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April 1st, 2010
Renesas Electronics Corporation

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Manual for Using Sample Program Functions Serial Communication (UARTA) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2)

This manual explains the sample program functions of the asynchronous serial interface A (UARTA) for the V850E/IA4 microcontroller.

The explanations are based on usage with the V850E/IA4 microcontroller. Refer to this manual when using the V850E/IA3, V850ES/IK1, and V850ES/IE2 microcontrollers.

Caution

This sample program is provided for reference purposes only and operations are therefore not subject to guarantee by NEC Electronics Corporation. When using this sample program, customers are kindly advised to sufficiently evaluate this product based on their system before usage.

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Date Published November 2006 N CP(K)

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.

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M8E 02. 11-1

INTRODUCTION

Cautions 1. Download the program used in this manual from the NEC Electronics Website (http://www.necel.com/).

2. When using this sample program, reference the following startup file and link directive file and adjust them if as necessary.

- **Startup file: IA4_start.s**
- **Link directive file: IA4_link.dir**

Conventions The function lists are structured as follows.

Hardware name (symbol)

[Function]	Function description
[Function name]	Name of sample function
[Argument]	Type and overview of argument
[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
[Processing content]	Processing content of interrupt function
[SFR(s) used]	Register name and setting content
[call function(s)]	None
[Variable(s)]	Name of variable, function
[File name]	Name of corresponding sample program file
[Caution(s)]	None

Product Differences The differences between the V850E/IA4 and the V850E/IA3, V850ES/IK1, and V850ES/IE2 related to the asynchronous serial interface A (UARTA) are shown below.

Item	V850E/IA4	V850E/IA3	V850ES/IK1	V850ES/IE2
Channel	2 channels (of which 1 channel has an alternate function as CSIB)	2 channels (of which 1 channel has an alternate function as CSIB)	2 channels	
Base clock (f_{UCLK})	$f_{XX}/2$, $f_{XX}/4$, $f_{XX}/8$, $f_{XX}/16$, $f_{XX}/32$, $f_{XX}/64$, $f_{XX}/128$, $f_{XX}/256$, $f_{XX}/512$, $f_{XX}/1024$, $f_{XX}/2048$, $f_{XX}/4096$	$f_{XX}/2$, $f_{XX}/4$, $f_{XX}/8$, $f_{XX}/16$, $f_{XX}/32$, $f_{XX}/64$, $f_{XX}/128$, $f_{XX}/256$, $f_{XX}/512$, $f_{XX}/1024$, $f_{XX}/2048$, $f_{XX}/4096$	f_{XX}, $f_{XX}/2$, $f_{XX}/4$, $f_{XX}/8$, $f_{XX}/16$, $f_{XX}/32$, $f_{XX}/64$, $f_{XX}/128$, $f_{XX}/256$, $f_{XX}/512$, $f_{XX}/1024$, $f_{XX}/2048$	

Remark f_{XX}: Peripheral clock frequency

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/IA3, V850E/IA4, V850ES/IK1, and V850ES/IE2

Document Name	Document No.
V850E1 Architecture User's Manual	U14559E
V850E/IA3, V850E/IA4 Hardware User's Manual	U16543E
V850ES Architecture User's Manual	U15943E
V850ES/IK1 Hardware User's Manual	U16910E
V850ES/IE2 Hardware User's Manual	U17716E
Inverter Control by V850 Series Vector Control by Hole Sensor Application Note	U17338E
Inverter Control by V850 Series Vector Control by Encoder Application Note	U17324E
Inverter Control by V850 Series 120° Excitation Method Control by Zero-Cross Detection Application Note	U17209E
Manual for Using Sample Program Functions Serial Communication (UARTA) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	This manual
Manual for Using Sample Program Functions Serial Communication (CSIB) (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18234E
Manual for Using Sample Program Functions DMA Functions (V850E/IA3, V850E/IA4) Application Note	U18235E
Manual for Using Sample Program Functions Timer M (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18236E
Manual for Using Sample Program Functions Watchdog Timer (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18237E
Manual for Using Sample Program Functions Timer P (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18238E
Manual for Using Sample Program Functions Timer Q (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18239E
Manual for Using Sample Program Functions Timer ENC (V850E/IA3, V850E/IA4) Application Note	U18240E
Manual for Using Sample Program Functions Port Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18241E
Manual for Using Sample Program Functions Clock Generator (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18242E
Manual for Using Sample Program Functions Standby Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18243E
Manual for Using Sample Program Functions Interrupt Functions (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18244E
Manual for Using Sample Program Functions A/D Converters 0 and 1 (V850E/IA3, V850E/IA4, V850ES/IK1, V850ES/IE2) Application Note	U18245E
Manual for Using Sample Program Functions A/D Converter 2 (V850E/IA3, V850E/IA4) Application Note	U18246E

