

Preliminary Application Note

V850E/IF3, V850E/IG3

32-bit Single-Chip Microcontrollers

Sample Programs for Serial Communication (UARTA)

V850E/IF3:

***μ*PD70F3451**

***μ*PD70F3452**

V850E/IG3:

***μ*PD70F3453**

***μ*PD70F3454**

[MEMO]

NOTES FOR CMOS DEVICES

① VOLTAGE APPLICATION WAVEFORM AT INPUT PIN

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (MAX) and V_{IH} (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (MAX) and V_{IH} (MIN).

② HANDLING OF UNUSED INPUT PINS

Unconnected CMOS device inputs can be cause of malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

③ PRECAUTION AGAINST ESD

A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it when it has occurred. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

④ STATUS BEFORE INITIALIZATION

Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

⑤ POWER ON/OFF SEQUENCE

In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current.

The correct power on/off sequence must be judged separately for each device and according to related specifications governing the device.

⑥ INPUT OF SIGNAL DURING POWER OFF STATE

Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

Caution: This product uses SuperFlash® technology licensed from Silicon Storage Technology, Inc.

SuperFlash is a registered trademark of Silicon Storage Technology, Inc. in several countries including the United States and Japan.

- **The information contained in this document is being issued in advance of the production cycle for the product. The parameters for the product may change before final production or NEC Electronics Corporation, at its own discretion, may withdraw the product prior to its production.**
- No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Electronics. NEC Electronics assumes no responsibility for any errors that may appear in this document.
- NEC 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 NEC Electronics products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Electronics or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of a customer's equipment shall be done under the full responsibility of the customer. NEC Electronics assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special", and "Specific". The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of an NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics products before using it in a particular application.
 - "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.
 - "Special": 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, life support systems and medical equipment for life support, etc.

The quality grade of NEC Electronics products is "Standard" unless otherwise expressly specified in NEC Electronics data sheets or data books, etc. If customers wish to use NEC Electronics products in applications not intended by NEC Electronics, they must contact an NEC Electronics sales representative in advance to determine NEC Electronics' willingness to support a given application.

(Note)

- (1) "NEC Electronics" as used in this statement means NEC Electronics Corporation and also includes its majority-owned subsidiaries.
- (2) "NEC Electronics products" means any product developed or manufactured by or for NEC Electronics (as defined above).

M5 02. 11-1

INTRODUCTION

- Cautions**
1. This Application Note explains a case where the V850E/IG3 is used as a representative microcontroller. Use this Application Note for your reference when using the V850E/IF3.
 2. Download the program used in this manual from the page of Programming Examples (<http://www.necel.com/micro/en/designsupports/sampleprogram/index.html>) in the NEC Electronics Website (<http://www.necel.com/>).
 3. This sample program is provided for reference purposes only and operations are therefore not subject to guarantee by NEC Electronics Corporation. When using sample programs, customers are advised to sufficiently evaluate this product based on their systems, before use.
 4. When using sample programs, reference the following startup routine and link directive file and adjust them if necessary.
 - Startup routine: `ig3_start.s`
 - Link directive file: `ig3_link.dir`

Target Readers This Application Note is intended for users who understand the functions of the V850E/IF3 (μ PD70F3451, 70F3452), and V850E/IG3 (μ PD70F3453, 70F3454), and who design application systems that use these microcontrollers.

Purpose This manual is intended to give users an understanding of the basic functions of the V850E/IF3 and V850E/IG3, using the application programs.

How to Use This Manual It is assumed that the reader of this Application Note has general knowledge in the fields of electrical engineering, logic circuits, and microcontrollers.

For details of hardware functions (especially register functions, setting methods, etc.) and electrical specifications

→ See the **V850E/IF3, V850E/IG3 Hardware User's Manual**.

For details of instruction functions

→ See the **V850E1 Architecture User's Manual**.

Conventions

Data significance:	Higher digits on the left and lower digits on the right
Active low representation:	$\overline{\text{xxx}}$ (overscore over pin or signal name)
Memory map address:	Higher addresses on the top and lower addresses on the bottom
Note:	Footnote for item marked with Note in the text
Caution:	Information requiring particular attention
Remark:	Supplementary information
Numeric representation:	Binary ... xxxx or xxxxB Decimal ... xxxx Hexadecimal ... xxxxH
Prefix indicating the power of 2 (address space, memory capacity):	K (kilo): $2^{10} = 1,024$ M (mega): $2^{20} = 1,024^2$ G (giga): $2^{30} = 1,024^3$

The function lists are structured as follows.

