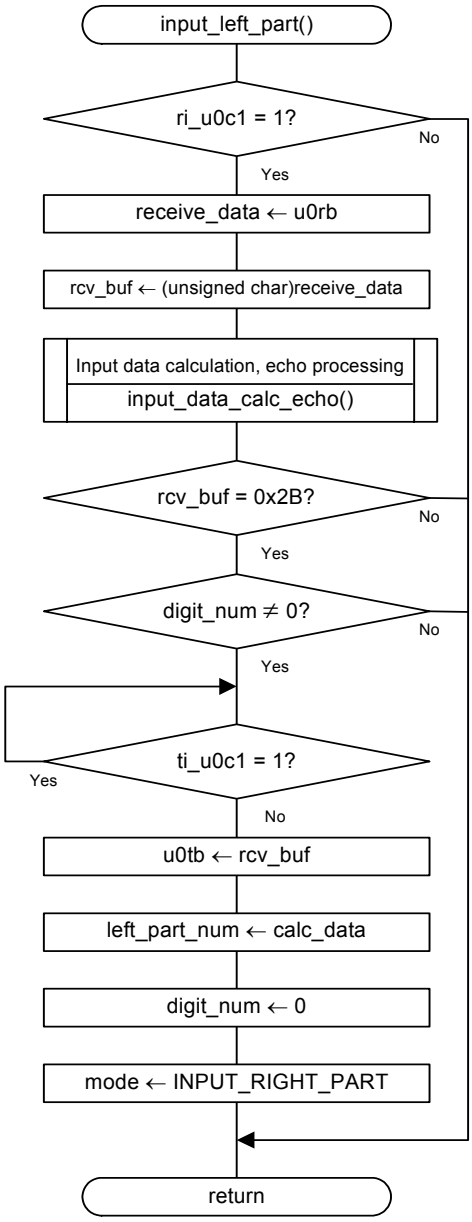
Enable UART0 transmission

Enable UART0 reception

5.3 PC Communication Processing



5.4 Left-Part Input Processing



Any data in the U0RB register?

Receive data (16 bits)

Store the data in the variable rcv_buf

Input data calculation and echo processing

Has + (0x2B) been received?

Has one or more digits been received?

No data in U0TB?

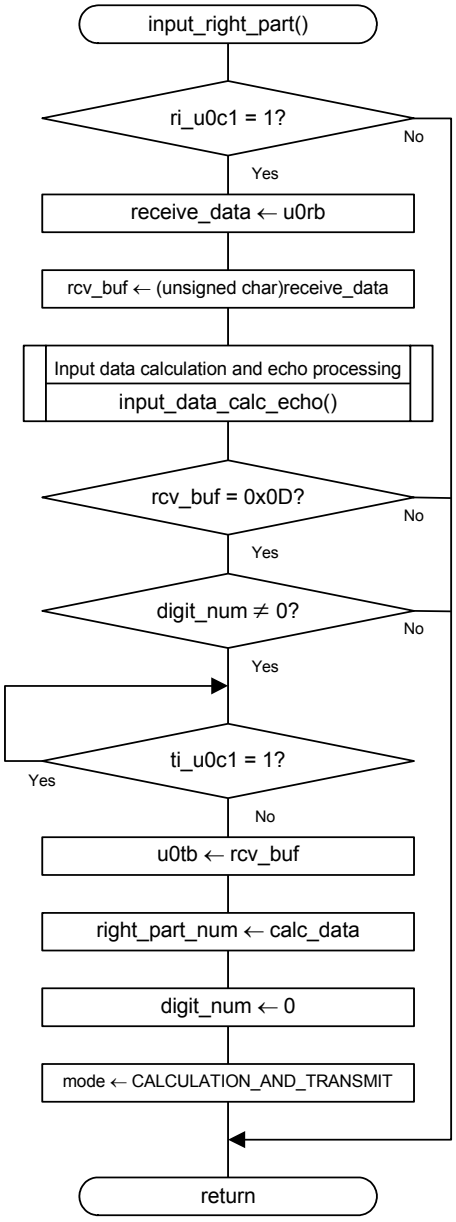
Transmit + (0x2B) (echo)

Store the input data for the left-part

Clear the input data for the number of digits

Set to right-part input processing mode

5.5 Right-Part Input Processing



Any data in the U0RB register?