Asynchronous serial interface A (UARTAn) (n = 0, 1)

[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]	UA0REIC: 0x07 (Clears UARTA0 reception error interrupt request signal (INTUA0RE), releases mask, sets to priority level 7.) UA0TIC: 0x07 (Clears UARTA0 transmission enable interrupt request signal (INTUA0T), releases mask, sets to priority level 7.) UA0RIC: 0x07 (Clears UARTA0 reception end interrupt request signal (INTUA0R), releases mask, sets to priority level 7.)
[call functions]	uarta_port_set, uarta_set, uarta_start, uarta_receive_end, uarta_send_end, uarta_end
[Variables]	unsigned char buf_tx[]: Transmit data storing buffer unsigned char buf_rx[]: Receive data storing buffer volatile unsigned char count_tx: Transmission count variable volatile unsigned char count_rx: Reception count variable unsigned char count: Transfer data generating variable
[Interrupts]	uarta_error, uarta_int_send, uarta_int_receive
[Interrupt sources]	INTUA0RE, INTUA0T, INTUA0R
[File name]	uarta.c
[Caution]	None

[Function name]	uarta_port_set
[Processing content]	Sets alternate-function pin to UARTA0 I/O pin.
[SFR used]	PMC3: 0x03 (Sets TXDA0 output and RXDA0 input.)
[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]	volatile unsigned char count_tx: Transmission count variable
	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_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_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

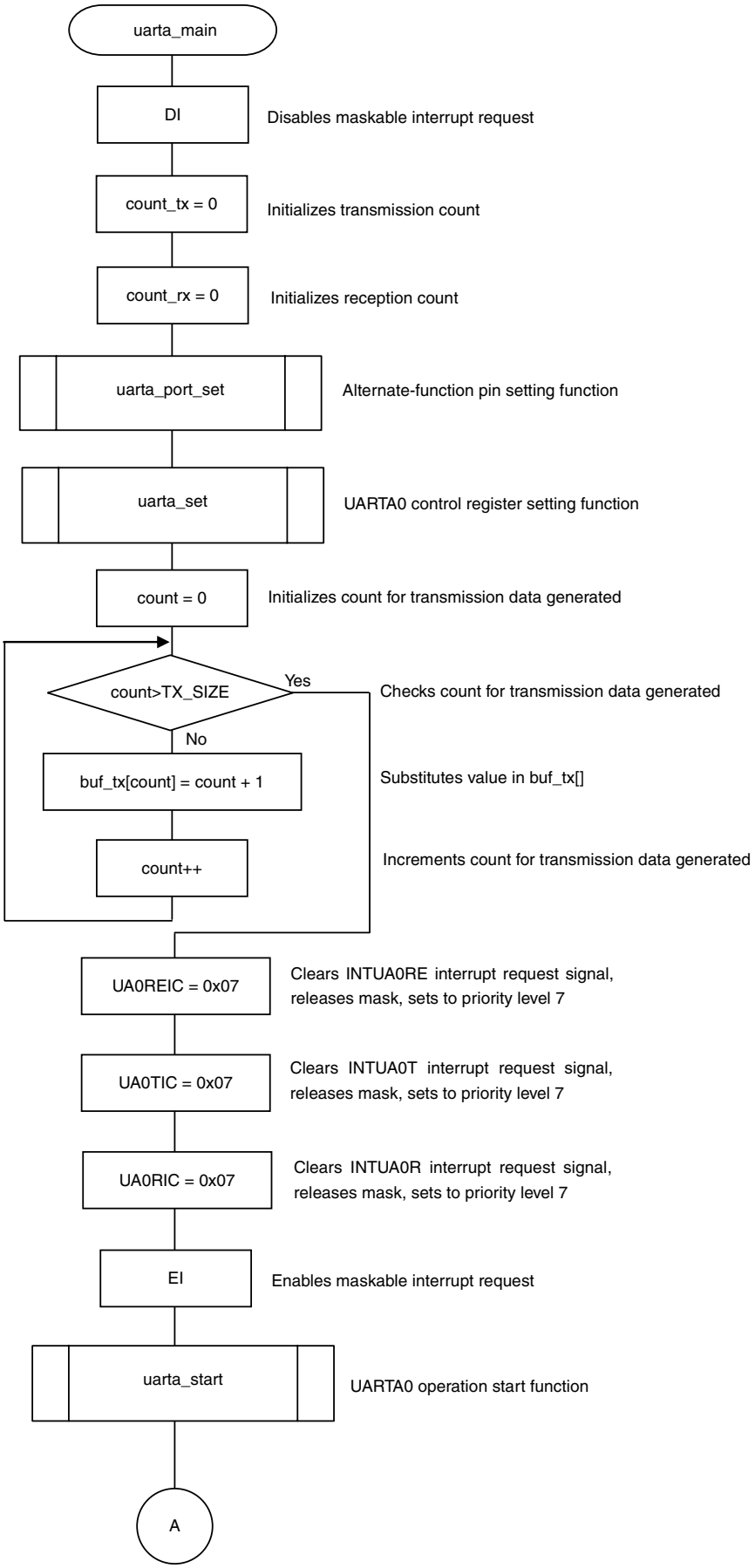
[Function name]	uarta_ end
[Processing content]	Disables operation of UARTA0.
[SFR used]	UA0CTL0.UA0PWR: 0 (Disables operation of UARTA0.)
[call function]	None
[Variable]	None
[File name]	uarta.c
[Caution]	None