Hardware name (symbol)

[Function]	Function description
[Function name]	Name of sample function
[Argument(s)]	Type and overview of argument(s)
[Processing content]	Processing content of sample function
[SFR(s) used]	Register name and setting content
[call function(s)]	Name and function of call function(s)
[Variable(s)]	Type, name, and overview of variable(s) used in sample function
[Interrupt(s)]	Name of function
[Interrupt source(s)]	Name
[File name]	Name of corresponding sample program file
[Caution(s)]	Caution(s) upon function usage

Interrupt function

[Function name]	Name of interrupt function
[Servicing content]	Servicing content of interrupt function
[SFR(s) used]	Name of interrupt and conditions for occurrence
[call function(s)]	None
[Variable(s)]	Name of variable, function
[File name]	Name of corresponding sample program file
[Caution(s)]	None

Related Documents

The related documents indicated in this publication may include preliminary versions. However, preliminary versions are not marked as such.

Documents related to V850E/IF3 and V850E/IG3

Document Name	Document No.
V850E1 Architecture User's Manual	U14559E
V850E/IF3, V850E/IG3 Hardware User's Manual	U18279E
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (UARTA) Application Note	This manual
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (UARTB) Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (CSIB) Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Serial Communication (I ² C) Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for DMA Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer M Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Watchdog Timer Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer AA Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer AB Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Timer T Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Port Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Clock Generator Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Standby Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Interrupt Function Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for A/D Converters 0 and 1 Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for A/D Converter 2 Application Note	To be prepared
V850E/IF3, V850E/IG3 Sample Programs for Low-Voltage Detector (LVI) Function Application Note	To be prepared
V850E/IF3, V850E/IG3 6-Phase PWM Output Control by Timer AB, Timer Q Option, Timer AA, A/D Converters 0 and 1 Application Note	U18717E

CONTENTS

CHAPTER 1 CONTINUOUS TRANSMISSION/RECEPTION.....	9
--------------------------------------------------	---

CHAPTER 1 CONTINUOUS TRANSMISSION/RECEPTION

[Function]	Performs continuous UARTA0 transmission/reception.
[Function name]	uarta_main
[Argument]	None
[Processing content]	Performs transmission/reception for ten times using UARTA0. Stores received data in buf_rx[], and transmitted data in buf_tx[].
[SFRs used]	<p>UA0REIC: 0x07 (Clears UARTA0 reception error interrupt request signal (INTUA0RE), releases mask, sets to priority level 7.)</p> <p>UA0TIC: 0x07 (Clears UARTA0 transmission enable interrupt request signal (INTUA0T), releases mask, sets to priority level 7.)</p> <p>UA0RIC: 0x07 (Clears UARTA0 reception end interrupt request signal (INTUA0R), releases mask, sets to priority level 7.)</p>
[call functions]	uarta_port_set, uarta_set, uarta_start, uarta_send_end, uarta_receive_end, uarta_end
[Variables]	<p>unsigned char buf_tx[]: Transmit data storing buffer</p> <p>unsigned char buf_rx[]: Receive data storing buffer</p> <p>volatile unsigned char count_tx: Transmission count variable</p> <p>volatile unsigned char count_rx: Reception count variable</p> <p>unsigned char count: Transfer data generating variable</p>
[Interrupts]	uarta_int_send, uarta_int_receive, uarta_error
[Interrupt sources]	INTUA0T, INTUA0R, INTUA0RE,
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_port_set
[Processing content]	Sets alternate-function pin to UARTA0 I/O pin.
[SFRs used]	<p>PFC4: 0x03 (Sets TXDA0 output and RXDA0 input.)</p> <p>PFCE4: 0x00 (Sets TXDA0 output and RXDA0 input.)</p> <p>PMC4: 0x03 (Sets TXDA0 output and RXDA0 input.)</p>
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_set
[Processing content]	Sets UARTA0 control register. Sets baud rate to 9,600 (bps).
[SFRs used]	UA0CTL1: 0x03 (Sets baud rate to 9,600 (bps).) UA0CTL2: 0xD0 (Sets baud rate to 9,600 (bps).) UA0OPT0: 0x14 (Sets to ordinary output of transfer data, ordinary input of transfer data.) UA0CTL0: 0x8A (Enables UARTA0 operation, sets to MSB first, and sets odd parity to output, data character length of 8 bits, and stop bit length of 1 bit.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_start
[Processing content]	Enables transmission/reception and writes data to UA0TX register.
[SFRs used]	UA0CTL0.UA0TXE: 1 (Enables transmission operation.) UA0CTL0.UA0RXE: 1 (Enables reception operation.) UA0TX Transmit data register
[call function]	None
[Variables]	unsigned char buf_tx[]: Transmit data storing buffer
[File name]	uarta.c
[Caution]	Set UA0RXE and UA0TXE bits to 1 after setting UA0CTL.UA0PWR bit to 1.