Receive data (16 bits)

Store the data in the variable rcv_buf

Input data calculation and echo processing

Has CR (0x0D) been received?

Has one or more digits been received?

No data in U0TB?

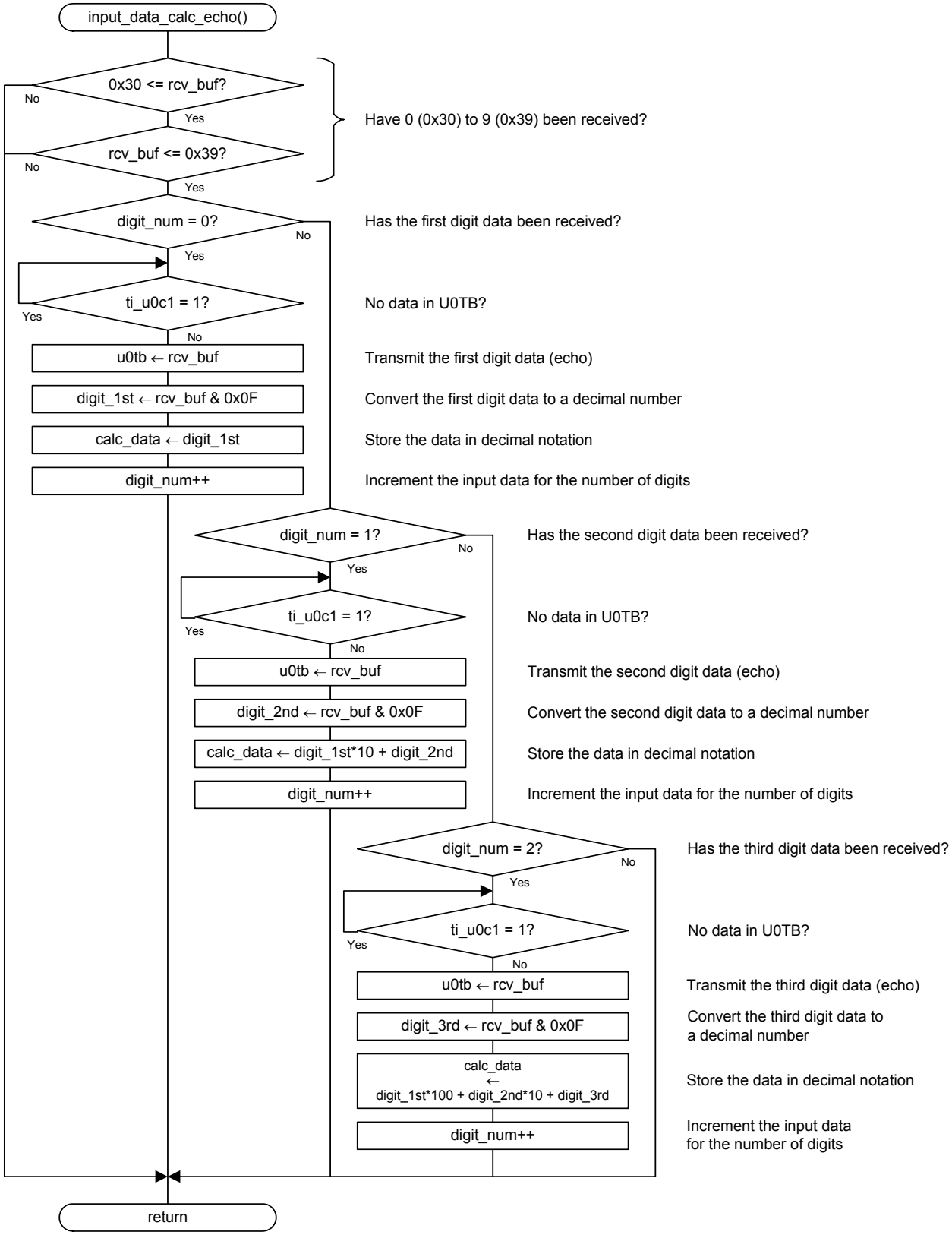
Transmit CR (0x0D) (echo)