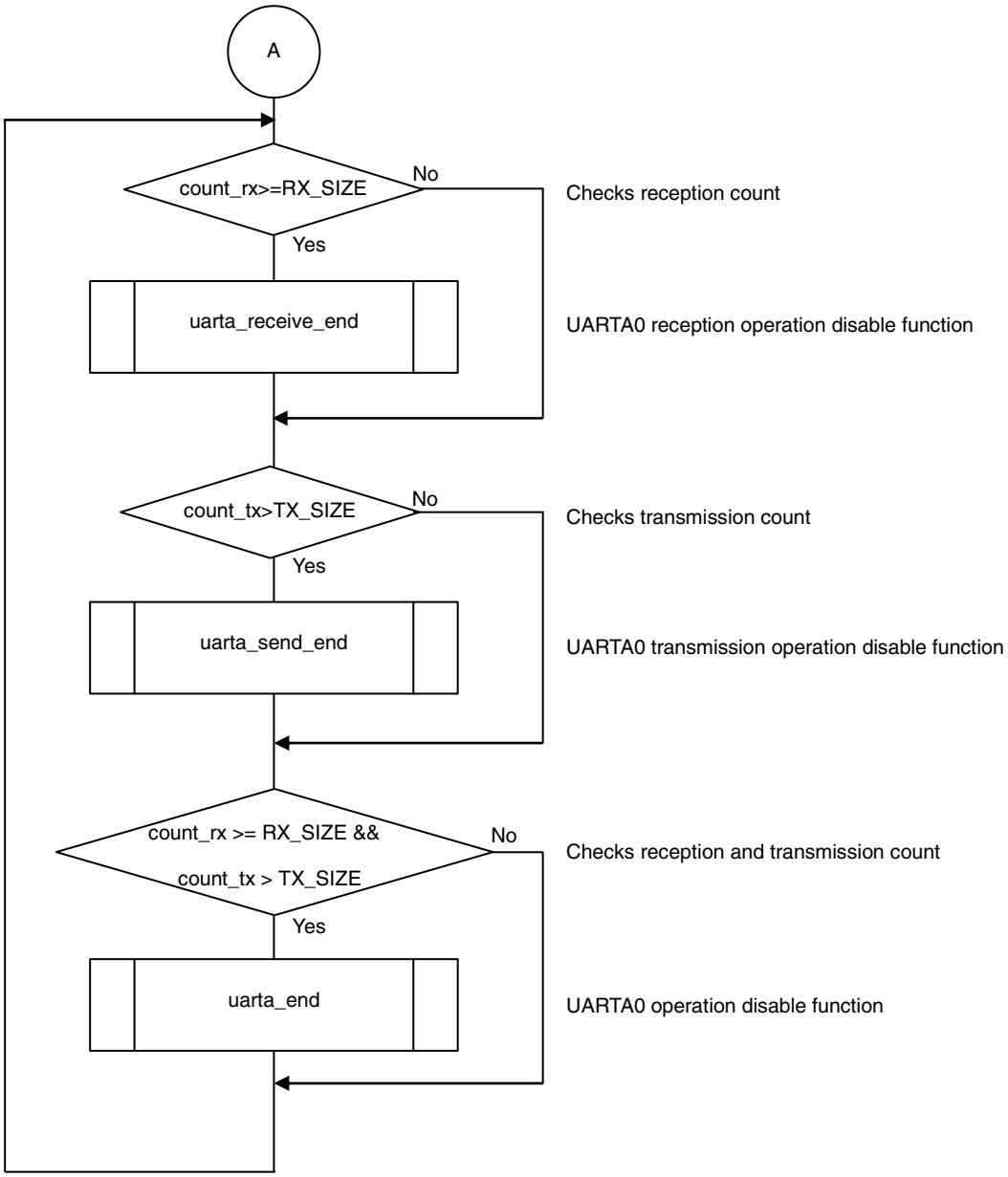
Interrupt function

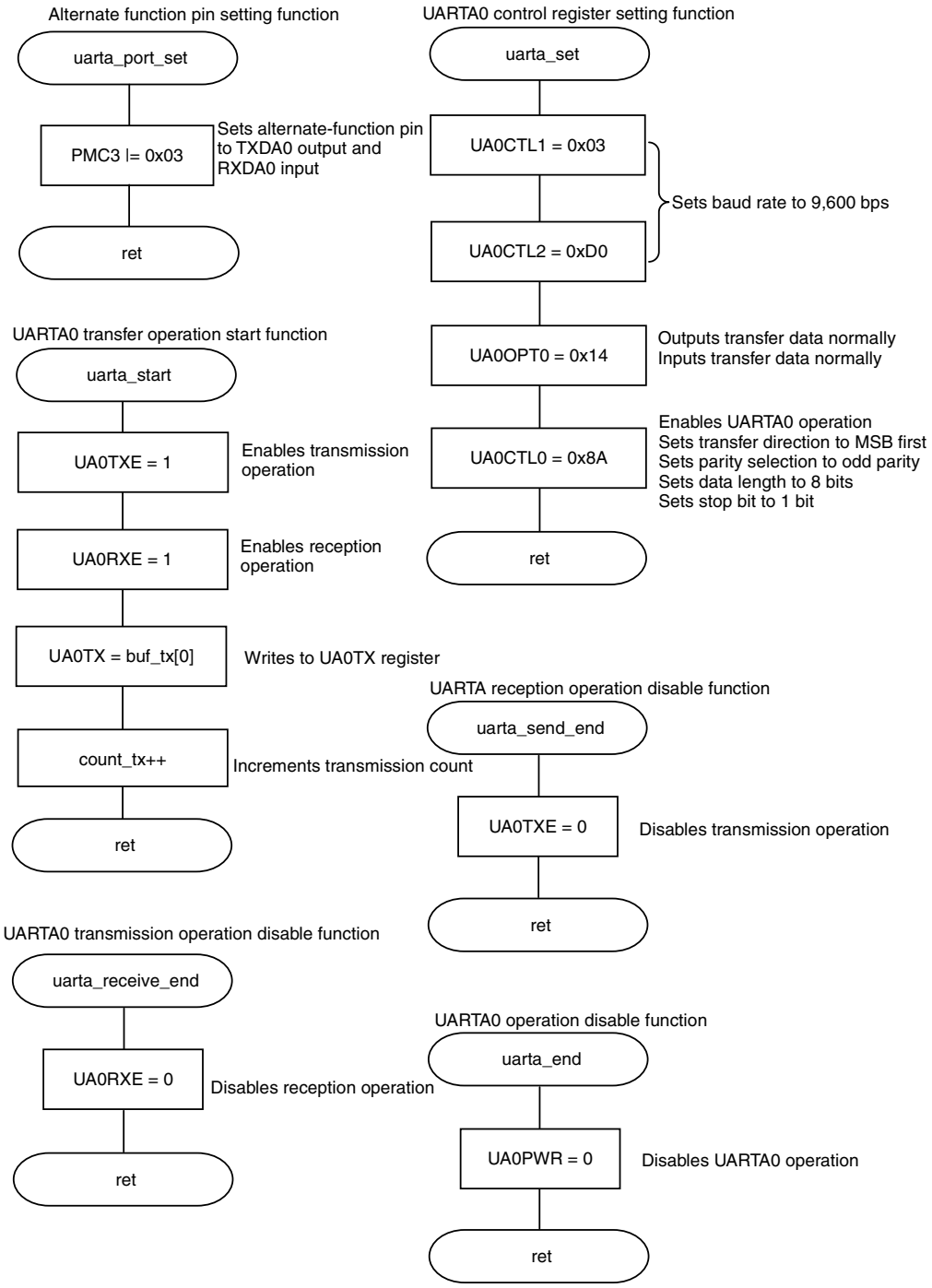
[Function name]	uarta_int_send	
[Processing content]	Writes transmit data to transmit data register.	
	Stops transmission operation if number of transmissions and counts match.	
[SFR used]	UA0TX Transmit data register	
[call function]	None	
[Variables]	unsigned char buf_tx[]:	Transmit data storing buffer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