[Function name]	uarta_send_end
[Processing content]	Disables transmission operation.
[SFR used]	UA0CTL0.UA0TXE: 0 (Disables transmission operation.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_receive_end
[Processing content]	Disables reception operation.
[SFR used]	UA0CTL0.UA0RXE: 0 (Disables reception operation.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_end
[Processing content]	Disables operation of UARTA0.
[SFR used]	UA0CTL0.UA0PWR: 0 (Disables operation of UARTA0.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

Interrupt function

[Function name]	uarta_int_send
[Processing content]	Writes transmit data to transmit data register. Stops transmission operation if number of transmissions and the count value match.
[SFR used]	UA0TX Transmit data register
[call function]	None
[Variables]	unsigned char buf_tx[]: Transmit data storing buffer volatile unsigned char count_tx: Transmission count variable
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_int_receive
[Processing content]	Writes receive data to receive data register. Stops and disables reception operation if number of receptions and the count value match.
[SFR used]	UA0RX Receive data register
[call function]	None
[Variables]	unsigned char buf_rx[]: Receive data storing buffer volatile unsigned char count_rx: Reception count variable
[File name]	uarta.c
[Caution]	To stop reception operation, set UA0PWR bit to 0 after setting UA0RXE and UA0TXE bits to 0.

[Function name]	uarta_error
[Processing content]	Clears error flag when reception error occurs.
[SFRs used]	UA0STR.UA0PE: 0 (Clears parity error flag.) UA0STR.UA0FE: 0 (Clears framing error flag.) UA0STR.UA0OVE: 0 (Clears overrun error flag.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

Figure 1-1. Continuous Transmission/Reception (1/4)