Store the input data for the right-part

Clear the input data for the number of digits

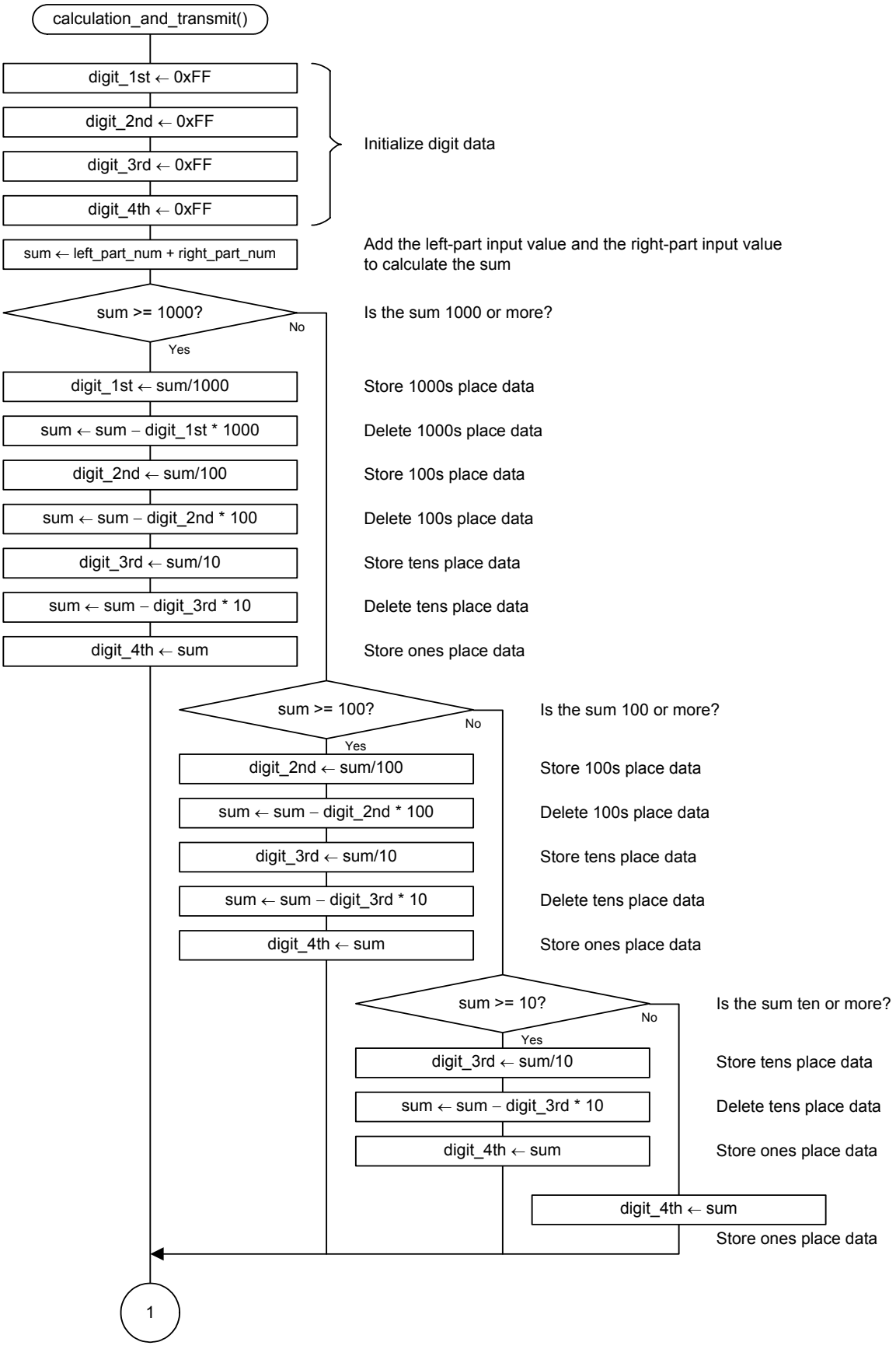
Set to data calculation and transmit processing mode