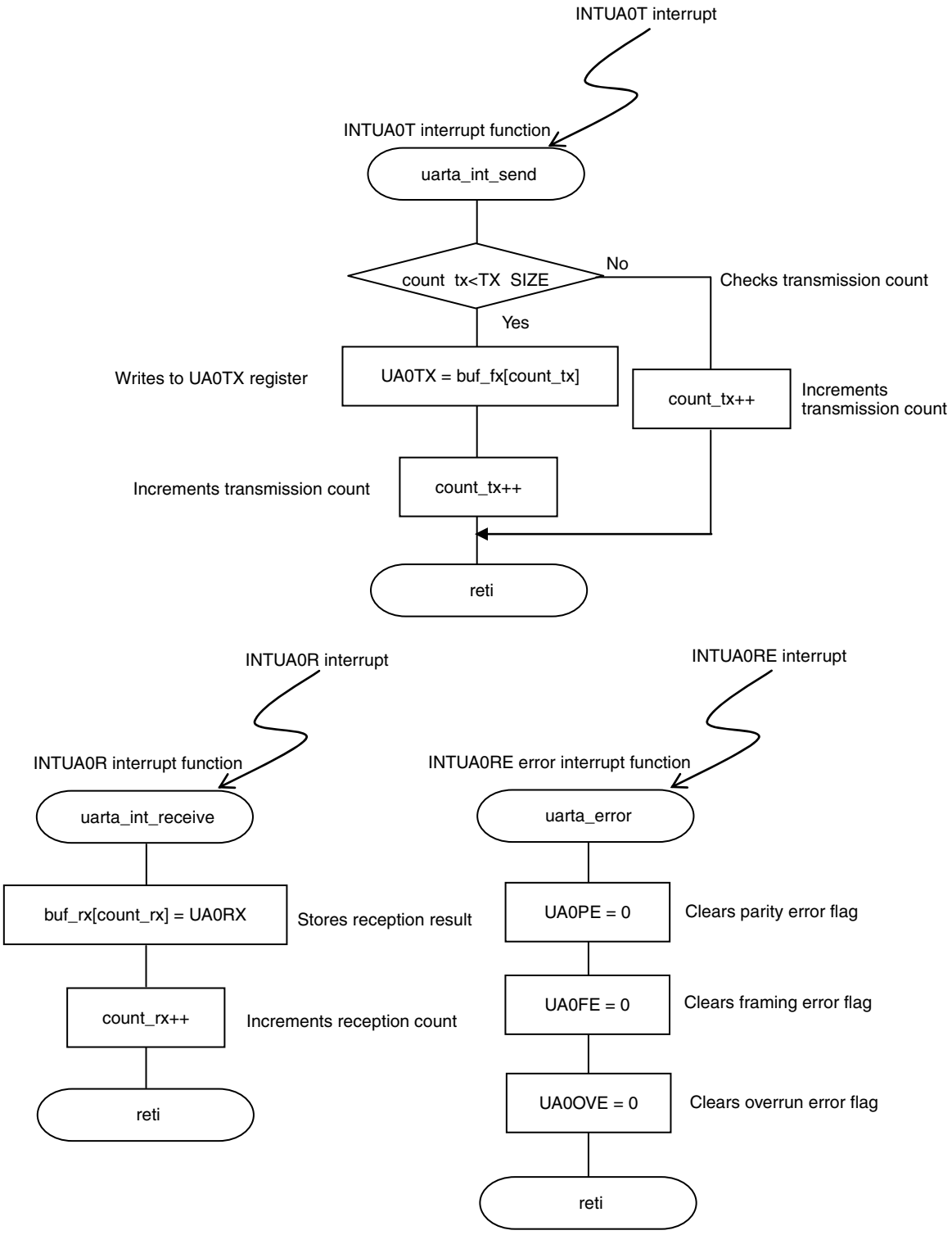
[Function name]	uarta_int_receive
[Processing content]	Writes receive data to receive data register. Stops and disables reception operation if number of receptions and counts match.
[SFR used]	UA0RX Receive data register
[call function]	None
[Variables]	unsigned char buf_rx[]: Receive data storing buffer 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