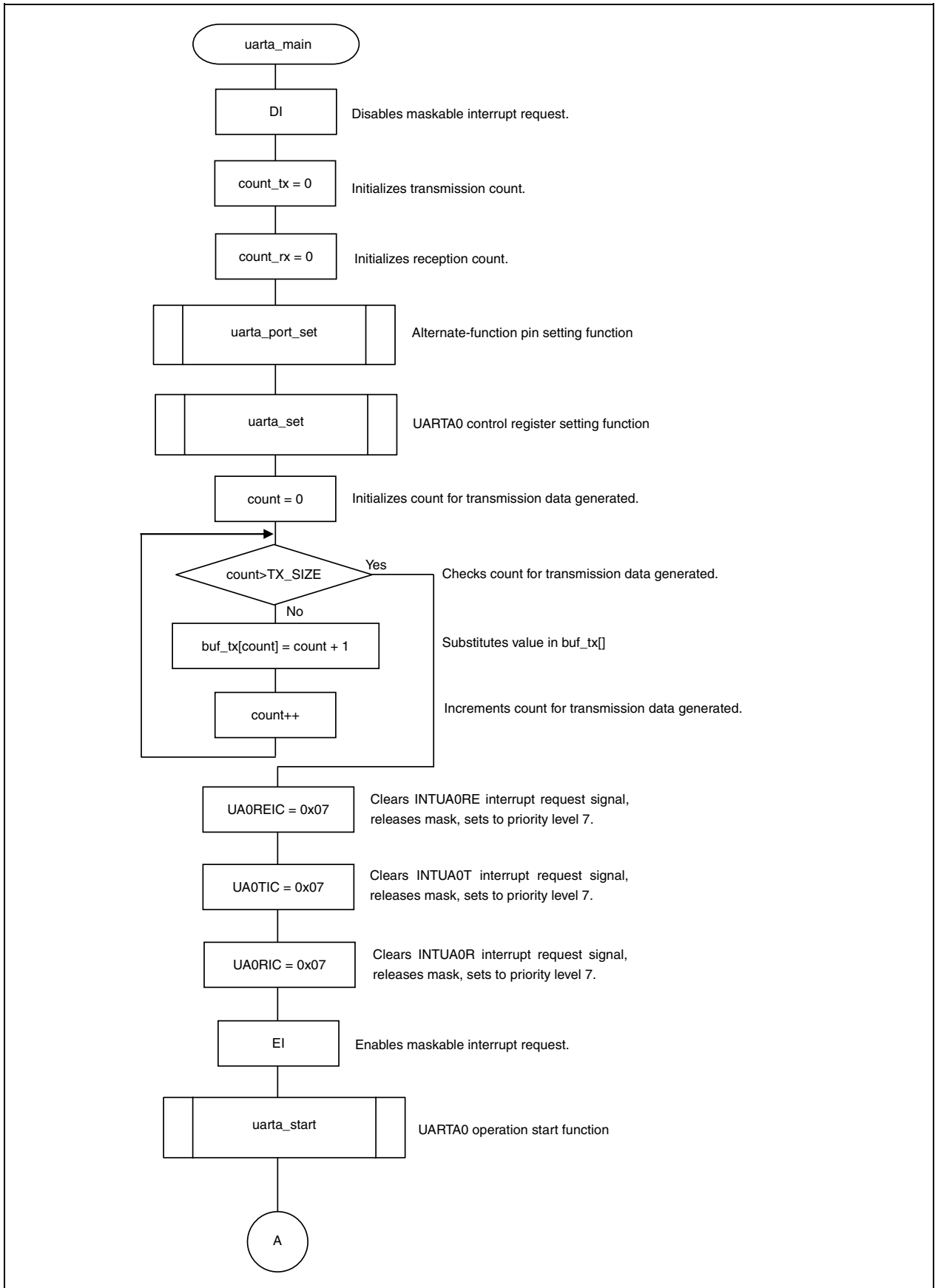


Figure 1-1. Continuous Transmission/Reception (2/4)