5.6 Input Data Calculation and Echo Processing

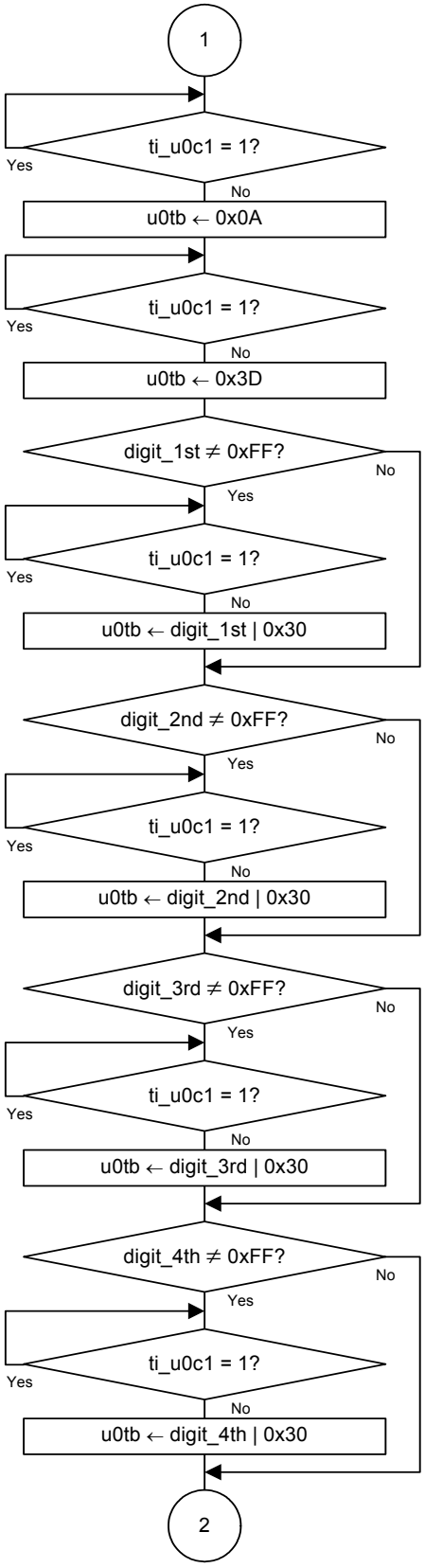


5.7 Data Calculation and Transmit Processing

5.7.1 Data Calculation and Transmit Processing 1



5.7.2 Data Calculation and Transmit Processing 2



No data in U0TB?

Transmit LF/NL (0x0A)

No data in U0TB?

Transmit = (0x3D)

Is the 1000th digit data present?

No data in U0TB?

Convert the 1000th digit data to ASCII code and transmit the code

Is the 100th digit data present?

No data in U0TB?

Convert the 100th digit data to ASCII code and transmit the code

Is the tenth digit data present?

No data in U0TB?

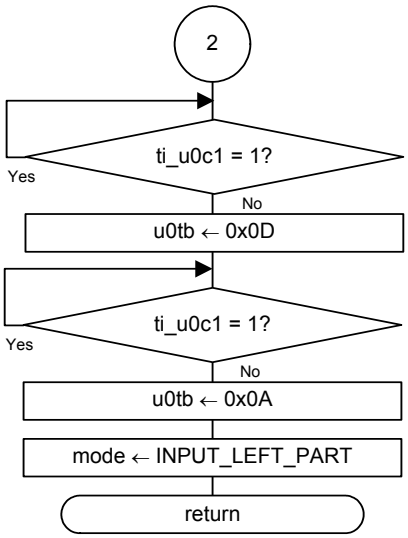
Convert the tenth digit data to ASCII code and transmit the code

Is the first digit data present?

No data in U0TB?

Convert the first digit data to ASCII code and transmit the code

5.7.3 Data Calculation and Transmit Processing 3



No data in U0TB?

Transmit CR (0x0D)

No data in U0TB?

Transmit LF/NL (0x0A)

Set to left-part input processing mode

6. Sample Programming Code

A sample program can be downloaded from the Renesas Technology website.
To download, click “Application Notes” in the left-hand side menu of the R8C/Tiny Series page.

7. Reference Documents

Hardware Manual
R8C/25 Group Hardware Manual
The latest version can be downloaded from the Renesas Technology website.

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Rev.	Date	Description	
		Page	Summary
1.00	July 31, 2007	–	First Edition issued

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