uarta_main
DI
Disables maskable interrupt request
count_tx = 0
Initializes transmission count
count_rx = 0
Initializes reception count
uarta_port_set
Alternate-function pin setting function
uarta_set
UARTA0 control register setting function
count = 0
Initializes count for transmission data generated
count>TX_SIZE
Yes
Checks count for transmission data generated
No
buf_tx[count] = count + 1
Substitutes value in buf_tx[]
count++
Increments count for transmission data generated
UA0REIC = 0x07
Clears INTUA0RE interrupt request signal, releases mask, sets to priority level 7
UA0TIC = 0x07
Clears INTUA0T interrupt request signal, releases mask, sets to priority level 7
UA0RIC = 0x07
Clears INTUA0R interrupt request signal, releases mask, sets to priority level 7
EI
Enables maskable interrupt request
uarta_start
UARTA0 operation start function
A


A
count_rx>=RX_SIZE
No
Yes
Checks reception count
uarta_receive_end
UARTA0 reception operation disable function
count_tx>TX_SIZE
No
Yes
Checks transmission count
uarta_send_end
UARTA0 transmission operation disable function
count_rx >= RX_SIZE &&
count_tx > TX_SIZE
No
Yes
Checks reception and transmission count
uarta_end
UARTA0 operation disable function


Alternate function pin setting function
uarta_port_set
PMC3 |= 0x03
Sets alternate-function pin to TXDA0 output and RXDA0 input
ret
UARTA0 control register setting function
uarta_set
UA0CTL1 = 0x03
Sets baud rate to 9,600 bps
UA0CTL2 = 0xD0
UA0OPT0 = 0x14
Outputs transfer data normally
Inputs transfer data normally
UA0CTL0 = 0x8A
Enables UARTA0 operation
Sets transfer direction to MSB first
Sets parity selection to odd parity
Sets data length to 8 bits
Sets stop bit to 1 bit
ret
UARTA0 transfer operation start function
uarta_start
UA0TXE = 1
Enables transmission operation
UA0RXE = 1
Enables reception operation
UA0TX = buf_tx[0]
Writes to UA0TX register
count_tx++
Increments transmission count
ret
UARTA reception operation disable function
uarta_send_end
UA0TXE = 0
Disables transmission operation
ret
UARTA0 transmission operation disable function
uarta_receive_end
UA0RXE = 0
Disables reception operation
ret
UARTA0 operation disable function
uarta_end
UA0PWR = 0
Disables UARTA0 operation
ret


INTUA0T interrupt
INTUA0T interrupt function
uarta_int_send
count tx<TX SIZE
No
Checks transmission count
Yes
Writes to UA0TX register
UA0TX = buf_fx[count_tx]
count_tx++
Increments transmission count
Increments transmission count
count_tx++
reti
INTUA0R interrupt
INTUA0R interrupt function
uarta_int_receive
buf_rx[count_rx] = UA0RX
Stores reception result
count_rx++
Increments reception count
reti
INTUA0RE interrupt
INTUA0RE error interrupt function
uarta_error
UA0PE = 0
Clears parity error flag
UA0FE = 0
Clears framing error flag
UA0OVE = 0
Clears overrun error flag
reti

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.
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http://www.am.necel.com/

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Tel: 0 511 33 40 2-0

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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 Esplandiu, 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/

NEC Electronics Shanghai Ltd.
Room 2511-2512, 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/

NEC Electronics Hong Kong Ltd.
12/F., Cityplaza 4,
12 Taikoo Wan Road, 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/

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