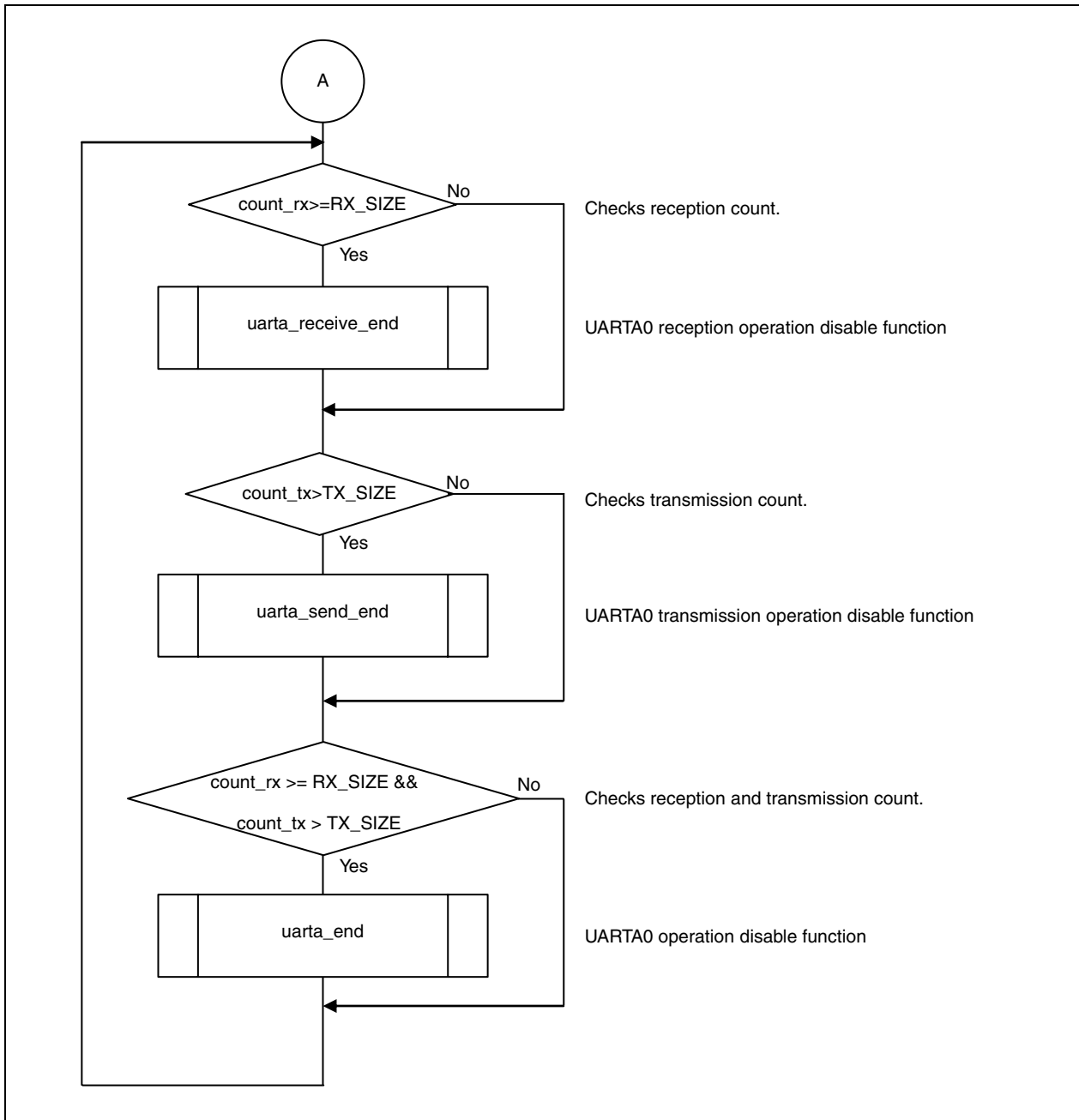


Figure 1-1. Continuous Transmission/Reception (3/4)

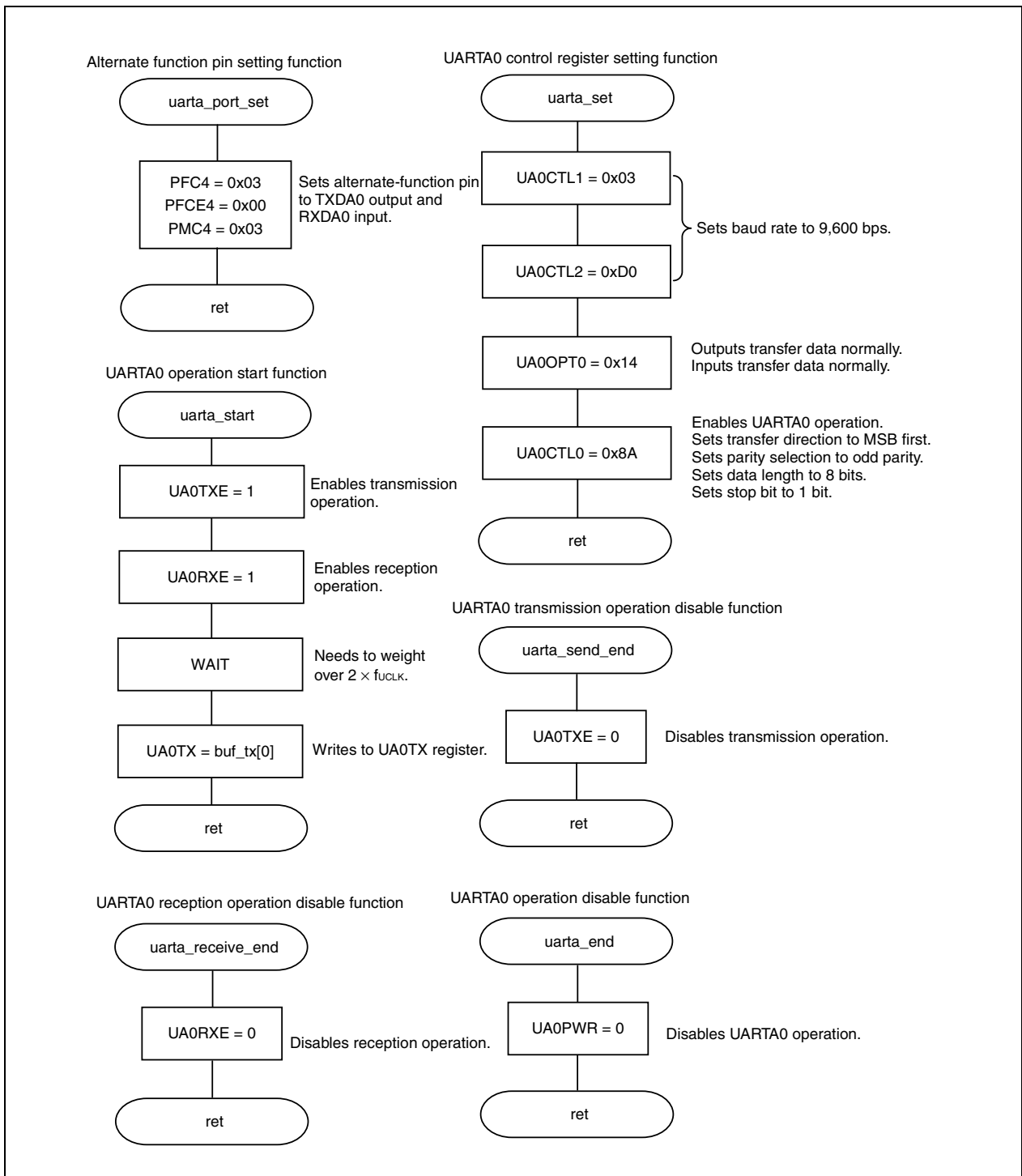
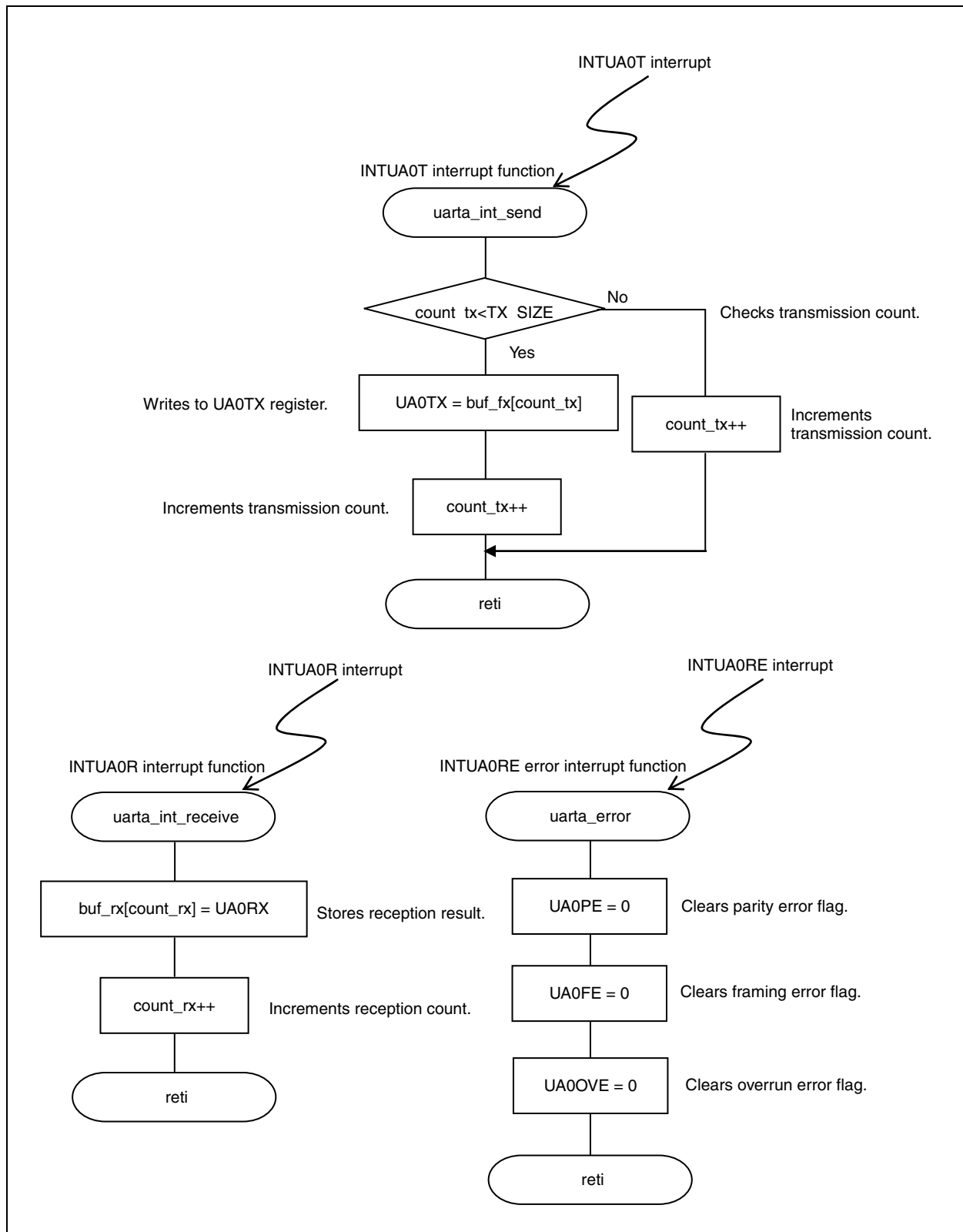


Figure 1-1. Continuous Transmission/Reception (4/4)



*For further information,
please contact:*

NEC Electronics Corporation
1753, Shimonumabe, Nakahara-ku,
Kawasaki, Kanagawa 211-8668,
Japan
Tel: 044-435-5111
<http://www.necel.com/>

[America]

NEC Electronics America, Inc.
2880 Scott Blvd.
Santa Clara, CA 95050-2554, U.S.A.
Tel: 408-588-6000
800-366-9782
<http://www.am.necel.com/>

[Europe]

NEC Electronics (Europe) GmbH
Arcadiastrasse 10
40472 Düsseldorf, Germany
Tel: 0211-65030
<http://www.eu.necel.com/>

Hanover Office
Podbielskistrasse 166 B
30177 Hannover
Tel: 0 511 33 40 2-0

Munich Office
Werner-Eckert-Strasse 9
81829 München
Tel: 0 89 92 10 03-0

Stuttgart Office
Industriestrasse 3
70565 Stuttgart
Tel: 0 711 99 01 0-0

United Kingdom Branch
Cygnus House, Sunrise Parkway
Linford Wood, Milton Keynes
MK14 6NP, U.K.
Tel: 01908-691-133

Succursale Française
9, rue Paul Dautier, B.P. 52
78142 Velizy-Villacoublay Cédex
France
Tel: 01-3067-5800

Sucursal en España
Juan Esplandiú, 15
28007 Madrid, Spain
Tel: 091-504-2787

Tyskland Filial
Täby Centrum
Entrance S (7th floor)
18322 Täby, Sweden
Tel: 08 638 72 00

Filiale Italiana
Via Fabio Filzi, 25/A
20124 Milano, Italy
Tel: 02-667541

Branch The Netherlands
Steijgerweg 6
5616 HS Eindhoven
The Netherlands
Tel: 040 265 40 10

[Asia & Oceania]

NEC Electronics (China) Co., Ltd
7th Floor, Quantum Plaza, No. 27 ZhiChunLu Haidian
District, Beijing 100083, P.R.China
Tel: 010-8235-1155
<http://www.cn.necel.com/>

Shanghai Branch
Room 2509-2510, Bank of China Tower,
200 Yincheng Road Central,
Pudong New Area, Shanghai, P.R.China P.C:200120
Tel:021-5888-5400
<http://www.cn.necel.com/>

Shenzhen Branch
Unit 01, 39/F, Excellence Times Square Building,
No. 4068 Yi Tian Road, Futian District, Shenzhen,
P.R.China P.C:518048
Tel:0755-8282-9800
<http://www.cn.necel.com/>

NEC Electronics Hong Kong Ltd.
Unit 1601-1613, 16/F., Tower 2, Grand Century Place,
193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: 2886-9318
<http://www.hk.necel.com/>

NEC Electronics Taiwan Ltd.
7F, No. 363 Fu Shing North Road
Taipei, Taiwan, R. O. C.
Tel: 02-8175-9600
<http://www.tw.necel.com/>

NEC Electronics Singapore Pte. Ltd.
238A Thomson Road,
#12-08 Novena Square,
Singapore 307684
Tel: 6253-8311
<http://www.sg.necel.com/>

NEC Electronics Korea Ltd.
11F., Samik Lavied'or Bldg., 720-2,
Yeoksam-Dong, Kangnam-Ku,
Seoul, 135-080, Korea
Tel: 02-558-3737
<http://www.kr.necel.com/>